

Inside Rhinoceros

RON K. C. CHENG

CENGAGE
Learning*

Australia • Brazil • Mexico • Singapore • United Kingdom • United States

CONTENTS



Introduction vi

MODELING PROJECTS 1

NURBS Curves, NURBS Surfaces, Polygon Meshes, and Solids 3 • Design Development 3 • Surface Modeling Projects 4

MODELING PROJECT 1: BUBBLE CAR CHASSIS 5

Introduction 5 • Objectives 6 • Overview 6 • Constructing the Mechanical Components 7 • Surface Crease 8 • Surface Creases 9 • Summary 26

MODELING PROJECT 2: BUBBLE CAR BODY 27

Introduction 27 • Objectives 27 • Overview 28 • Bodywork Construction 29 • Curves for Making the Surfaces 30 • Continuity Issue 31 • Mirroring and Surface Continuity 34 • Summary 51

MODELING PROJECT 3: SMALL OBJECTS 52

Introduction 52 • Objectives 52 • Overview 52 • Models 53 • Summary 67

MODELING PROJECT 4: TOY CAR ASSEMBLY 68

Introduction 68 • Objectives 68 • Overview 68 • Components and Assembly 69 • Summary 78

CHAPTER 1 RHINOCEROS-WHAT IS IT? 79

Introduction 79 • Objectives 79 • Overview 79 • Computer Modeling and Rhinoceros 79 • Rhino's User Interface 88 • Utilities and Help 113 • Filing 114 • Consolidation 116 • Review Questions 116

CHAPTER 2 FAMILIARIZING RHINOCEROS 117

Introduction 117 • Objectives 117 • Overview 117 • Multiple Construction Planes Concept 117 • Using Coordinates Input 119 • Using Drawing Aids 121 • Manipulating Geometric Objects 132 • Holding Down the Alt Key While Dragging 138 • History Manager 150 • Layer Manipulation 153 • Object Properties 161 • Construction Plane Manipulation 164 • Consolidation 172 • Review Questions 172

CHAPTER 3 RHINOCEROS NURBS SURFACE MODELING 173

Introduction 173 • Objectives 173 • Overview 173 • Surface Modeling Concepts 173 • Surface Modeling Approaches 174 • Concepts of Surfaces and Curves Continuity 177 • Rhino's Major Advantage 179 • Rhino's NURBS Surface 179 • Common Free-Form Surfaces 179 • Other Kinds of Rhino Free-Form Surfaces 204 • Planar Surfaces 210 • Derived Surfaces 213 • Lightweight Extrusion Objects 218 • Consolidation 219 • Review Questions 219

CHAPTER 4 FREE-FORM NURBS CURVES AND POINT OBJECTS 220

Introduction 220 • Objectives 220 • Overview 220 • Curves for Surface Modeling 220 • Rhino Curves 222 • Spline Segment, Polynomial Degree, and Control Point 230 • Point Editing 231 • Points and Point Clouds 240 • Consolidation 245 • Review Questions 245

CHAPTER 5 CURVES OF REGULAR PATTERN 246

Introduction 246 • Objectives 246 • Overview 246 • Line 246 • Polyline 252 • Rectangle 254 • Polygon 256 • Circle 258 • Arc 261 • Ellipse 263 • Parabola 264 • Hyperbola 265 • Conic 266 • Helix 266 • Spiral 268 • Degree of Polynomial and Point Editing 270 • Consolidation 270 • Review Questions 270

CHAPTER 6 CURVE MANIPULATION 271

Introduction 271 • Objectives 271 • Overview 271 • Manipulating a Curve's Length 271 • Treating Two or More Separate Curves 277 • Curve Refinement Methods 286 • Curves and Points from Existing Objects 293 • Consolidation 312 • Review Questions 313

CHAPTER 7 NURBS SURFACE MANIPULATION 314

Introduction 314 • Objectives 314 • Overview 314 • Surface Boundary Manipulation 314 • Treating Two or More Separate Surfaces 328 • Surface Profile Manipulation 340 • Surface Edge Manipulation 350 • Consolidation 355 • Review Questions 355

CHAPTER 8 RHINOCEROS POLYSURFACES AND SOLIDS 356

Introduction 356 • Objectives 356 • Overview 356 • Rhino's Solid Modeling Method 356 • Solids of Regular Geometric Shapes 357 • Constructing Free-Form Solid Objects 386 • Combining Rhino Solids 390 • Detailing a Solid 393 • Editing Solids 404 • Lightweight Extrusion Objects 417 • Consolidation 417 • Review Questions 417

CHAPTER 9 POLYGON MESHES 418

Introduction 418 • Objectives 418 • Overview 418 • Constructing Polygon Mesh Primitives 418 • Constructing Polygon Meshes from Existing Objects 434 • Mapping Polygon Meshes 439 • Combining and Separating 441 • Manipulating Mesh Faces 445 • Consolidation 462 • Review Questions 462

CHAPTER 10 ADVANCED MODELING METHODS-TRANSFORMATION 463

Introduction 463 • Objectives 463 • Overview 463 • Translation 463 • Deformation 476 • Translate and Deform 490 • Consolidation 496 • Review Questions 496

CHAPTER 11 RHINOCEROS DATA ANALYSIS 497

Introduction 497 • Objectives 497 • Overview 497 • General Tools 497 • Dimensional Analysis Tools 503 • Surface Analysis Tools 506 • Mass Properties Tools 510 • Diagnostics Tools 513 • Consolidation 515 • Review Questions 515

CHAPTER 12 GROUP, BLOCK, AND WORK SESSION 516

Introduction 516 • Objectives 516 • Overview 516 • Group 516 • Block 518 • Worksession Manager and Design Collaboration 535 • Drag and Drop 540 • Textual Information 540 • Consolidation 540 • Review Questions 541

CHAPTER 13 2D DRAWING OUTPUT AND DATA EXCHANGE 542

Introduction 542 • Objectives 542 • Overview 542 • Engineering Drawing 542 • Data Exchange 564 • Consolidation 568 • Review Questions 568

CHAPTER 14 RENDERING 569

Introduction 569 • Objectives 569 • Overview 569 • Digital Rendering and Animation 570 • Camera Setting 582 • Digital Lighting 586 • Digital Material 604 • Environment Objects 625 • Render Properties 630 • Consolidation 632 • Review Questions 633

Index 634