DIRECTORY
OF FIGURES
AND TABLES
DIRECTORY OF FIGURES

Figure 2-1: Median Detail: Right In Right Out.............................................................................. 2-11
Figure 2-2: Raised Median Detail: Right In Right Out................................................................. 2-11
Figure 2-3: Vehicle-Pedestrian Conflict ..................................................................................... 2-13
Figure 2-4: Pork Chop with Non-Traversable Median ......................................................... 2-14
Figure 2-5: Left Ingress from One Direction Only ................................................................. 2-15
Figure 2-6: Left Ingress from Both Directions ......................................................................... 2-16
Figure 2-7: Example of Frontage Road Locations ................................................................. 2-19
Figure 2-8: U-Turn at Intersection ........................................................................................... 2-20
Figure 2-9: U-turn at Midblock ................................................................................................. 2-21

Figure 3-1: Determining Stopping Sight Distance ...................................................................... 3-3
Figure 3-2: SSD on Horizontal Curves ....................................................................................... 3-7
Figure 3-3: Standard Superelevation ......................................................................................... 3-13
Figure 3-4: Developing Superelevation on 2-Lane Highways .................................................. 3-14
Figure 3-5: Developing Superelevation on 2-Lane Highways (Cont'd) .................................... 3-15
Figure 3-6: Examples of Additional Methods for Developing Superelevation ................... 3-16
Figure 3-7: Developing Superelevation on 4-Lane Highways ............................................... 3-17
Figure 3-8: SSD Crest Vertical Curve ......................................................................................... 3-21
Figure 3-9: SSD Sag Vertical Curve .......................................................................................... 3-22

Figure 4-1: Rounding of Cutbanks............................................................................................ 4-10
Figure 4-2: Full Width Median .................................................................................................. 4-15
Figure 4-3: Landscaping Accommodation ............................................................................... 4-17
Figure 4-4: Median Tree placement .......................................................................................... 4-19
Figure 4-5: End Treatments ....................................................................................................... 4-21
Figure 4-6: Interstate Clearance Envelopes for Single Lane .................................................... 4-27
Figure 4-7: Freeway & Highway Clearances ............................................................................. 4-28
Figure 4-8: Railroad Clearances ............................................................................................... 4-29
Figure 4-9: Concrete Barrier Placement at Bridge Column .................................................... 4-33
Figure 4-10: Truck Speed Distance Curve ................................................................. 4-48

Figure 5-1: Standard Urban Freeway Section (Includes Non-Interstate Facilities) ........ 5-11
Figure 5-2: Standard Freeway Section (Includes Non-Interstate Facilities) ................. 5-12

Figure 6-1: OHP Land Use Designation Overlay ......................................................... 6-5
Figure 6-2: Expressway Median Widths and Dual Left Turn Lanes .............................. 6-12
Figure 6-3: Positive and Negative Offset ................................................................... 6-13
Figure 6-4: Typical Special Transportation Area (STA) ............................................. 6-17
Figure 6-5: Potential Urban Business Area (UBA) ..................................................... 6-29
Figure 6-6: Commercial Center ............................................................................... 6-37
Figure 6-7: Urban Fringe/Suburban Area ................................................................. 6-43

Figure 7-1: Standard Sections For Rural Highways .................................................... 7-13

Figure 8-1: Accommodating And Designing For Vehicles ........................................ 8-4
Figure 8-2: Offset Approaches ................................................................................. 8-6
Figure 8-3: Functional Intersection Area ................................................................. 8-6
Figure 8-4: Throat Distance at Approaches .............................................................. 8-7
Figure 8-5: Driveway Approaches With Sidewalks .................................................. 8-11
Figure 8-6: Driveway Approaches Without Sidewalks ............................................. 8-12
Figure 8-7: Sidewalk Ramp Details .......................................................................... 8-13
Figure 8-8: Right Turn Channelization ...................................................................... 8-16
Figure 8-9: Left-Turn Channelization ...................................................................... 8-22
Figure 8-10: Reversing Curve Option for Left-Turn Channelization ......................... 8-23
Figure 8-11: Right Turn Acceleration Lane from at Grade Intersection .................... 8-27
Figure 8-12: Median Acceleration Lane - Narrow Median ....................................... 8-31
Figure 8-13: Median Acceleration Lane - Wide Median .......................................... 8-32
Figure 8-14: Left Turn Add Lane .............................................................................. 8-33
Figure 8-15: Typical Multi-Lane Channelized Intersection ....................................... 8-34
Figure 8-16: Curb Extension .................................................................................... 8-36
Figure 8-17: Skew Angle and Field of View ............................................................. 8-38
Figure 8-18: Island Geometry .................................................................................. 8-39
Figure 8-19: Crosswalk Ramp Placement ................................................................. 8-41
Figure 8-20: Signal Pole Placement ....................................................................... 8-42
Figure 8-21: Dual Left Turn Channelization ............................................................ 8-45
Figure 8-22: Channelization & Intersection Details ............................................... 8-46
Figure 8-23: Dual Right Turn Channelization ....................................................... 8-48
Figure 8-24: Elements of a Roundabout ............................................................... 8-52
Figure 8-25: Estimated Vehicle Speed and Radius Relationship – Fastest Path .... 8-60
Figure 8-26: Five Critical Path Radii for Fastest Path Analysis .......................... 8-62
Figure 8-27(a): Fastest Vehicle Path Through a Single Lane Roundabout ........ 8-63
Figure 8-27(b): Fastest Vehicle Path Through a Multi-Lane Roundabout .......... 8-63
Figure 8-28: Roundabout Cross-Section ............................................................... 8-64
Figure 8-29: Truck Apron Mountable Concrete Curb ............................................ 8-67
Figure 8-30(a): Typical Truck Apron and Circulating Roadway Cross-Slope .... 8-68
Figure 8-30(b): Truck Apron and Crowned Circulating Roadway Cross-Slope ... 8-69
Figure 8-31: Modified Truck Apron .................................................................... 8-70
Figure 8-32: Approach Alignment ........................................................................ 8-73
Figure 8-33: Angle Between Approaches ............................................................ 8-74
Figure 8-34: Skewed Alignments ........................................................................ 8-75
Figure 8-35: Three Legged Approaches ............................................................... 8-76
Figure 8-36: Five Approach Roundabout ............................................................ 8-77
Figure 8-37: Exit Geometry – Alternate Speed Prediction Method ..................... 8-79
Figure 8-38(a): Oversize Vehicle Entrance Apron .............................................. 8-81
Figure 8-38(b): Swept Path of Oversize Vehicle Using an Entrance Apron ...... 8-82
Figure 8-39: Minimum Splitter Island Dimensions, Single Lane Roundabout ... 8-83
Figure 8-40(a): Various Multi-Lane Roundabout Entrance and Exit Options .... 8-86
Figure 8-40(b): Additional Multi-Lane Roundabout Entrance and Exit Options 8-87
Figure 8-41: Path Overlap .................................................................................. 8-88
Figure 8-42: Minimizing Path Overlap ................................................................. 8-89
Figure 8-43(a): WB-67 Entering in the Inside Lane, Using Gore Striping ......... 8-90
Figure 8-43(b): WB-67 Entering in the Outside Lane, Using Gore Striping ..... 8-91
Figure 8-44: Bike Curb Cut ................................................................................ 8-94

Figure 9-1: Examples of System Interchange Forms ........................................... 9-8
Figure 9-2: Common Service Interchange Forms ................................................................. 9-9
Figure 9-3: Examples of Compact Diamond Interchange Forms ........................................... 9-10
Figure 9-4: Directional Ramps with Diamond Interchange Superimposed ............................ 9-11
Figure 9-5: Non-Freeway Interchange Forms .......................................................................... 9-12
Figure 9-6: Examples of Specialized Interchange Forms .......................................................... 9-13
Figure 9-7: Freeway Lane Drops ............................................................................................ 9-16
Figure 9-8: Minimum Ramp Terminal Spacing ........................................................................ 9-20
Figure 9-9: Discrete Areas of A Typical Ramp ........................................................................ 9-23
Figure 9-10: Ramp Types ......................................................................................................... 9-25
Figure 9-11: Entrance Ramp Details ........................................................................................ 9-28
Figure 9-12: Exit Ramp Details ................................................................................................ 9-29
Figure 9-13: Consecutive Entrance Ramps ............................................................................. 9-30
Figure 9-14: Two-Lane Parallel Entrance Ramp ....................................................................... 9-31
Figure 9-15: Entrance Ramps on Curves ................................................................................. 9-34
Figure 9-16: Exit Ramps on Curves .......................................................................................... 9-35
Figure 9-17: Interchange Ramp Spread ..................................................................................... 9-39
Figure 9-18: Detail at Ramp and Crossroad Intersection ............................................................ 9-40
Figure 9-19: Ramp Terminal Curve Design .............................................................................. 9-41
Figure 9-20: Maximum I.D.V. Swept Path ................................................................................. 9-43
Figure 9-21: Two-Lane Ramp Meter with Taper to One-lane Entrance Ramp ......................... 9-45
Figure 9-22: Freeway Ramps Standard Typical ......................................................................... 9-47
Figure 9-23: Non-Freeway Interchange Ramp Typical Section ............................................... 9-48
Figure 9-24: Partial Cloverleaf Intersection Detail .................................................................... 9-50
Figure 9-25: Folded Diamond Terminal Detail ......................................................................... 9-51
Figure 9-26: Non-Freeway Interchange .................................................................................... 9-57
Figure 9-27: Non-Freeway Interchange Example And Future Improvements .......................... 9-58

Figure 12-1: Minimum Bus Pullout Details .............................................................................. 12-11
Figure 12-2: Near-Side Bus Stop with Curb .............................................................................. 12-13
Figure 12-3: Far-Side Bus Stop with Curb ............................................................................... 12-18
Figure 12-4: Fully Developed Bus Stop .................................................................................... 12-19
Figure 12-5: Typical Intersection Design for Bus ..................................................................... 12-26
Figure 12-6: Conceptual Park and Ride Applications ............................................................... 12-32

§ Directory of Figure
Figure 13-1: On-Road Bikeway Definition ................................................................. 13-2
Figure 13-2: Handrail at Bridges and Vertical Drops greater than 5' ...................... 13-13
Figure 13-3: Criteria for Pedestrian Rail At Back Of Walk...................................... 13-14
Figure 13-4: Continuous Raised Median versus Cut-Through Crossing Island .......... 13-19
Figure 13-5: Sight Lines with Curb Extensions ......................................................... 13-20
Figure 13-6: Types of Separated Paths ................................................................. 13-24

Figure 16-1: Display of Components with Existing Ground Contours and Triangles .... 16-6
Figure 16-2: Sample Template from ODOT Template Library .................................... 16-9
Figure 16-3: Top View of Adjacent Corridors ......................................................... 16-14
Figure 16-4: Rotated View - Vertical Gap Problem Between Corridors .................... 16-14
Figure 16-5: Surface Triangulation Error .............................................................. 16-20
Figure 16-6: Display of 3D Solids ............................................................................. 16-21
Figure 16-7: Display of Solids and Roadway Prism .................................................. 16-21
Figure 16-8: Index in Spreadsheet .......................................................................... 16-23
Figure 16-9: Index Contained in Narrative .............................................................. 16-24
Figure 16-10: Index in HTML Document with Links to Reports ............................... 16-24
Figure 16-11: Delete Unused Alignments .............................................................. 16-25
Figure 16-12: Alignments Displayed in Design File ................................................. 16-26
Figure 16-13: Review Active Alignment Report ..................................................... 16-27
Figure 16-14: LandXML Translator for Alignments ............................................... 16-28
Figure 16-15: Rotated View of Features and Triangles Displayed in Design File .......... 16-29
Figure 16-16: Index of Surface Names andLocations .............................................. 16-30
Figure 16-17: LandXML Translator for Surfaces .................................................... 16-31
Figure 16-18: Critical Section Choices for Cross Sections ........................................ 16-32
Figure 16-19: Cross Sections Displayed and Labeled ............................................. 16-33
Figure 16-20: Cross Section Report Using One of Many Stylesheets ...................... 16-34
Figure 16-21: Create Report When Calculating End-Area Volume ......................... 16-35
Figure 16-22: Grid Volume ...................................................................................... 16-36
Figure 16-23: Stitch Mesh Faces When Displaying Components .............................. 16-37

Figure M-1: Approximate Durations - Roadway Digital Design Delivery Schedule (Typical) M-2
Figure P–1: Estimated Vehicle Speed and Radius Relationship ...................................................... P-1
Figure P–2: Vehicle Path Through a Roundabout - Speed, Radius ..................................................... P-3
Figure P–3: Vehicle Path Through a Roundabout - Speed, Radius, Acceleration Distance ........... P-4
Figure P–4: Exit Geometry – Comparison Tangential and Small Radius ....................................... P-8
## DIRECTORY OF TABLES

Table 1-1: Design Standards Selection Matrix ................................................................. 1-23

Table 3-1: Stopping Sight Distance .................................................................................. 3-4
Table 3-2: Open Road Superelevation & Spiral Lengths .................................................... 3-10
Table 3-3: Urban Superelevation & Spiral Lengths ............................................................. 3-11
Table 3-4: Suburban Superelevation & Spiral Lengths ....................................................... 3-12
Table 3-5: Comfort Speed ............................................................................................... 3-19

Table 4-1: Additional Embankment Widening on High Fills ............................................. 4-9
Table 4-2: Left Side Shy Distance .................................................................................... 4-15
Table 4-3: Clear Zone Distances ..................................................................................... 4-30
Table 4-4: Horizontal Curve Adjustments ........................................................................ 4-31

Table 5-1: Median Barrier Systems .................................................................................. 5-7
Table 5-2: ODOT 4R/New Freeway Design Standards Minimums .................................. 5-10
Table 5-3: Maximum Gradient ....................................................................................... 5-15
Table 5-4: Interstate Maintenance Design Features ......................................................... 5-17
Table 5-5: Interchange Spacing ...................................................................................... 5-26

Table 6-1: ODOT 4R/New Urban Standards – Expressways ............................................ 6-15
Table 6-2: ODOT 4R/New Urban Standards – STAs ......................................................... 6-28
Table 6-3: ODOT 4R/New Urban Standards – UBAs ......................................................... 6-36
Table 6-4: ODOT 4R/New Urban Standards – Urban Fringe/Suburban Area .................. 6-48
Table 6-5: ODOT 4R/New Urban Standards -Traditional Downtown/ Central Business District ................................................................................................................. 6-56
Table 6-6: ODOT 3R Urban Non-Freeway Design Standards ........................................... 6-58
Table 6-7: Minimum Useable Bridge Widths .................................................................... 6-60
Table 6-8: Mandatory 3R Design Features .................................................................... 6-62
Table 6-9: Low-Cost Safety Measures .......................................................................... 6-63
Table 6-10: Urban Preservation Design Features ................................................................. 6-65
Table 6-11: Additional Urban Design Features ................................................................. 6-68

Table 7-1: ODOT 4R/New Rural Standards - Expressway .................................................. 7-3
Table 7-2: ODOT 4R/New Rural Arterial Design Standards ............................................ 7-9
Table 7-3: Minimum 3R Lane and Shoulder Widths ......................................................... 7-21
Table 7-4: Minimum Useable Bridge Widths ................................................................. 7-22
Table 7-5: Mandatory Design Features ........................................................................ 7-24
Table 7-6: Low-Cost Safety Measures ......................................................................... 7-25

Table 8-1: Typical Private Approach Style and Width ...................................................... 8-8
Table 8-2: Desirable Length of Full Width Median Acceleration Lane ......................... 8-29
Table 8-3: Speed, Radius Relationship .......................................................................... 8-61
Table 8-4: Inscribed Diameters .................................................................................... 8-65

Table 9-1: Freeway and Non-Freeway Interchange Spacing .......................................... 9-2
Table 9-2: Ramp Design Speed .................................................................................... 9-26
Table 9-3: Single Lane Ramp Capacity ......................................................................... 9-26
Table 9-4: Maximum Degree of Curvature and Sight Distance on Ramps .................... 9-32
Table 9-5: Maximum Grades For Ramps ....................................................................... 9-36

Table 10-1: List of Permits and The Units Responsible .................................................... 10-34
Table 10-2: 20 Year Design-Mobility Standards (Volume/Capacity [V/C]) Ratio ........ 10-61
Table 10-3: Ideal Daily Capacity .................................................................................. 10-63
Table 10-4: Signalized Intersection Adjustment Factor (FS) ......................................... 10-64
Table 10-5: FT (Reduction factor for presence of trucks) .............................................. 10-64

Table 12-1: Typical Ranges for Bus Stop Spacing Based on Highway Segment Designation .... 12-4
Table 12-2: Advantages and Disadvantages of Far-side, Near-side and Mid-block Bus Stops .... 12-7
Table 12-3: Advantages and Disadvantages of Bus Pullouts ........................................ 12-9

Table 13-1: 4R Shoulder Widths and Bicycle Accommodations .................................. 13-5
Table 13-2: 3R Shoulder Widths ................................................................................ 13-6
Table 13-3: 4R Sidewalk Widths ................................................................. 13-11

Table 14-1: Data Needs For Exception Justification ............................................ 14-11
Table 14-2: Design Exception Request Form ....................................................... 14-14
Table 14-3: Design Exception List ................................................................. 14-19

Table P–1: Speed, Radius Relationship ............................................................ P-2
Table P–2: Maximum Straight Line Acceleration Performance by Vehicle ............. P-11