

Contents

1	Introduction	1
1.1	Arranging Rooms for the Study of Modelling	3
1.2	Development and Design Process and Engineering Graphics	4
2	Technical Freehand Sketching	15
2.1	Sketching Basics	15
2.2	CAD and Technical Freehand Drawing	17
2.3	Basic Rules of Freehand Drawing	18
2.3.1	Material, Sketching Tools	18
2.3.2	Sketching Straight Lines	20
2.3.3	Sketching Curved Lines	29
2.4	CAD and Technical Freehand Sketching	34
2.4.1	Procedural Sketching	36
2.4.2	Stroke Sketching	42
2.5	Sketching Spatial Drawings	42
2.5.1	Presenting a Half Cross-Section	43
3	3D Modelling	49
3.1	Topological Elements in a 3D Modeller	50
3.1.1	Point	51
3.1.2	Edge	53
3.1.3	Loop	54
3.1.4	Surface	55
3.1.5	Volume	55
3.2	Presenting 3D Models	56
3.2.1	Wireframe Model	56
3.2.2	Surface Model	57
3.2.3	Volume (Solid) Model	58
3.3	Geometric Transformations	63
3.3.1	Translation	64
3.3.2	Rotation	65

3.3.3	Scaling	66
3.3.4	Mirroring.	67
3.3.5	Perspective Projection.	68
4	3D-Modelling Software Packages	71
4.1	Introduction	71
4.2	SolidWorks	72
4.2.1	Menu Bar	72
4.2.2	Command Manager and Toolbars	73
4.2.3	Heads-Up View Toolbar	73
4.2.4	Manager Window	74
4.2.5	Task Pane	77
4.2.6	Status Bar	78
4.2.7	Graphic Area	78
4.2.8	SolidWorks Options	80
4.3	Siemens NX PLM	83
4.3.1	Introductory Window	83
4.3.2	Manipulating the View in the Graphic Window	85
4.3.3	Ribbon Bar	85
4.3.4	Top Border Bar	87
4.3.5	Resource Bar	88
4.3.6	Radial Tool Bar/Shortcut.	89
4.3.7	Keyboard Shortcuts.	92
4.3.8	NX Options	94
4.3.9	Application Tab	94
4.3.10	Synchronous Modelling.	94
4.3.11	Command Finder	95
5	Extrusion	97
5.1	Manufacturing Technology	97
5.2	Modelling Prismatic Objects	99
5.2.1	Object Formation in Space	100
5.2.2	Basic Sketches on the Basic Plane	101
5.2.3	Extrusion of a Basic Sketch on a Plane Into Space.	103
5.2.4	The Formation of Complex Shapes and Details Using Extrusions	105
5.3	Modelling in SolidWorks.	108
5.3.1	Basic Form	108
5.3.2	Cut-Out on the Front Top Part.	111
5.3.3	Cone Cut-Out 30 × 10 mm on the Back Top Part	111
5.3.4	Groove Modelling 8 × 4 mm	112
5.3.5	Creation of Through Holes $\phi 8.5$ mm	113

5.3.6	Slot Modelling $\phi 13 \times 20$ mm	113
5.3.7	Grove Modelling 25×8 mm on the Bottom Part	114
5.3.8	Final Model	114
5.4	Modelling in NX	116
5.4.1	The Creation of a Model	116
5.4.2	The Positioning of an Object in Space	116
5.4.3	Basic Sketch	118
5.4.4	The Creation of a Basic Sketch	119
5.4.5	Cut-Out on the Front Part of the Model	120
5.4.6	Prismatic Cut-Out 30×10 mm on the Top Upper Part	122
5.4.7	Modelling of a Small Groove 8×4 mm on the Bottom of the Cone Cut Out	122
5.4.8	Modelling of Through Holes $\phi 8.5$ mm on the Basic Sketch	123
5.4.9	Modelling of a Slot $\phi 13 \times 20$ mm	125
5.4.10	Modelling of a Special Groove 25×8 mm	125
5.4.11	Final Model	127
5.5	Examples	129
6	Revolving	135
6.1	Manufacturing Technology	135
6.2	Modelling of Axisymmetric Models	136
6.2.1	Positioning of an Object in Space	137
6.2.2	Positioning of the Basic Sketch	137
6.3	Modelling in Solid Works	141
6.3.1	Basic Shaft Form	141
6.3.2	Formation of Centre Bores	143
6.3.3	Formation of the Retaining Ring Grooves	144
6.3.4	Formation of the Keyseats	145
6.3.5	Edge Filleting and Chamfering	148
6.3.6	Final Model	148
6.4	Modelling in NX	149
6.4.1	Positioning of an Object in Space	149
6.4.2	Formation of a Base Sketch in the Plane XC–YC	150
6.4.3	Revolving into Space	150
6.4.4	Modelling a Centre Bore	151
6.4.5	Modelling of the Retaining Ring Groove	154
6.4.6	Modelling a Keyseat	156
6.5	Examples	161

7	Sweep	167
7.1	Manufacturing Technology	167
7.2	Modelling Products with Constant Cross-Sections	169
7.2.1	Positioning an Object in Space	170
7.2.2	Creating a Base Sketch	170
7.2.3	Sweep	170
7.3	Modelling in SolidWorks	173
7.3.1	Creating a Guide Curve	173
7.3.2	Setting a Cross-Section profile	174
7.3.3	Curve Sweep	174
7.3.4	Shape Complementing	176
7.3.5	Final Model	176
7.4	Modelling in NX	178
7.4.1	Creating the Guide Curve	179
7.4.2	Creating a Cross-Section Profile	180
7.4.3	Complementing the Technological Shape	180
7.5	Examples	184
8	Loft-Transition	191
8.1	Manufacturing Technology and Use	191
8.2	Modelling Objects with a Variable Cross-Section	193
8.2.1	Placing an Object in Space	193
8.2.2	Creating a Base Sketch	194
8.2.3	Transition in Space	194
8.3	Modelling in SolidWorks	196
8.3.1	Positioning the Cross-Sections	196
8.3.2	Forming a Transition in Space	196
8.3.3	Creating the Inlet Part of the Casing	197
8.3.4	Creating the Shell	200
8.3.5	Adding the Central Part	201
8.3.6	Adding the Guide-Vane Blades	202
8.3.7	Completing the Shape and the Final model	204
8.4	Modelling in NX	204
8.4.1	Setting the Main Cross-Sections for Loft-Transition	204
8.4.2	Creating the Guide Curve and Orienting the Curves of the Cross-Sections	204
8.4.3	Creating a Transition Through Cross-Sections by Means of the Guide Curve	209
8.4.4	Completing the Shape	209
8.5	Examples	217

9	Supplementing the Shape	221
9.1	Manufacturing Technology and Use	221
9.2	Auxiliary Shapes in the Modelling Process	222
9.2.1	Fillet	223
9.2.2	Chamfer	224
9.2.3	Shelling	225
9.2.4	Ribs	226
9.2.5	Draft	226
9.2.6	Patterning Geometric Entities (Pattern)	228
9.2.7	Mirroring Geometric Entities (Mirror)	229
9.3	Modelling in SolidWorks	229
9.3.1	A Base Model	231
9.3.2	Reinforcing Ribs	233
9.3.3	Attachment Holes	234
9.3.4	Draft	236
9.3.5	Fillet	236
9.3.6	Final Model	237
9.4	Modelling in NX	240
9.4.1	Creating a Rough Model	240
9.4.2	Chamfer	240
9.4.3	Carving the Cover (Shell)	240
9.4.4	Patterning Geometric Entities (Pattern)	243
9.4.5	Rib Modelling (Rib)	244
9.4.6	Mirroring About a Plane (Mirror)	245
9.4.7	Creating Bores (Bore-Hole)	246
9.4.8	Draft Modelling (Draft)	246
9.4.9	Adding Detailed Edge Blends	250
9.5	Examples	254
10	Welding a Construction	259
10.1	Manufacturing Technology and Use	260
10.2	Modelling Welded Constructions	261
10.2.1	Modelling Welded-Beam Constructions	261
10.2.2	Modelling Other Welded Constructions and Marking Welded Assemblies	264
10.3	Modelling in SolidWorks	267
10.3.1	Creation of the System Structure: Skeleton	267
10.3.2	Profile Formating Through Skeleton	267
10.3.3	Extrusion in Space	270
10.3.4	End-Forming Profiles	271
10.3.5	Welds Modelling	271

10.3.6	Cut List of Individual Parts of a Welded Construction	273
10.3.7	Final Model of the Welded Construction of a Chair	273
10.4	Modelling in NX	274
10.4.1	Creation of the System Structure: Skeleton	274
10.4.2	Formation of a Standard Profile	276
10.4.3	Extrusion of Profiles in a Skeleton Structure	279
10.4.4	End Formation of the Profiles	282
10.5	Examples.	293
11	Sheet-Metal Bending.	297
11.1	Manufacturing Technology and Use	298
11.2	Modelling Sheet-Metal Products.	299
11.2.1	Definition of the Material's Parameters.	300
11.2.2	Methods of Modelling Sheet-Metal Products	300
11.2.3	Features and Settings	301
11.2.4	Setting Bent Edges	304
11.2.5	Modelling Sheet-Metal Products.	305
11.3	Modelling in SolidWorks.	306
11.3.1	Creating the Base Shape	306
11.3.2	Adding Edge Flanges	308
11.3.3	Completing the Shape	312
11.3.4	Unfolding the Sheet Metal and Cutting	313
11.3.5	Final model	316
11.4	Modelling in NX	317
11.4.1	Selecting a Module for Modelling Sheet-Metal Products	317
11.4.2	Creating the Base Shape	318
11.4.3	Adding Edge Reinforcements.	320
11.4.4	Completing the Shape	325
11.4.5	Flat Surface of the Sheet-Metal Product's Final Shape	328
11.5	Examples.	332
12	Modelling Physical Models and Parameterization	335
12.1	Measuring Physical Models	336
12.2	Base Model	339
12.2.1	Screw Parametrization.	341
12.2.2	Bearing Parameterization.	344
12.3	Modelling in SolidWorks.	344
12.3.1	Rough Shape	344
12.3.2	Detailed Shape	345

12.3.3	Parameterization	347
12.3.4	Generation of a Configuration	348
12.4	Modelling in NX	351
12.4.1	Creation of a Rough Shape of the Model	351
12.4.2	Formation of a Detailed Shape of the Model	353
12.4.3	Formation of the Generator of Parts	359
12.5	Examples.	364
13	Assemblies	367
13.1	Technology	367
13.2	Modelling Assemblies.	371
13.2.1	Assembly Structure.	371
13.2.2	Bottom-Up Building of an Assembly	371
13.2.3	Top-Down Building of an Assembly.	372
13.2.4	Relations Between the Components in an Assembly	373
13.3	Modelling in SolidWorks.	374
13.3.1	Preparing Components	374
13.3.2	Assembly: Bottom-Up Design Technique	377
13.3.3	Modelling a Housing in the Top-Down Technique	383
13.3.4	Final Assembly Model	388
13.3.5	Exploded View	388
13.4	Modelling in NX	388
13.4.1	Bottom-Up Method.	388
13.4.2	Top-Down Method	398
13.5	Examples.	409
14	Technical Documentation (Drawing)	413
14.1	Assembling Drawing.	413
14.2	Manufacturing Drawing.	418
14.3	Modelling in SolidWorks.	419
14.3.1	Drawing Sheet Format	419
14.3.2	Views	421
14.3.3	Dimensioning.	427
14.3.4	Marks in the Figure	428
14.3.5	The Title Block of the Drawing	432
14.4	Modelling in NX	434
14.4.1	Format and the Title Block of the Drawing	435
14.4.2	Defining Views of 3D Objects	437
14.4.3	Break-Out View	441
14.4.4	Creating Details (Detail View).	443
14.4.5	Dimensioning.	443

14.4.6	Tolerances and Matings.	445
14.4.7	Miscellaneous Marks in the Drawing	445
14.5	Examples.	451
15	Modellers and Technical Documentation	455
15.1	The Size of Written Text and Dimensions.	455
15.2	Automated Dimensioning	456
15.3	Labelling Cross-Sections	459
15.4	Hatching	468
15.5	Presenting the Section Planes of Axes and Screws	472
15.6	Parts List.	477
	References	489

Space Modeling with SolidWorks and NX

Duhovnik, J.; Demsar, I.; Drešar, P.

2015, XIV, 490 p. 650 illus., Hardcover

ISBN: 978-3-319-03861-2