THE ESSENTIALS OF DESCRIPTIVE GEOMETRY

Published @ 2017 Trieste Publishing Pty Ltd

ISBN 9780649244065

The essentials of descriptive geometry by F. G. Higbee

Edited by Trieste Publishing Pty Ltd.
Cover @ 2017

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OF

DESCRIPTIVE GEOMETRY

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SECOND EDITION REVISED

TOTAL ISSUE SIX THOUSAND

NEW YORK
JOHN WILEY & SONS, Inc.
LONDON: CHAPMAN & HALL, Limited
1917

PREFACE

It has been the endeavor of the author in writing this text to include only those portions of descriptive geometry which possess industrial utility and which develop the qualities of mind so essential in a draftsman.

First and foremost descriptive geometry should aim to teach projection. A draftsman must be able both to read and to write drawings with facility, and projection is the very grammar of the language of the designer. Secondly, descriptive geometry should aim to develop the ability to solve problems concerning the relations of points, lines, and planes. These are, of course, but elementary parts of all engineering structures as shown on drawings and it is important that a draftsman be prepared to solve problems relating to them directly on the drawing board. Thirdly, and perhaps most important of all, descriptive geometry should aim to promote the ability to analyse a problem into its component parts, to reason from a given set of conditions to a required set of conclusions, and to build up from the drawing a mental picture of the object which is there represented, for without the ability to analyse, to reason, and to visualize a draftsman is lacking in the essential qualifications of his calling.

For these reasons the subject has been discussed from the point of view of a draftsman and the essential relations of points, lines, and planes have been treated in the third quadrant. The order of the material has been carefully considered and while there is some departure from traditional arrangement it is believed that the selection of material and its arrangement will be found both logical and conducive to a natural development of the subject. Many problems of a carefully graded character and of a practical "flavor" have been inserted at frequent intervals in the belief that such work is invaluable in fixing principles and promoting genuine interest.

In the discussion on surfaces considerable variation may be found from other works on the subject both in content and treatment. It is believed, however, that the material included is broad enough in character for practical purposes; and it is hoped that the method of treatment, the character of the problems, and the discussion on model making will stimulate interest in this important and useful part of the subject.

In the preparation of this text the author has consulted and acknowledges his indebtedness to the following standard texts: Geometrie Descriptive by G. Monge; Theoretical and Practical Graphics by F. N. Willson; Elements of Descriptive Geometry by Albert E. Church; Elements of Descriptive Geometry by C. W. MacCord; Engineering Drawing by Thos. E. French.

F. G. HIGBEE.

IOWA CITY, IA., *Feb.* 1, 1915.

PREFACE TO SECOND EDITION

THE second edition of this book presents no departure from the original endeavor of the author which was to discuss only the essentials of descriptive geometry.

The material in the first edition has been corrected and revised, some portions have been entirely rewritten, and at the request of a number of teachers who are using the book as a text a chapter on tangencies has been added. The changes from the first edition are those which practical classroom use has demonstrated as advisable.

The author wishes to acknowledge his indebtedness to his colleagues in the department of Descriptive Geometry and Drawing at the University of Iowa, to Dr. F. M. Comstock and his associates at the Case School of Applied Science, to Professor E. F. Chillman, Rensselaer Polytechnic Institute, and to many others who have aided in the preparation of this edition with helpful criticisms and suggestions.

F. G. HIGBEE.

IOWA CITY, IA., *March* 15, 1917.

CONTENTS

CHAPTER I — PAGE

ORTHOGRAPHIC PROJECTION 1

CHAPTER II

PROFILE PLANE 11

CHAPTER III

ASSUMPTION OF POINTS AND LINES 21

CHAPTER IV

PLANES 27

CHAPTER V

LOCATION OF POINTS, LINES, AND PLANES 33

CHAPTER VI

REVOLUTION OF POINTS 38

CHAPTER VII

PROBLEMS ON THE LINE 45

CHAPTER VIII

PROBLEMS ON THE PLANE 52

CHAPTER IX

PROBLEMS ON ANGLES 59

CHAPTER X

PROBLEMS ON POINTS, LINES, AND PLANES 63

CHAPTER XI

SURFACES 84

CHAPTER XII

PLANE SURFACES 91

CHAPTER XIII PAGE

CYLINDRICAL SURFACES 101

CHAPTER XIV

CONICAL SURFACES 115

CHAPTER XV

INTERSECTION OF SURFACES 131

CHAPTER XVI

SURFACES OF REVOLUTION 145

CHAPTER XVII

WARPED SURFACES 155

CHAPTER XVIII

TANGENT PLANES AND LINES 179

CHAPTER XIX

MODEL MAKING 193

CHAPTER XX

APPENDIX 211

ESSENTIALS OF DESCRIPTIVE GEOMETRY

CHAPTER I

ORTHOGRAPHIC PROJECTION

1. Descriptive Geometry is the science of graphic representation. It is the means by which objects are shown on drawings and by which problems relating to these objects are solved.

2. When an object such as a machine, a bridge, a building, or any elemental part of such an engineering structure, is designed a drawing or set of drawings of it is made. Such a drawing is not only invaluable to the designer in recording his ideas step by step and in assisting him in his design but it is also indispensable to the artisan who constructs the object. A drawing, as used in the engineering sense, is a complete set of instructions from the designer to the workman by means of which the workman may reproduce, in exact shape and size and in material and finish, the identical object which the designer represented on the drawing.

The principles by which the shape and size of objects, and by which problems relating to such representations are graphically solved, are found in descriptive geometry. The art of putting on the drawing such additional information as dimensions, shop notes, finish, and other data regarding the construction of the object represented, is not a part of descriptive geometry but is included as a part of the art which is generally known as drafting.

3. There are two general systems by which graphic representations are made. One system has for its purpose the representation of objects as they appear, and is called *scenographic projection*. When an object is looked at from some particular