

Contents

1	Descriptive Geometry	1
1.1	The Subject Matter of Descriptive Geometry	1
1.2	Aims and Problems of Descriptive Geometry	2
1.3	Types of Geometric Figures and Objects (Images)	2
1.4	A Determinant of a Geometric Image (Object)	3
1.5	A Projecting Method. The Components and the Operations of Projection	3
	References	4
2	Types of Projection. The Center of Projection	7
2.1	Central (conical) Projection	7
2.2	Parallel (cylindrical) Projection.	7
2.3	Properties of the Central (conic) Projection	8
2.4	Properties of Parallel (cylindrical) Oblique-Angled Projection	10
2.5	Properties of Parallel Rectangular (orthogonal) Projection	12
	References	13
3	Formation of the Complex Drawing. Octants. The Method of Gaspard Monge	15
3.1	The Concept of Octant	15
3.2	The Essence of the Method of Gaspard Monge	16
	References	17
4	Geometrical Models and an Analytical Model of a Point	19
4.1	The Laws of Projective Connections	22
4.2	Classification of Points	22
4.3	Review Questions on the First Block (Chaps. 1–4)	23
	References	23

5	Geometric and Analytical Models of a Straight Line	25
5.1	Classification of Straight Lines	26
5.2	Ways of Representation for a Line Segment and Determinants of a Straight Line	26
5.3	Geometric Model of a Straight Line of General Position	27
5.4	The Peculiarities of a Complex Drawing of a Straight Line of General Position	27
5.5	Geometric Models of a Level Line	28
5.5.1	A Geometric Model of a Horizontal Level Line and Properties of This Model	28
5.5.2	A Geometric Model of a Frontal Level Line and Properties of This Model	29
5.5.3	A Geometric Model of a Profile Level Line and Properties of This Model	30
5.5.4	Peculiarities of the Complex Drawing of a Level Line.	31
5.6	Geometric Models of a Projecting Straight Line	32
5.6.1	A Geometric Model of a Horizontally Projecting Straight Line and Properties of the Model	32
5.6.2	A Geometric Model of a Frontally Projecting Straight Line and Properties of This Model	33
5.6.3	A Geometric Model of a Profiled Projecting Straight Line and Properties of the Model	34
5.6.4	Peculiarities of the Complex Drawing of a Projecting Straight Line.	35
5.7	Analytical Models of a Straight Line.	36
	References	37
6	Geometric Models and Analytical Models of a Plane	39
6.1	Classification of Planes	39
6.2	Ways of Representation of a Plane in the Complex Drawing. Plane Determinants	40
6.3	A Geometric Model of a Plane of General Position.	41
6.4	Peculiarities of the Complex Drawing of a Plane of General Position.	41
6.5	Geometric Models of a Plane of Level	42
6.5.1	A Geometric Model of a Horizontal Plane of Level and Properties of This Model	43
6.5.2	A Geometric Model of a Frontal Plane of Level and Properties of This Model	44
6.5.3	A Geometric Model of a Profile Plane of Level and Properties of This Model	45
6.5.4	Peculiarities of the Complex Drawing of a Plane of Level	47

6.6	Geometric Models of a Projecting Plane	47
6.6.1	A Geometric Model of a Horizontally Projecting Plane and Properties of This Model.	48
6.6.2	A Geometric Model of a Frontally Projecting Plane and Properties of This Model.	49
6.6.3	A Geometric Model of a Profiled Projecting Plane and Properties of This Model.	50
6.6.4	Peculiarities of the Complex Drawing of a Projecting Plane.	52
6.7	Analytical Models of a Plane	52
6.8	The Main Lines of a Plane	53
6.9	Review Questions for Chap. 5 and this Chapter	54
	References	55
7	Geometric and Analytical Models of a Surface	57
7.1	Ways of Formation, Description and Mapping, and Classification of Surfaces.	57
7.2	A Surface Contour and a Surface Sketch. The Way of Representing a Surface in a Complex Drawing.	60
7.3	Ruled Developable Surfaces with One Directional Line.	60
7.4	Ruled Undevelopable Surfaces with Two Directional Lines and a Plane of Parallelism.	64
7.5	Ruled Undevelopable Surfaces with Three Directional Lines	67
7.6	Screw Surfaces.	68
7.7	Surfaces of Revolution and Their Analytical Models.	70
7.8	An Indication of a Point Belonging to a Surface.	73
7.9	Review Questions the Third Block (This Chapter)	73
	References	75
8	Positional Problems	79
8.1	The Concept and Classification of Positional Problems	79
8.2	The Concept of Competing Points. The Rule to Define the Visibility of Constructive Elements of a Product	79
8.3	Mutual Location, Intersection and Belonging of the Same Linear Geometric Images to Each Other	80
8.3.1	Mutual Location, Intersection and Belonging of Points to Each Other. The Rule to Define the Visibility of Competing Points	80
8.3.2	Mutual Location, Intersection and Belonging of Straight Lines to Each Other	82
8.3.3	Mutual Location, Intersection and Belonging of Planes to Each Other.	87

8.4	Mutual Location, Intersection and Belonging of Different Types of Linear Geometric Images to Each Other.	89
8.4.1	Mutual Location, Intersection and Belonging of a Point and a Straight Line.	89
8.4.2	Mutual Location, Intersection and Belonging of a Point and a Plane	91
8.4.3	Mutual Location, Intersection and Belonging of a Straight Line and a Plane	93
8.5	Mutual Location, Intersection and Belonging of a Point and a Surface.	96
8.6	Application of the Indications of Incidence of Geometric Images to Solve Engineering Problems	98
8.6.1	A Problem of Belonging of a Straight Line to a Plane (Problem 1).	98
8.6.2	The Problem of a Point Belonging to the Plane (Problem 2)	100
8.6.3	The Problem of Parallel Planes (Problem 3)	104
8.7	Mutual Intersection of Geometric Images.	108
8.7.1	Classification of Positional Problems of Mutual Intersection of Geometric Images	109
8.7.2	The Concept and Criterion of a Choice of the Intermediary for Positional Problems	109
8.7.3	Algorithm for Solving Positional Problems of Mutual Intersection of Geometric Images	110
8.7.4	Construction of a Point of Intersection of a Straight Line and a Plane (Problems 4, 5). The First Basic Positional Problem of Descriptive Geometry	113
8.7.5	Construction of a Line of Intersection of Two Planes (Problem 6). The Second Basic Positional Problem of Descriptive Geometry	126
8.7.6	Construction of Points of Intersection of a Straight Line and a Surface (Problem 7)	134
8.7.7	Construction of the Line of Intersection of a Plane and a Surface (Problem 8)	141
8.7.8	Construction of the Line of Intersection of Two Surfaces (Problems 9, 10, 11).	149
8.8	Review Questions to the Fourth Block (Chapter 8).	174
	References	175
9	Metric Problems	179
9.1	The Theorem of a Right Angle Projection	180
9.2	Solving Metric Problems Without Transformation of the Complex Drawing	181

9.2.1	Perpendicularity of Straight Lines (Problems 1, 2).	181
9.2.2	Perpendicularity of a Straight Line and a Plane (Problem 3)	184
9.2.3	Perpendicularity of Two Planes.	185
9.2.4	Angles Between Straight Lines.	186
9.2.5	Angle Between a Straight Line and a Plane (Problem 4)	186
9.2.6	Angle Between Planes.	190
9.3	Solving Metric Problems by Means of Complex Drawing Transformation.	192
9.3.1	Classification of Transformation Methods of the Complex Drawing of a Geometric Image . . .	192
9.3.2	Methods of Complex Drawing Transformation for a Motionless Geometric Image	193
9.3.3	Methods of Transformation of Complex Drawing in Changeable (Mobile) Position of Geometric Image in Space.	202
9.4	Review Questions on the Fifth Block (This Chapter).	222
	References	222
10	Development of Surfaces	227
10.1	Basic Properties of Development	227
10.2	A Condition of Surface Development	228
10.3	The General Principle, Method and Algorithm for Constructing Development of a Curvilinear Developed Surface	228
10.4	Methods of Constructing Development	231
10.5	Development of Cones and Pyramids (Problem 1)	231
10.6	Development of Cylinders and Prisms (Problem 2).	236
10.7	Review Questions on the Sixth Information Block (This Chapter)	243
	References	244
11	Axonometric Projections.	245
11.1	The Projection Drawing. Requirements for the Projective Drawing and Its Construction.	245
11.2	Principles of Construction of a Drawing	246
11.3	Axonometry Definition	247
11.4	The Essence, the Components and Operations of the Method of Axonometric Projection	248
11.5	Properties of Axonometric Projections.	249
11.5.1	Visualization of Axonometric Projections.	249
11.5.2	Convertibility of Axonometric Projections	250
11.5.3	Measurability of Axonometric Projections	252

11.6	The Polke-Schwarz Theorem	254
11.7	Classification of Axonometric Projections	254
11.8	Standard Kinds of Axonometric Projections	256
11.8.1	A Rectangular Isometry	256
11.8.2	Rectangular Dimetry	261
11.8.3	Oblique-Angled Frontal Isometry	270
11.8.4	Oblique-Angled Frontal Dimetry	272
11.8.5	Oblique-Angled Horizontal Isometry	274
11.9	Algorithm of Construction of Axonometric Projections	276
11.10	Review Questions on the Seventh Block (This Chapter)	283
	References	284
12	Conclusion and Summary.	287
12.1	The Collection of Recent Developments	287
	References	292
	Appendix	295
	Index	333

<http://www.springer.com/978-3-319-29717-0>

Engineering Graphics

Theoretical Foundations of Engineering Geometry for
Design

Brailov, A.Y.

2016, XIX, 338 p. 251 illus., 105 illus. in color.,

Hardcover

ISBN: 978-3-319-29717-0