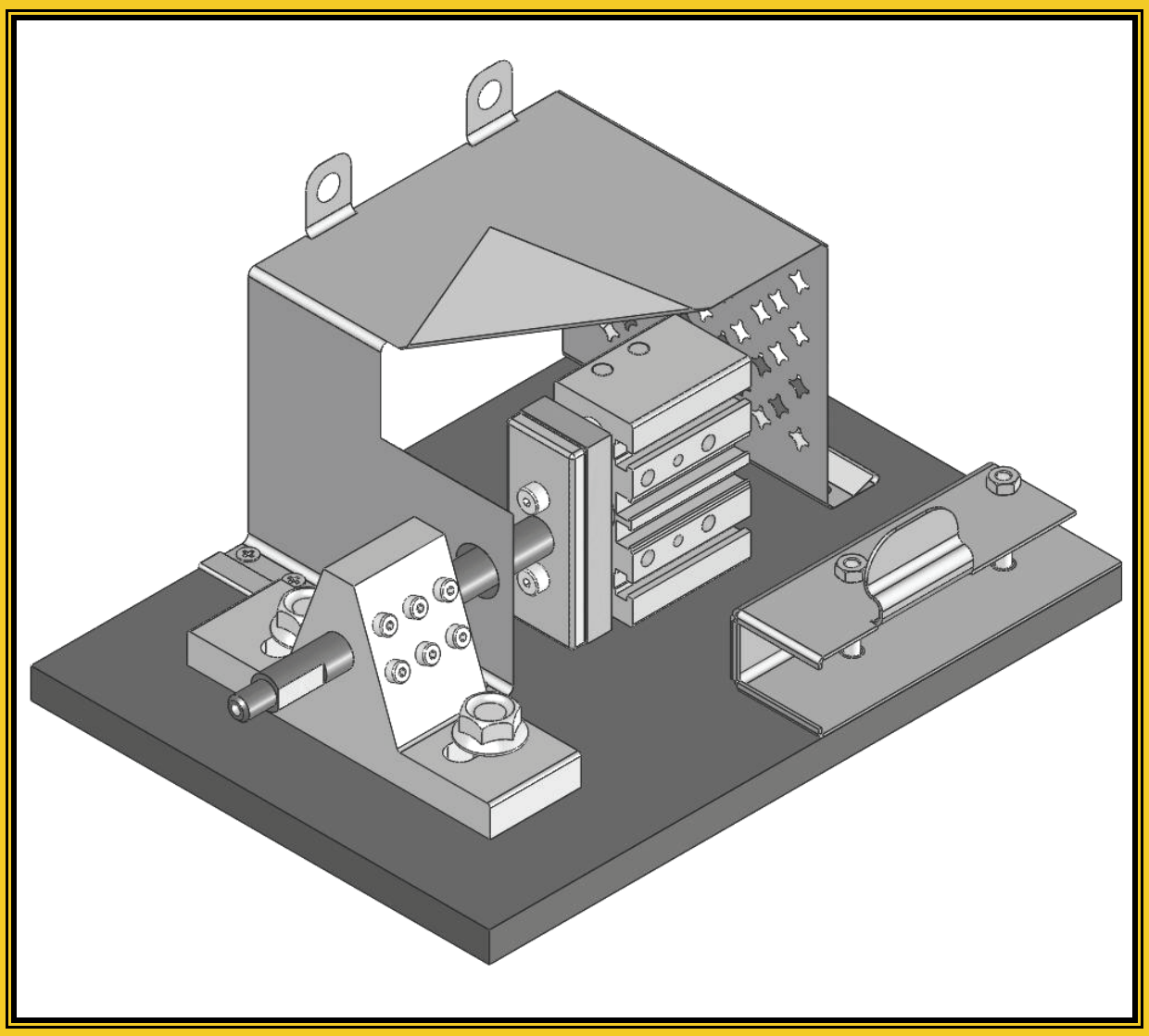
INSIDE:

# Engineering Design with SolidWorks 2010

A Step-by-Step Project Based Approach Utilizing 3D Solid Modeling

Introductory Level ♦ Tutorial Style ♦ Video Instruction



David C. Planchard & Marie P. Planchard, CSWP

SDC
PUBLICATIONS
Schroff Development Corporation
www.schroff.com

SolidWorks Solution Partner

Better Textbooks. Lower Prices.

# Table of Contents

**Introduction** **I-1**
About the Cover 2
About the Authors 2
Acknowledgements 3
Contact the Authors 3
Note to Instructors 3
Trademarks, Disclaimer and Copyrighted Material 3
References 4
Table of Contents 6
Overview of Projects 13
What is SolidWorks? 17
About the Book 19
Windows Terminology in SolidWorks 19

**Project 1 - Fundamentals of Part Modeling** **1-1**
Project Objective 3
Project Situation 4
Project Overview 5
File Management 7
Start a SolidWorks Session 9
Understand the SolidWorks User Interface and CommandManager 10
Menu bar toolbar 10
Menu bar menu 10
Drop-down menu 11
Right-click 11
Consolidated toolbar 12
System feedback icons 12
Confirmation Corner 12
Heads-up View toolbar 13
Default Parts CommandManager 15
FeatureManager Design Tree 15
Fly-out FeatureManager 18
Task Pane 19
Design Library 19
File Explore 20
Search 20
View Palette 20
Appearance/Scenes 21
Custom Properties 21
Document Recovery 21
Motion Study tab 22
MotionManager 22
Animation 22
Basic Motion 22
System Options 28
Part Document Template and Document Properties 30
PLATE Part Overview 32
PLATE Part-New SolidWorks Document 34

PLATE Base Feature 35
Machined Part 35
Reference Planes and Orthographic Projection 37
PLATE Part-Extruded Boss/Base Feature 41
PLATE Part-Modify Dimensions and Rename 49
Display Modes, View Modes, View tools, and Appearances 51
Fasteners 53
PLATE Part-Extruded Cut Feature 54
PLATE Part-Fillet Feature 60
PLATE Part-Hole Wizard 62
ROD Part Overview 65
ROD Part-Extruded Boss/Base Feature 67
Rod Part-Hole Wizard Feature 69
ROD Part-Chamfer Feature 70
ROD Part-Extruded Cut Feature & Convert Entities Sketch Tool 71
ROD Part-View Orientation, Named Views & Viewport option 76
ROD Part-Copy/Paste Function 77
ROD Part-Design Changes with Rollback 78
ROD Part-Recover from Rebuild Errors 80
ROD Part-Edit Part Color 84
GUIDE Part Overview 86
GUIDE Part-Extruded Boss/Base Feature and Dynamic Mirror Feature 88
GUIDE Part-Extruded Cut Slot Profile 91
GUIDE Part-Mirror Feature 95
GUIDE Part-Holes 96
GUIDE PART-Linear Pattern Feature 99
GUIDE Part-Materials Editor and Mass Properties 101
Manufacturing Considerations 103
Sketch Entities and Sketch Tools 106
Project Summary 107
Project Terminology 107
Questions / Exercises 111

**Project 2 - Fundamentals of Assembly Modeling 2-1**
Project Objective 3
Project Situation 4
Project Overview 5
Bottom-Up Assembly Modeling Approach 5
Linear Motion and Rotational Motion 6
GUIDE-ROD assembly 7
GUIDE-ROD assembly - Insert Components 11
FeatureManager Syntax 13
Mate Types 16
  Standard Mates 16
  Advanced Mates 17
  Mechanical Mates 17
GUIDE-ROD Assembly-Mate the ROD Component 18
GUIDE-ROD Assembly-Mate the PLATE Component 23
GUIDE-ROD Assembly-Mate Errors 27
Collision Detection 30
Modify Component Dimension 31

Design Library 32
GUIDE-ROD Assembly- Inert Mates for Flange bolts 35
Socket Head Cap Screw Part 39
SmartMates 44
Coincident/Concentric SmartMate 44
Tolerance and Fit 47
Exploded View 51
Section View 56
Analyze an Interference Problem 58
Save As Copy Option 59
GUIDE-ROD Assembly-Feature Driven Component Pattern 62
Redefining Mates and Linear Components Pattern 64
Folders and Suppressed Components 68
Make-Buy Decision: 3D ContentCentral 69
CUSTOMER Assembly 72
Copy the CUSTOMER Assembly 78

**Project 3 - Fundamentals of Drawing 3-1**
Project Objective 3
Project Situation 4
Project Overview 4
Drawing Template and Sheet Format 5
Sheet Format and Title Block 12
Company Logo 17
Save Sheet Format and Save As Drawing Template 20
GUIDE Part-Modify 23
GUIDE Part-Drawing 24
Move Views and Properties of the Sheet 27
Auxiliary View, Section View and Detail View 30
Auxiliary View 31
Section View 32
Detail View 33
Partial Auxiliary View – Crop View 34
Display Modes and Performance 36
Detail Drawing 38
Move Dimensions in the Same View 41
Partial Auxiliary View-Crop View 41
Move Dimensions to a Different View 45
Dimension Holes and the Hole Callout 46
Center Marks and Centerlines 49
Modify the Dimension Scheme 51
GUIDE Part-Insert an Additional Feature 55
General Notes and Parametric Notes 57
Revision Table 60
Part Number and Document Properties 62
Exploded View 68
Balloons 70
Bill of Materials 72
Associative Part, Assembly, and Drawing 77
Project Summary 78

Project Terminology 79
Questions / Exercises 81

**Project 4 - Extrude and Revolve Features 4-1**
Project Objective 3
Project Overview 4
Design Intent 6
Project Situation 9
Part Template 11
BATTERY Part 15
BATTERY Part-Extruded Boss/Base Feature 17
BATTERY Part-Fillet Feature Edge 22
BATTERY Part-Extruded Cut Feature 23
BATTERY Part-Fillet Feature Face 25
BATTERY Part-Extruded Boss/Boss Feature 27
Injection Molded Process 32
BATTERYPLATE Part 33
Save As, Delete, Modify and Edit Feature 34
BATTERYPLATE Part-Extruded Boss/Base Feature 36
BATTERYPLATE Part-Fillet Features-Full Round, options 37
Multibody Parts and the Extruded Boss/Base Feature 40
LENS Part 42
LENS Part-Revolved Base Feature 43
LENS Part-Shell Feature 46
Extruded Boss Feature and Convert Entities Sketch tool 47
LENS Part-Hole Wizard 48
LENS Part-Revolved Boss Thin Feature 51
LENS Part-Extruded Boss/Boss Feature and Offset Entities 53
LENS Part-Extruded Boss/Boss Feature and Transparent Optical Property 55
BULB Part 57
BULB Part-Revolved Base Feature 58
BULB Part-Revolved Boss Feature and Spline Sketch tool 60
BULB Part-Revolved Cut Thin Feature 62
BULB Part-Dome Feature 64
BULB Part-Circular Pattern Feature 65
Customizing Toolbars and Short Cut Keys 69
Design Checklist and Goals before Plastic Manufacturing 71
Mold Base 73
Applying SolidWorks Features for Mold Tooling Design 74
Manufacturing Design Issues 83
Project Summary 84
Project Terminology 85
Questions / Exercises 88

**Project 5 - Swept, Lofted and Additional Features** **5-1**
Project Objective 3
Project Overview 4
Project Situation 5
O-RING Part- Swept Base Feature 7
O-RING Part-Design Table 9
SWITCH Part-Lofted Base Feature 13
SWITCH Part-Dome Feature 18
Four Major Categories of Solid Features 20
LENSCAP Part 20
LENSCAP Part-Extruded Boss/Base, Extruded Cut and Shell Features 21
LENSCAP Part-Revolved Cut Thin Feature 24
LENSCAP Part-Thread, Swept Feature and Helix/Spiral Curve 25
HOUSING Part 31
HOUSING Part-Lofted Boss Feature 34
HOUSING Part-Second Extruded Boss/Base Feature 38
HOUSING Part-Shell Feature 39
HOUSING Part-Third Extruded Boss/Base Feature 40
HOUSING Part-Draft Feature 41
HOUSING Part-Thread with Swept Feature 43
HOUSING Part-Handle with Swept Feature 48
HOUSING Part-Extruded Cut Feature with Up To Surface 53
HOUSING Part-First Rib and Linear Pattern Feature 55
HOUSING Part-Second Rib Feature 58
HOUSING Part-Mirror Feature 61
FLASHLIGHT Assembly 64
Assembly Template 65
LENSANDBULB Sub-assembly 65
BATTERYANDPLATE Sub-assembly 70
CAPANDLENS Sub-assembly 72
FLASHLIGHT assembly 76
Addressing Interference Issues 82
Export Files and eDrawings 83
Project Summary 86
Project Terminology 86
Questions / Exercises 89

**Project 6 - Top-Down Assembly Modeling and Sheet Metal** **6-1**
Project Objective 3
Project Situation 5
Top Down Design Approach 6
BOX Assembly Overview 8
InPlace Mates and In-Context features 10
Part Template and Assembly Template 12
Box Assembly and Layout Sketch 13
Link Values and Equations 17
MOTHERBOARD-Insert Component 20
POWERSUPPLY-Insert Component 26
Sheet Metal Overview 32
Bends 32

Relief 35
CABINET-Insert Component 35
CABINET-Rip Feature and Sheet Metal Bends 38
CABINET-Edge Flange 40
CABINET-Hole Wizard and Linear Pattern 43
CABINET-Sheetmetal Library Feature 47
CABINET-Louver Forming tool 51
Manufacturing Considerations 52
Additional Pattern Options 58
CABINET-Formed and Flat States 60
CABINET-Sheet Metal Drawing with Configurations 62
PEM Fasteners and IGES Components 68
Derived Component Pattern 72
MOTHERBOARD-Assembly Hole Feature 74
Assembly FeatureManager and External References 75
Replace Components 77
Equations 80
Design Table 84
BRACKET Part-Sheet Metal Features 87
BRACKET Part-In-Content Features 89
BRACKET Part-Edge, Tab, Break Corner and Miter Features 91
BRACKET Part-Mirror Component 96
MirrorBRACKET Part-Bends, Fold, Unfold and Jog Features 100
Project Summary 105
Project Terminology 106
Questions / Exercises 109

**Project 7 - SolidWorks SimulationXpress, Sustainability and DFMXpress 7-1**
Project Objective 3
SolidWorks SimulationXpress 3
SolidWorks SimulationXpress Wizard 7
  Welcome 7
  Fixtures 7
  Loads 8
  Materials 8
  Run 8
  Results 8
  Optimize 8
Analyze the MGPMRod Part 9
Review of SolidWorks SimulationXpress 12
SolidWorks SustainabilityXpress 13
  Carbon Footprint 13
  Energy Consumption 13
  Air Acidification 13
  Water Eutrophication 13
Analyze the CLAMP Part 13
  Material Class 14
  Material Name 14
  Manufacturing Process 14
  Manufacturing Region 14
  Transportation and Usage region 14

| | |
|---|---|
| Baseline | 14 |
| Find Similar Material | 15 |
| Run Report | 17 |
| Summary | 17 |
| SolidWorks DFMXpress | 17 |
| DFMXpress Wizard | 18 |
| Run | 18 |
| Settings | 18 |
| Close | 18 |
| Help | 18 |
| Summary | 19 |
| Exercises | 20 |
| **Appendix** | **A-1** |
| ECO Form | 1 |
| Types of Decimal Dimensions (ASME Y14.5M) | 2 |
| SolidWorks Keyboard Shortcuts | 3 |
| Windows Shortcuts | 3 |
| CSWA Certification Introduction | 5 |
| Intended Audience | 5 |
| CSWA Exam Content | 6 |
| About the CSWA exam | 8 |
| CSWA Certification | 8 |
| Exam day | 8 |
| When I pass | 15 |
| Helpful On-Line information | 17 |
| **Index** | **I-1** |