# TABLE OF CONTENTS

## Chapter 11: Design

### Section 11-1 Introduction
- 11-1-1 General Design Introduction
  - 1.1 Originator
  - 1.2 General Introduction
- 11-1-5 Asset Management by a Practical Design System Preservation Approach
  - 5.1 Federal Highway Administration (FHWA) Perspective on Performance-Based Practical Design
  - 5.2 WisDOT Perspective on Performance-Based Practical Design
- 11-1-10 Application of Design Criteria
  - 10.1 S-1 Application
  - 10.2 S-2 Application
  - 10.3 S-3 Application
- Attachment 10.1 Improvement Strategies, Improvement Concepts, and Standard Applications

### Section 11-2 Alternative Contracting
- 11-2-1 Alternative Contracting
  - 1.1 Introduction
  - 1.2 Process for Selecting an Alternative Contracting Method
  - 1.3 "Low Bid" Design Build
  - 1.4 Flexible Notice-to-Proceed
  - 1.5 Lane Rental
  - 1.6 "Enhanced" Liquidated Damages
  - 1.7 Interim Liquidated Damages
  - 1.8 Incentives / Disincentives
  - 1.9 Cost Plus Time Bidding
  - 1.10 Warranty Clauses
- Attachment 1.1 Alternative Contracting Decision Flowchart
- Attachment 1.2 Cost Plus Bidding Examples
- Attachment 1.3 Cost Plus Lane Rental Bidding Examples

### Section 11-3 Community Sensitive Design
- 11-3-1 Policy & Principles
  - 1.1 General
  - 1.2 Design Policy: "Community Sensitive Design"
  - 1.3 A Changing Context for Transportation
  - 1.4 Outcomes of Community Sensitive Design
  - 1.5 Principles of Community Sensitive Design

---

**References**

---

**February 18, 2020 Page 1**
11-3-5 Decision Making Guidance
  5.1 Introduction
  5.2 Decision Making Steps
  5.3 Project Information, Data Collection and Analyses
  5.4 Things to Consider When Making Decisions on Design Criteria

Attachment 5.1 CSD Considerations for Horizontal Alignment
Attachment 5.2 CSD Considerations for Vertical Alignment
Attachment 5.3 CSD Considerations for Stopping Sight Distance
Attachment 5.4 CSD Considerations for Intersection Sight Distance
Attachment 5.5 CSD Considerations for Passing Sight Distance
Attachment 5.6 CSD Considerations for Decision Sight Distance
Attachment 5.7 CSD Considerations for Cross Section (Lane)
Attachment 5.8 CSD Considerations for Cross Section (Shoulder)
Attachment 5.9 CSD Considerations for Cross Section (Medians)
Attachment 5.10 CSD Considerations for Cross Section (Roadside)
Attachment 5.11 CSD Considerations for Intersections
Attachment 5.12 CSD Considerations for Access Control
Attachment 5.13 CSD Considerations for Pedestrian/Bicycle Accommodations
Attachment 5.14 CSD Considerations for Bridges

Section 11-4 Reports

11-4-1 Concept Definition Report
  1.1 General
  1.2 Content
  1.3 CDR Process
  1.4 Community Sensitive Design
  1.5 Notes to Design

Attachment 1.1 Concept Definition Report

11-4-3 Final Scope Certification
  3.1 General
  3.2 Concurrence
  3.3 Content

Attachment 3.1 Final Scope Certification Document

11-4-5 Location Study Report
  5.1 General

11-4-10 Design Study Report
  10.1 General
  10.2 Concurrence Process
  10.3 Distribution
  10.4 Content

Attachment 10.1 Modernization and Rehabilitation Design Study Report Template
Attachment 10.2 New Construction, Reconstruction and Rehabilitation Design Study Report Template
Attachment 10.3 Abbreviated Design Study Report Template
Attachment 10.4 Group III Pavement Strategies Preventative Maintenance Project Design Study Report Template
Attachment 10.5 Perpetuation Design Study Report Template
Attachment 10.6 FHWA Design Justification Approval Signature Page
Attachment 10.7 Local Program Signature Sheet
Attachment 10.8 NHS Local Program Signature Sheet
Attachment 10.9 Sample Cross Sections

Section 11-5 General Design Considerations

11-5-1 Scope of Construction Projects
  1.1 Discussion

11-5-2 Traffic Demand Forecasts
  2.1 Traffic Forecasts General

11-5-3 Highway Capacity
  3.1 General
  3.2 Incremental Improvements for Non-Interstates and Non-Freeways
  3.3 Incremental Improvements for Interstates and Freeways
  3.4 Level of Service Analysis
  3.5 Level of Service Evaluation for Environmental Documentation
  3.6 Traffic Analysis Tool Selection
11-5-5 Access Control

5.1 Introduction
5.2 State Access Management Plan (SAMP)
5.3 Spacing
5.4 Intersecting Roadways
5.5 Interchange Areas
5.6 Traffic Impact Analysis
5.7 References

Attachment 5.1 Access Spacing Guidelines
Attachment 5.2 Access Control for Typical Interchange

11-5-10 Earthwork

10.1 Preliminary Design
10.2 General Considerations
10.3 Project Scheduling
10.4 Total Volume Concept for Project Earthwork.
10.5 Borrow
10.6 Earthwork Quantities
10.7 Earthwork Computations
10.8 Excess Incidental Excavation
10.9 Soil Compaction
10.10 Bridge Approach Embankments
10.11 Geosynthetics

Attachment 10.1 Earthwork Calculation Examples
Attachment 10.2 Compaction of Soils
Attachment 10.3 Bridge Approach Construction Techniques

11-5-15 Select Materials in Subgrades

15.1 Policy
15.2 Application
15.3 Design
15.4 Other Design Considerations

Attachment 15.1 Areas for Inclusion of Select Materials
Attachment 15.2 Standard Select Materials Systems
Attachment 15.3 Typical Half Section with Select Materials
Attachment 15.4 Typical Half Section with Select Materials, 4-Lane Divided Highway, 50 ft Median
Attachment 15.5 Typical Half Section with Select Materials, 4-Lane Divided Highway, 60 ft Median
Attachment 15.6 Median Drain Detail for Select Materials Layer Greater Than \( c_{\text{max}} \)
Attachment 15.7 Typical Section for 1-Lane Ramp with Select Materials

Section 11-10 Design Controls

11-10-1 Basic Criteria

1.1 Design Year
1.2 Traffic
1.3 Highway Capacity
1.4 Functional Classification
1.5 Design Speeds
1.6 References

11-10-5 Geometric Elements

5.1 Sight Distances
5.2 Horizontal Alignments
5.3 Superelevations
5.4 Vertical Alignments
5.5 References

Attachment 5.1 Sight Distance Values
Attachment 5.2 Sight Distance Categories and Applications
Attachment 5.3 Maximum Grades by Functional Classification
Attachment 5.4 Sight Distance for Crest Vertical Curves
Attachment 5.5 Sight Distance for Crest Vertical Curves - Graphs
Attachment 5.6 Sight Distance for Sag Vertical Curves
Attachment 5.7 Sight Distance for Sag Vertical Curves - Graphs
Attachment 5.8 Passing Sight Distance for Crest Vertical Curves
Attachment 5.9 Sight Distance on Horizontal Curves
Attachment 5.10 Super-elevation Transition of Two-Lane Highway to the Right
Attachment 5.11 Super-elevation Transition of Divided Highway Curve to Right
FDM Chapter 11 Table of Contents

Attachment 5.12 ....Super-elevation Chart for Low Speed Urban Street
Attachment 5.13 ....Guide Dimensions for Vision Triangles, Stop Control on Minor Road
Attachment 5.14 ....Sample Problem - Intersection Sight Distance
Exhibit 5.1 ..........Superelevation Tables (emax = 4% and 6%)

Section 11-15 Cross-Section Elements for Modernization Projects on Rural Highways, Freeways and Interstates

11-15-1 ......Modernization Design Guidance for Highways
1.0 ..........Introduction
1.1 ..........Overview and Scope of Modernization Projects
1.2 ..........Safety and Traffic Operations
1.3 ..........Design Standards Application
1.4 ..........Shoulders
1.5 ..........Railroad Crossings
1.6 ..........Cross Slopes
1.7 ..........Shoulders
1.8 ..........Rumble strips
1.9 ..........Auxiliary Lanes
1.10 ..........Subgrade Side Slopes and Widths
1.11 ..........Side Slopes
1.12 ..........Side Ditches
1.13 ..........Clear Zones, Horizontal Clearances, and Clear Roadway Widths of Bridges
1.14 ..........Median
1.15 ..........Transition from Divided to Two-Way Roadways
1.16 ..........Marsh Section
1.17 ..........Local Service
1.18 ..........Rural Driveways and Entrances
1.19 ..........Traffic Control Devices/Signing on Interstate Highways
1.20 ..........Access Control on Interstate Highways

Attachment 1.1 ......Modernization Design Criteria for Rural State Trunk Highways Functionally Classified as Arterials
Attachment 1.2 ......Modernization Design Criteria for Rural State Trunk Highways Functionally Classified as Collectors
Attachment 1.3 ......Modernization Design Criteria for Rural State Trunk Highways Functionally Classified as Local Roads
Attachment 1.4 ......Modernization Design Standards for Town Roads (New Construction Only)
Attachment 1.5 ......Rural State Trunk Highway Modernization Paved Shoulder Width Criteria
Attachment 1.6 ......Typical Modernization Cross Sections for Rural 2-Lane Highways
Attachment 1.7 ......Typical Modernization Cross Sections for Divided Highways and 1-Lane Ramps
Attachment 1.8 ......Modernization Roadway Sections in Rock Cut
Attachment 1.9 ......Modernization Clear Zone Distance Tables and Recovery Area Width Determination
Attachment 1.10 ......Modernization Horizontal Curve Correction Factors
Attachment 1.11 ......Modernization Ditch Traverseability Evaluation Charts
Attachment 1.12 ......Typical Modernization 2- to 4-Lane Transition
Attachment 1.13 ......Typical Modernization Marsh Sections
Attachment 1.14 ......Lateral Clearance on Modernization Rural Roadways
Attachment 1.15 ......Modernization Design Criteria for County Trunk Highways Functionally Classified as Arterials
Attachment 1.16 ......Modernization Design Criteria for County Trunk Highways Functionally Classified as Collectors
Attachment 1.17 ......Modernization Design Criteria for County Trunk Highways Functionally Classified as Local Roads
Attachment 1.18 ......Modernization Design Criteria for Interstate Highways

11-15-5 ......Design Criteria for the Great River Road
5.1 ..........Introduction
5.2 ..........Design Criteria
5.3 ..........Shoulder Width
5.4 ..........Special Design Features
5.5 ..........Application of Design Criteria

Attachment 5.1 ......Great River Road Map

11-15-10 ......Passing Lanes and Climbing Lanes
10.1 ......Passing Lanes
10.2 ......Climbing Lanes

Attachment 10.1 ......Rural STH Passing Lane Corridors
Section 11-20 Cross Section Elements for Modernization of Urban Highways

11-20-1 Modernization Dimensions and Design Classes
   1.0 General
   1.1 Cross Slopes
   1.2 Curbs or Curb and Gutters
   1.3 Design Criteria Guidance
   1.4 Medians
   1.5 Travel Lanes
   1.6 Auxiliary and Parking Lanes
   1.7 Borders
   1.8 Slopes and Ditches
   1.9 Clearances for Urban Roadways

Attachment 1.1 Urban Streets Modernization Roadway Design Criteria for Posted Speed Limits of 40 mph or less
Attachment 1.2 Typical Street Cross Sections, Classes 1b, 2a, 2b & 3
Attachment 1.3 Typical Street Cross Sections, Class 4 and Class 5
Attachment 1.4 Factors Used for Highway Capacity Manual LOS Thresholds
Attachment 1.5 Transitional and High Speed Urban Roadway Criteria for Posted Speed Limits of 45 - 55 mph
Attachment 1.6 Typical Transitional / High-Speed Urban Street Cross Sections
Attachment 1.7 Required Lateral Clearance
Attachment 1.8 Run Off the Road Frequency Calculator

Section 11-25 Intersections at Grade

11-25-1 General
   1.1 Design Consideration
   1.2 Urban Intersections
   1.3 Rural Intersections
   1.4 Truck Routes and Routes for Oversized-Overweight (OSOW) Vehicles
   1.5 References

Attachment 1.1 Selection Criteria for Rural High-Speed Intersections

11-25-2 Design Criteria and Guidelines
   2.1 Design Vehicles
   2.2 Physical and Functional Areas of an Intersection
   2.3 Turn Bays
   2.4 Taper Design
   2.5 Corner Clearance to Driveways
   2.6 Intersection Vertical Alignment
   2.7 Intersection Sight Distance
   2.8 Angle of Intersection
   2.9 Intersections on Curves
   2.10 References

Attachment 2.1 WisDOT Vehicle Inventory of Oversized Overweight (OSOW) Vehicles
Attachment 2.2 WisDOT Interim Policy on Checking Criteria for OSOW-ST and OSOW-MT Vehicles at Intersections
Attachment 2.3 Taper Length Criteria

11-25-3 Intersection Control Evaluation
   3.1 Intersection Control Evaluation (ICE)
   3.2 ICE Process

Attachment 3.1 Relationship between the Facilities Development Process and the ICE Process
Attachment 3.2 Intersection Control Evaluation (ICE) Process Flow Chart
FDM Chapter 11 Table of Contents

Attachment 3.3......Traffic Control Summary Tables
Attachment 3.4......Phase I: ICE Memorandum
Attachment 3.5......Phase I: ICE Brainstorming Guide
Attachment 3.6......Phase II: ICE Worksheets
Attachment 3.7......ICE Submittal Checklist

11-25-5......Left Turn Lanes
  5.1........Introduction
  5.2........Warranting Criteria
  5.3........Design Criteria
  5.4........Special Designs
  5.5........Tee Intersection Bypass Lane
  5.6........References

Attachment 5.1......Urban Median Opening and Intersection Guidelines
Attachment 5.2......Median Openings and Left Turn Lanes in Urban Roadways
Attachment 5.3......Details for Slotted Left Turn Lanes and Median Opening Openings at Urban Intersections
Attachment 5.4......Median Opening with Left Turn Lane on Rural High-Speed 4-Lane Divided Highway

11-25-10......Right-Turn Lanes
  10.1.......Introduction
  10.2.......Intersections in Rural and Developing Areas
  10.3.......Two-Way Stop-Controlled Intersections on Urban Low Speed and Transitional Roads
  10.4.......Signalized Intersection Considerations
  10.5.......References

11-25-15......Turning Roadways (Channelized Right)
  15.1......Criteria
  15.2......Speed and Curvature
  15.3......Design Guides
  15.4......References

11-25-20......Median Openings
  20.1.......Introduction
  20.2.......U-Turns
  20.3.......Length of Opening
  20.4.......Spacing
  20.5.......References

11-25-25......Channelization
  25.1.......General
  25.2.......Islands
  25.3.......Pavement Markings
  25.4.......References

11-25-35......Auxiliary Lanes
  35.1.......Auxiliary Lanes
  35.2.......Acceleration Lanes
  35.3.......Bus Stops

11-25-40......Railroad Crossings
  40.1.......General
  40.2.......References

11-25-45......Frontage Roads
  45.2.......References

11-25-50......Master Reference List

Section 11-26 Roundabouts

11-26-1.......General
  1.1.......General
  1.2.......Modern Roundabout vs. Other Circular Intersections
  1.3.......Advantages and Disadvantages
  1.4.......Defining Physical Features
  1.5.......Roundabout Categories
  1.99.......References

11-26-5.......Design Process and Qualifications
  5.1.......Roundabout Design Process and Qualifications
  5.2.......Roundabout Designer Requirements
  5.3.......Intersection Control Evaluation, Program Level Scoping Phase
  5.4.......The 3-Stage Roundabout Design Process

Attachment 5.1.......Roundabout Critical Design Parameters Document
11-26-10 ..... User Considerations
10.1 ..... Pedestrian and Bicyclist Accommodations
10.2 ..... Transit, Large Vehicle, Oversize Vehicles and Emergency Vehicle Considerations
10.99 ..... References

11-26-15 ..... Agency & Public Coordination
15.1 ..... Public Meetings
15.2 ..... Public Outreach Resources & Methods
15.99 ..... References

11-26-17 ..... System Considerations
17.1 ..... System Considerations
17.2 ..... Adjacent Intersections and Highway Segments and Coordinated Signal Systems
17.3 ..... Roundabouts in an Arterial Network
17.4 ..... Closely Spaced Roundabouts
17.5 ..... Roundabout Interchange Ramp Terminals
17.6 ..... Traffic Signals at Roundabouts
17.7 ..... At-Grade Rail Crossings
17.99 ..... References

11-26-20 ..... Operations
20.1 ..... Operational Analysis References and Methods
20.2 ..... Roundabout Operation
20.4 ..... Operational Analysis Methodology
20.5 ..... Supplemental Tools for Operational Analysis and Design
20.6 ..... Capacity Analysis of an Existing Roundabout
20.99 ..... References

Attachment 20.1 ..... Roundabout Traffic Flow Worksheet

11-26-25 ..... Access Control
25.1 ..... Access Management
25.2 ..... Functional Intersection Area
25.3 ..... Corner Clearance and Driveway Location Considerations
25.4 ..... Parking near Roundabouts
25.5 ..... Interchange Ramps
25.99 ..... References

11-26-30 ..... Principle Based Design Guidance
30.1 ..... Introduction
30.2 ..... Design Principles
30.3 ..... Roundabout Design Process
30.4 ..... General Design Steps & Explanation
30.5 ..... Design Considerations
30.6 ..... Plan Preparation
30.99 ..... References

11-26-35 ..... Signing and Pavement Marking
35.1 ..... Signing
35.2 ..... Pavement Marking

Attachment 35.1 ..... Example Pavement Markings for Typical Designs
Attachment 35.2 ..... Sample Signing Layout for Single-lane Roundabout
Attachment 35.3 ..... Sample Signing Layout for a Multilane Roundabout
Attachment 35.4 ..... Sample Signing Plan for Roundabout Ramp Terminals
Attachment 35.5 ..... Sample Signing Plan for Roundabout Ramp Terminals

11-26-40 ..... Landscaping and Maintenance
40.1 ..... Central Island Landscaping
40.2 ..... Landscape Design
40.3 ..... Landscape Maintenance
40.4 ..... Shared-Use Path Maintenance

11-26-45 ..... Work Zone Traffic Control
45.1 ..... Work Zone Traffic Control
45.99 ..... References

11-26-50 ..... Design Aides
50.1 ..... Example Plan Sheets
50.2 ..... Creating Roundabout Fastest Paths (B-spline Curves) and Using AutoTurn software
50.3 ..... OSOW Vehicle Inventory Evaluation Overview

Attachment 50.1 ..... Creating Roundabout Fastest Paths (Spline Curves) in AutoCAD Civil 3D
Attachment 50.2 ..... Creating Roundabout Fastest Paths (Spline Curves) in Microstation Version 8i
Attachment 50.3 ..... Guide for Using AutoTURN in AutoCAD Civil 3D and MicroStation Version 8i
Section 11-30 Interchange

11-30-1 Design Elements
   1.1 Warranting Guidelines
   1.2 General Design
   1.3 Interchange Type and Selection
   1.4 Ramps
   1.5 Intersection Sight Distance
   1.6 Grades and Profile
   1.7 Superelevation and Cross Slope
   1.8 References

Attachment 1.1 Single Lane Entrance Terminal
Attachment 1.2 Typical Entrance and Exit Ramp Terminal Details
Attachment 1.3 Single Lane Exit Terminal
Attachment 1.4 Typical Details of Ramp - Mainline Intersections
Attachment 1.5 Details of Ramp - Mainline Intersections with Special Turn Lanes
Attachment 1.6 Layout for Turning Volumes

11-30-5 Cross Section, Ramp and Crossroad
   5.1 Interchange Ramp Roadway Widths
   5.2 Interchange Ramp Median (Two-Way Operations)
   5.3 Intersecting Road

11-30-10 Collector Distributor Roads
   10.1 Collector-Distributor Roads

Section 11-35 Structures

11-35-1 Widths, Clearances, Sidewalks and Protective Screening
   1.1 Structure Survey Reports
   1.2 Clear Roadway Width of Bridges
   1.3 Lateral Underclearances to Structures [2,3]
   1.4 Parapets on Structures
   1.5 Vertical Clearances [1-3]
   1.6 Sidewalks, Bicycle Accommodations, Shared Use Paths and Roundabout Sidepaths
   1.7 Touchdown Points on Local Program Bridge Projects
   1.8 Protective Screening
   1.9 References

Attachment 1.1 Structure Roadway Widths and Approach Details
Attachment 1.2 4 - Lane Divided Highway Structure Widths (w/Acceleration Lanes)
Attachment 1.3 4 - Lane Divided Highway Structure Widths (w/Deceleration Lanes)
Attachment 1.4 2, 4, and 6 - Lane Structure Widths (Special Situations)
Attachment 1.5 Lateral Underclearance to Structure for Rural Highways, Expressways, and Freeways
Attachment 1.6 Lateral Underclearance to Structure for Urban Streets
Attachment 1.7 Examples of Lateral Underclearance to Structure
Attachment 1.8 Minimum Vertical Clearance for New Bridges and Replacement Bridges
Attachment 1.9 Minimum Vertical Clearance for Bridges to Remain

11-35-5 Temporary Bridges

11-35-10 Three Lane Bridge Criteria
   10.1 General
   10.2 Bridge Widening Warrants
   10.3 Bridge Rehabilitation and Widening Practices
   10.4 Other Factors to Consider

Section 11-38 Safety Certification Process

11-38-1 General
   1.1 Overview
   1.2 Acronyms and Definitions

11-38-3 Policy

11-38-5 Overview of Safety Quantification in the Project Development Process

11-38-10 WisDOT Safety Certification Process
   10.1 General
   10.2 Sites of Promise by System Screening
   10.3 Crash Vetting for the Sites of Promise
   10.4 Contributing Geometric Analysis (CGA)
   10.5 Safety Mitigation Certification
   10.6 Safety Certification Document

Attachment 10.1 Safety Certification Process Flowchart
Attachment 10.2 ..... Safety Certification Worksheet
Attachment 10.3 ..... Sites of Promise by System Screening Process Flowchart
Attachment 10.4 ..... Geometric Features
Attachment 10.5 ..... Safety Improvement Prompt List
Attachment 10.6 ..... Design Elements Covered in HSM Predictive Methods
Attachment 10.7 ..... Flowchart for Choosing a Safety Mitigation Method
Attachment 10.8 ..... Safety Certification Document
11-38-15 ..... Examples for Safety Certification Process
15.1 ..... General
11-38-99 ..... References

Section 11-40 Perpetuation and Rehabilitation Requirements for Highways

11-40-1 ..... General Perpetuation and Rehabilitation Requirements for Highways
1.0 ..... Introduction
1.1 ..... Overview of Perpetuation and Rehabilitation Projects
1.2 ..... Safety Analysis
1.3 ..... Design Criteria Application
1.4 ..... Bridge Improvements
1.5 ..... Pavement Design
1.6 ..... Traffic Control Devices and Pavement Marking
1.7 ..... Rumble Strips
1.8 ..... Passing Sight Distance for Vertical Curves
1.9 ..... Passing and Truck Climbing Lanes
1.10 ..... Bicycle and Pedestrian Accommodations
1.11 ..... Roadside Design

11-40-6 ..... Design Standards for Perpetuation Projects
6.0 ..... General
6.1 ..... General Perpetuation Design Criteria with S-1 Application
6.2 ..... Intersections
6.3 ..... Roadway Cross Section Elements

11-40-7 ..... Design Standards for Rehabilitation Projects
7.0 ..... General
7.1 ..... References

Attachment 7.1 ..... S-2 Application of Design Criteria for Rehabilitation Projects
Attachment 7.2 ..... Design Standards for Rehabilitation Projects on Rural State Trunk Highways Functionally Classified as Arterials
Attachment 7.3 ..... Design Standards for Rehabilitation Projects on Rural State Trunk Highways Functionally Classified as Collectors and Locals
Attachment 7.4 ..... Design Standards for Rehabilitation Projects on Town Roads
Attachment 7.5 ..... Design Standards for Rehabilitation Projects on Rural County Trunk Highways Functionally Classified as Arterials
Attachment 7.6 ..... Design Standards for Rehabilitation Projects on Rural County Trunk Highways Functionally Classified as Collectors and Locals

11-40-8 ..... Design Standards for 3R Projects on Expressways and Freeways (Non-Interstate)
11-40-99 ..... References

Section 11-45 Other Elements Affecting Geometric Design

11-45-10 ..... Roadside Design Application – Improvement Strategy
10.1 ..... Introduction
10.2 ..... Application of Improvement Strategy
10.3 ..... Roadside Hazard Analysis and Treatments
10.4 ..... Roadside Hardware Evaluation and Treatments

Attachment 10.1 ..... Roadside Hazard and Guardrail Decision Flowchart for Perpetuation and Rehabilitation Highway Improvement Projects

11-45-15 ..... Roadside Barrier - General
15.1 ..... Introduction

11-45-20 ..... Roadside Hazard Analysis
20.1 ..... Introduction
20.2 ..... Project Applicability
20.3 ..... Roadside Hazard
20.4 ..... Areas of Concern
20.5 ..... Area of Analysis
20.6 ..... Roadside Hazard Analysis (RHA) Documentation

Attachment 20.1 ..... Roadside Design Factors to Consider
Attachment 20.2 ..... AASHTO's Warrant for Shielding Foreslopes
FDM Chapter 11 Table of Contents

Attachment 20.3 . FHWA Warrants for Shielding Foreslopes
Attachment 20.4 . Shielding Hazardous Cross-Drains
Attachment 20.5 . Shielding Hazardous Water
Attachment 20.6 . Roadway Segments with High Tree Crash Rates
Attachment 20.7 . Shielding Hazardous Trees
Attachment 20.8 . Median Barrier Warrant for New Freeways
Attachment 20.9 . Shielding Hazardous Fixed Objects
Attachment 20.10 . Scoping/Preliminary Roadside Hazard Design Review List
Attachment 20.11 . Roadside Hazard Analysis Sheet Template
Attachment 20.12 . Roadside Hazard Analysis Sheet Example

11-45-30 . Roadside Barrier Design Guidance
  30.3 . Barrier System Design
  30.4 . End Treatments
  30.5 . Existing Barrier System Evaluation
  30.6 . Drainage Features and Cattle Passes
  30.7 . Safety Edge
  30.8 . Cross-Median Crash (CMC)
Attachment 30.1 . Example Problem 1: West Side of Structure
Attachment 30.2 . Example Problem 2: Rock Wall
Attachment 30.3 . Example Problem 3: Outside of Curve Cattle Pass
Attachment 30.4 . Example Problem 3: Inside of Curve Cattle Pass
Attachment 30.5 . Beam Guard Plan Sheet
Attachment 30.6 . Beam Guard Analysis
Attachment 30.7 . Beam Guard Bullnose
Attachment 30.8 . Sloped Concrete End Treatment
Attachment 30.9 . Grading Area for Hazardous Cross-Drain
Attachment 30.10 . Grading Area for Hazardous Parallel Drain
Attachment 30.11 . Crash Cushion Selection Tables
Attachment 30.12 . Length of Barrier and Working Width Examples
Attachment 30.13 . Barrier Working Width Table
Attachment 30.14 . Barrier Length Examples
Attachment 30.15 . Minimum Barrier Length Table
Attachment 30.16 . Shielding Large Fixed Objects in a Median with Cable Barrier and Other Barrier Systems
Attachment 30.17 . Median Cable Barrier on a Curve
Attachment 30.18 . Median Cable Barrier by an Interchange or Bridge
Attachment 30.19 . Median Cable Barrier by a Maintenance Cross Over
Attachment 30.20 . Underground Obstructions and Shifting Beam Guard
Attachment 30.21 . Crash Test Photos Sequence Beam Guard Attached to Rigid Barrier
Attachment 30.22 . Thrie Beam Transitions to Rigid Barrier Installations
Attachment 30.23 . Partial Removal of a Middle Section of an Older Barrier Section Details
Attachment 30.24 . Short Radius
Attachment 30.25 . Long-Span
Attachment 30.26 . Beam Guard Retaining Wall
Attachment 30.27 . Beam Guard Terminal Earthwork

11-45-40 . Fencing
  40.1 . Introduction
  40.2 . Application of Improvement Strategy
  40.3 . Roadside Hazard Analysis and Treatments
  40.4 . Roadside Hardware Evaluation and Treatments

11-45-99 . References

Section 11-46 Bicycle and Pedestrian Accommodations

11-46-1 . Bicycle and Pedestrian Elements Affecting Complete Streets
  1.1 . Introduction, Purpose, Definitions, Overview
  1.2 . Bikeways and Sidewalks
  1.3 . Project Development / Scoping Process
  1.4 . References
Attachment 1.1 . FHWA letter
Attachment 1.2 . DOJ/DOT Joint Technical Assistance on the ADA Title II Requirements to Provide Curb Ramps when Streets, Roads, or Highways are Altered through Resurfacing
Attachment 1.3 . Glossary of Terms for DOJ/FHWA Joint Technical Assistance on the ADA Title II Requirements to Provide Curb Ramps when Streets Roads or Highways are Altered Through Resurfacing
FDM Chapter 11 Table of Contents

11-46-5……Pedestrian Facilities
  5.1………Introduction
  5.2………Urban Borders and Zone System
  5.3………References

Attachment 5.1……Sidewalk Design Considerations

11-46-10……Curb Ramps
  10.1………General
  10.2………Curb Ramps and Detectable Warning Fields
  10.3………Curb Ramp Design Considerations
  10.4………Other Considerations
  10.5………Curb Ramp Adjacent to Historically Significant Resources
  10.6………References

Attachment 10.1……Legal Crosswalk and Crosswalk Closure Figures
Attachment 10.2……Curb Ramp Options with Restricted Right-of-Way
Attachment 10.3……Accessible Pedestrian Signals & Push Button Locations
Attachment 10.4……On-Street Parking for People with Mobility Impairments

11-46-15……Bicycle Facilities
  15.1………Introduction to Bicycle Facilities
  15.2………Design Guidelines and Basic Improvements
  15.3………Urban On-road Bicycle Accommodations
  15.4………Rural On-road Bicycle Accommodations
  15.5………Shared Roadways
  15.6………Shared-use Paths
  15.7………Bicycle Accommodations on Highway Structures
  15.8………Inlet, Manhole and Utility Covers
  15.9………At-Grade Railroad Crossings
  15.10………Signing and Marking
  15.11………References

11-46-20……Permanent Public Trail Crossing Rural Public Roads
  20.1………Introduction
  20.2………Engineering Warrants for Trail-Highway Crossings
  20.3………Freeways and Expressways
  20.4………At-Grade Treatments
  20.5………Grade Separation Structure Guidance
  20.6………Financial and Cost Share Responsibilities

Attachment 20.1……Grade Separation Warrants
Attachment 20.2……Grade Separation Warrant Worksheet
Attachment 20.3……Sample Grade Separation Warrant Determination
Attachment 20.4……Sight Distance for Trail Crossing

11-46-99……References

Section 11-50 Traffic Control

11-50-1……Work Zone Policy Statement

11-50-5……Transportation Management Plan Process
  5.1………Introduction
  5.2………What is a TMP?
  5.3………Project Development Process
  5.4………Work Zone Impacts Assessment
  5.5………TMP Development
  5.6………TMP Type Selection Matrix
  5.7………Mitigation Contracts
  5.8………Implement TMP
  5.9………Monitor TMP
  5.10………Documentation of Changes to TMP
  5.11………Post Construction Project Evaluation
  5.99………References

Attachment 5.1……Project Initiation Process & Project Management Plan
Attachment 5.2……Standard Work Zone Strategy Matrix
Attachment 5.3……Standard Public Information and Motorist Mitigation Strategy Matrix
Attachment 5.4……Standard Incident Management Approval Strategy Matrix
Attachment 5.5……Non-Standard Mitigation Strategy Form
Attachment 5.6……Law Enforcement Process Flowchart

11-50-10……Components of a Transportation Management Plan
  10.1………Components of a Transportation Management Plan
# FDM Chapter 11 Table of Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.2</td>
<td>Public Information &amp; Outreach Plan (PIOP)</td>
</tr>
<tr>
<td>10.3</td>
<td>Work Zone Incident Management Plan (IMP)</td>
</tr>
<tr>
<td>Attachment 10.1</td>
<td>Public Information &amp; Outreach Plan Checklist</td>
</tr>
<tr>
<td>Attachment 10.2</td>
<td>Transportation Operations Plan Checklist</td>
</tr>
<tr>
<td>Attachment 10.3</td>
<td>Example Communications Flow Diagram</td>
</tr>
<tr>
<td>Attachment 10.4</td>
<td>Example Emergency Alternatives Route Maps</td>
</tr>
<tr>
<td>Attachment 10.5</td>
<td>Example Emergency Access, Pullout and Traveler Information Equipment Location Map</td>
</tr>
</tbody>
</table>

## 11-50-15 Work Zone Traffic Control Plan Process

<table>
<thead>
<tr>
<th>Subsection</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>15.1</td>
<td>Project Scope</td>
</tr>
<tr>
<td>15.2</td>
<td>Traffic Control Scope</td>
</tr>
<tr>
<td>15.3</td>
<td>Construction Under Traffic</td>
</tr>
<tr>
<td>15.4</td>
<td>Detour Determination</td>
</tr>
<tr>
<td>15.5</td>
<td>Develop Staging Plan</td>
</tr>
<tr>
<td>15.6</td>
<td>SDDs</td>
</tr>
<tr>
<td>15.7</td>
<td>Prepare Preliminary Traffic Control Plan &amp; Details</td>
</tr>
<tr>
<td>15.8</td>
<td>Preliminary Plan &amp; Details Review</td>
</tr>
<tr>
<td>15.9</td>
<td>Finished Traffic Control Plan &amp; Review Meeting</td>
</tr>
<tr>
<td>15.10</td>
<td>Contractor Involvement</td>
</tr>
<tr>
<td>15.11</td>
<td>Bureau of Traffic Operations Involvement</td>
</tr>
</tbody>
</table>

| Attachment 15.1 | Work Zone Traffic Control Plan Process |

## 11-50-20 Safety and Design in Work Zones

<table>
<thead>
<tr>
<th>Subsection</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>20.1</td>
<td>General Requirements</td>
</tr>
</tbody>
</table>

## 11-50-21 Safety and Design in Work Zones

<table>
<thead>
<tr>
<th>Subsection</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>21.1</td>
<td>Signing</td>
</tr>
<tr>
<td>21.2</td>
<td>Pavement Marking</td>
</tr>
<tr>
<td>21.3</td>
<td>Channelizing Devices</td>
</tr>
<tr>
<td>21.4</td>
<td>Temporary Portable Rumble Strips</td>
</tr>
<tr>
<td>21.5</td>
<td>Work Area Ingress and Egress</td>
</tr>
<tr>
<td>21.6</td>
<td>Pavement Drop-off Protection</td>
</tr>
<tr>
<td>21.7</td>
<td>Freight Consideration</td>
</tr>
<tr>
<td>21.8</td>
<td>Traffic Control Quantities</td>
</tr>
<tr>
<td>21.9</td>
<td>Design of Traffic Control Plans</td>
</tr>
<tr>
<td>21.10</td>
<td>Speed Limits During Construction</td>
</tr>
<tr>
<td>21.11</td>
<td>Detours</td>
</tr>
<tr>
<td>21.99</td>
<td>References</td>
</tr>
</tbody>
</table>

## 11-50-22 Traffic Control Plans for Divided Highways

<table>
<thead>
<tr>
<th>Subsection</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>22.1</td>
<td>Traffic on Divided Roadways</td>
</tr>
<tr>
<td>22.2</td>
<td>Lane Shifts</td>
</tr>
<tr>
<td>22.3</td>
<td>Lane Closures</td>
</tr>
<tr>
<td>22.4</td>
<td>Lane Width</td>
</tr>
<tr>
<td>22.5</td>
<td>Entrance and Exit Ramps within Lane Closures</td>
</tr>
<tr>
<td>22.6</td>
<td>Crossover Design (Construction)</td>
</tr>
<tr>
<td>22.99</td>
<td>References</td>
</tr>
</tbody>
</table>

## 11-50-23 Traffic Control Plans for Undivided Highways

<table>
<thead>
<tr>
<th>Subsection</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>23.1</td>
<td>Traffic on Undivided Roadways</td>
</tr>
<tr>
<td>23.2</td>
<td>Lane Shifts</td>
</tr>
<tr>
<td>23.3</td>
<td>Lane Closures</td>
</tr>
<tr>
<td>23.4</td>
<td>Flagging</td>
</tr>
<tr>
<td>23.5</td>
<td>Temporary Signals</td>
</tr>
<tr>
<td>23.6</td>
<td>Full Closures and Detours</td>
</tr>
</tbody>
</table>

## 11-50-25 Smart Work Zones

<table>
<thead>
<tr>
<th>Subsection</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>25.1</td>
<td>Smart Work Zones</td>
</tr>
<tr>
<td>25.2</td>
<td>Dynamic Late Merge System</td>
</tr>
<tr>
<td>25.3</td>
<td>Queue Warning System</td>
</tr>
<tr>
<td>25.4</td>
<td>Digital Speed Limit Sign Assembly</td>
</tr>
<tr>
<td>25.5</td>
<td>Construction Truck Entering and Exiting System</td>
</tr>
<tr>
<td>25.99</td>
<td>References</td>
</tr>
</tbody>
</table>

## 11-50-30 Statewide Freeway and Expressway Lane Closure and Delay Guidelines

<table>
<thead>
<tr>
<th>Subsection</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>30.1</td>
<td>Introduction</td>
</tr>
<tr>
<td>30.2</td>
<td>Lane Closure System (LCS)</td>
</tr>
<tr>
<td>30.3</td>
<td>Special Events and Holiday Work Restrictions</td>
</tr>
<tr>
<td>Section</td>
<td>Title</td>
</tr>
<tr>
<td>---------</td>
<td>-------</td>
</tr>
<tr>
<td>30.4</td>
<td>Peak Hour Restrictions</td>
</tr>
<tr>
<td>30.5</td>
<td>Estimate Capacity Under Proposed Lane Closure</td>
</tr>
<tr>
<td>11-50-31</td>
<td>Temporary Pedestrian Accommodations</td>
</tr>
<tr>
<td>31.1</td>
<td>Introduction</td>
</tr>
<tr>
<td>31.2</td>
<td>Project Scoping/Planning</td>
</tr>
<tr>
<td>31.3</td>
<td>Transportation Management Plan / PS&amp;E</td>
</tr>
<tr>
<td>31.4</td>
<td>Design Considerations</td>
</tr>
<tr>
<td>31.99</td>
<td>References</td>
</tr>
<tr>
<td>11-50-32</td>
<td>Road User Costs</td>
</tr>
<tr>
<td>32.1</td>
<td>Introduction</td>
</tr>
<tr>
<td>32.2</td>
<td>Road User Cost Computation</td>
</tr>
<tr>
<td>11-50-35</td>
<td>Concrete Barrier Temporary Precast in Work Zone</td>
</tr>
<tr>
<td>35.1</td>
<td>Introduction</td>
</tr>
<tr>
<td>35.2</td>
<td>Factors to Consider</td>
</tr>
<tr>
<td>35.3</td>
<td>Guidelines for CBTP Use</td>
</tr>
<tr>
<td>35.4</td>
<td>CBTP Anchoring Requirement/Deflection Distance</td>
</tr>
<tr>
<td>35.5</td>
<td>Intersection Sight Distance</td>
</tr>
<tr>
<td>35.6</td>
<td>CBTP End Treatments</td>
</tr>
<tr>
<td>11-50-45</td>
<td>Pavement Marking</td>
</tr>
<tr>
<td>45.1</td>
<td>General</td>
</tr>
<tr>
<td>45.2</td>
<td>Pavement Marking Selection</td>
</tr>
<tr>
<td>11-50-50</td>
<td>Signals</td>
</tr>
<tr>
<td>50.1</td>
<td>General</td>
</tr>
<tr>
<td>50.2</td>
<td>Traffic Signal Investigation</td>
</tr>
<tr>
<td>50.3</td>
<td>Design Standards</td>
</tr>
<tr>
<td>11-50-55</td>
<td>Signing</td>
</tr>
<tr>
<td>55.1</td>
<td>General</td>
</tr>
<tr>
<td>55.2</td>
<td>Reflective Sheeting and Replacement Guidelines for Highway Signs</td>
</tr>
<tr>
<td>11-50-60</td>
<td>Lighting</td>
</tr>
<tr>
<td>60.1</td>
<td>General</td>
</tr>
</tbody>
</table>

**Section 11-52 Traffic Engineering and Operations**

<table>
<thead>
<tr>
<th>Subsection</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>11-52-1</td>
<td>Intelligent Transportation Systems (ITS) Guidance</td>
</tr>
<tr>
<td>11-52-10</td>
<td>Traffic Signal Design Manual (TSDM)</td>
</tr>
</tbody>
</table>

**Section 11-55 Special Features**

<table>
<thead>
<tr>
<th>Subsection</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>11-55-1</td>
<td>Boat Ramps</td>
</tr>
<tr>
<td>1.1</td>
<td>Site Layout</td>
</tr>
<tr>
<td>1.2</td>
<td>Launching Ramps</td>
</tr>
<tr>
<td>1.3</td>
<td>Parking Lots</td>
</tr>
<tr>
<td>1.4</td>
<td>Miscellaneous Design</td>
</tr>
<tr>
<td>Attachment 1.1</td>
<td>Boat Ramp Details</td>
</tr>
<tr>
<td>Attachment 1.2</td>
<td>Pier Details</td>
</tr>
<tr>
<td>Attachment 1.3</td>
<td>Boat Ramp Example Parking Layouts</td>
</tr>
<tr>
<td>Attachment 1.4</td>
<td>Boat Ramp Example Parking Layouts</td>
</tr>
<tr>
<td>11-55-3</td>
<td>Timber Management</td>
</tr>
<tr>
<td>11-55-5</td>
<td>Retaining Walls</td>
</tr>
<tr>
<td>5.1</td>
<td>General</td>
</tr>
<tr>
<td>5.2</td>
<td>Minor Retaining Wall</td>
</tr>
<tr>
<td>5.3</td>
<td>Barriers on Top of Retaining Walls</td>
</tr>
<tr>
<td>5.4</td>
<td>Right-Of-Way Requirements</td>
</tr>
<tr>
<td>11-55-10</td>
<td>Cattle Pass Design</td>
</tr>
<tr>
<td>10.1</td>
<td>General</td>
</tr>
<tr>
<td>10.2</td>
<td>Criteria</td>
</tr>
<tr>
<td>10.3</td>
<td>Design Guidelines</td>
</tr>
<tr>
<td>10.4</td>
<td>Other Considerations</td>
</tr>
<tr>
<td>Attachment 10.1</td>
<td>Documentation for Cattle Pass</td>
</tr>
<tr>
<td>11-55-20</td>
<td>Overhead Sign Structures</td>
</tr>
<tr>
<td>20.1</td>
<td>General</td>
</tr>
<tr>
<td>20.2</td>
<td>OSS Selection and Usage Criteria</td>
</tr>
<tr>
<td>20.3</td>
<td>OSS Design and Plan Submittal Process</td>
</tr>
<tr>
<td>20.4</td>
<td>OSS Design Types</td>
</tr>
<tr>
<td>20.5</td>
<td>Subsurface Investigation and Information</td>
</tr>
<tr>
<td>20.6</td>
<td>Roadside Design Guidelines</td>
</tr>
</tbody>
</table>
FDM Chapter 11 Table of Contents

Attachment 20.1....WisDOT Overhead Sign Structure Types
Attachment 20.2....Overhead Sign Structure Selection Examples
Attachment 20.3....Overhead Sign Structure Design Process Flow Chart

11-55-25 ..... Ramp Gates
   25.1....... Background
   25.2....... Deployment and General Considerations
   25.3....... Guideline Compliance Documentation
   25.4....... Other Design Considerations
   25.5....... Identification Plaques
   25.6....... Barricades in Conjunction with Ramp Closure Gates
   25.7....... Additional Information

Attachment 25.1....Wisconsin Ramp Gate Maintenance and Inspection Guideline
Attachment 25.2.... Inspection Form for Manual Ramp Gates
Attachment 25.3.... Example Ramp Closed Use Alternative Route (R11-54F) Sign Details