Received from Tammy Rabe
Thurs Feb 2nd, 2012

USH 41 Corridor Conversion To Interstate Highway
Milwaukee - Green Bay, Wisconsin

TABLE 1
ROADWAY DESIGN CRITERIA

Preliminary Draft for FHWA Review

11/28/08

Item	Reference	Freeway Mainline		System Interchanges & Ramps		Service Interchanges & Ramps	
		Existing, Min to Remain in Place	Reconst Reqd to Meet IH Criteria (ie Pvmt Replace, Add lanes)	Existing, Min to Remain in Place	Reconst. Reqd to Meet IH Criteria (i.e. Pvmt Replace, Add Lanes)	Existing, Min to Remain in Place	Reconst. Reqd to Meet IH Criteria (i.e. Pvmt Replace, Add Lanes)
DESIGN SPEED - V (MPH)	AASHTO IH Policy & FDM 11-10-1, 11-15-1, 11-30-1 & 11-44-1	70 mph rural; 50 mph urban	70 mph rural; 65 mph suburban; 60 mph urban	**Directional ramps:** 60 mph rural; 40 mph urban. **Loop ramps:** 30 mph **(See Notes 1 & 2)**	**Directional ramps:** 60 mph rural; 40 mph urban. **Loop ramps:** 30 mph **(See Notes 1 & 2)**	**Diamond ramps:** 55 mph rural; 40 mph urban. **Loop ramps:** 25 mph **(See Note 1)**	**Diamond ramps:** 55 mph rural; 40 mph urban. **Loop ramps:** 25 mph **(See Note 1)**
DESIGN VEHICLE	WisDOT policy	WB-65	WB-65	WB-65	WB-65	WB-65	WB-65
EXISTING POSTED SPEED	FDM 11-10-1	65 mph rural; 50 mph urban	65 mph rural; 60 mph suburban; 55 mph urban	Varies	Varies	Varies	Varies
DESIGN HOURLY VOLUME FACTOR (K) **(See Note 3)**	FDM 11-5-3, GDHS, pp. 59-62; Appendix B	K30 (Rural); K200 (Urban)	K30 (Rural); K200 (Urban)	Weekday a.m. & p.m. peak hours	Weekday a.m. & p.m. peak hours	Weekday a.m. & p.m. peak hours	Weekday a.m. & p.m. peak hours
LEVEL OF SERVICE **(see Note 4)**	AASHTO IH Policy; FDM 11-5-3; Appendix B	LOS C min (at time of conversion)--**Rural**; LOS D minimum--**Urban**	LOS C min for 20 Yrs--**Rural**; LOS D min for 20 Yrs--**Urban**	Same as Mainline	Same as Mainline	Same as Mainline	Same as Mainline
MIN. STOPPING SIGHT DISTANCE--based on design speeds noted above **(see Note 5)**	FDM 11-10-5, Figures 1, 3 & 4; Appendix A	730 feet rural; 425 feet urban	730 feet rural; 645 feet suburban; 570 feet urban	See FDM, 2001 GDHS values	See FDM, 2001 GDHS values	See FDM, 2001 GDHS values	See FDM, 2001 GDHS values
MIN. DECISION SIGHT DISTANCE **(see Note 5)**	Appendix A (Prop Rev FDM 11-10-5, Fig 1)	## --- 1105 feet rural; 1050 feet suburban; 990 feet urban	1105 feet rural; 1050 feet suburban; 990 feet urban	## --- **Directional ramps:** 990 feet rural; 600 feet urban. **Loop ramps:** 450 feet	**Directional ramps:** 990 feet rural; 600 feet urban. **Loop ramps:** 450 feet	## --- **Directional ramps:** 865 feet rural; 600 feet urban. **Loop ramps:** 375 feet	**Directional ramps:** 865 feet rural; 600 feet urban. **Loop ramps:** 375 feet
HORIZONTAL ALIGNMENT							
MIN. RADII OF CURVE--based on design speeds noted above **(see Note 6)**	FDM 11-10-5 Figure 9; FDM 11-30-1	2050 feet rural; 835 feet urban	2050 feet rural; 1660 feet suburban; 1340 feet urban	See FDM	See FDM	See FDM	See FDM
COMPOUND CURVATURE - Ratio of Radii for Increasing Curvature (flatter radius to sharper radius)--**see Note 7**	GDHS, pp. 201-202	1.5:1 desirable max for open highways; 1.75:1 absolute max	1.5:1 max for open highways	##--1.5:1 desirable max for open highways; 1.75:1 absolute max	1.5:1 desirable max for open highways; 1.75:1 absolute max	##--1.75:1 desirable max; 2:1 absolute max	1.75:1 desirable max; 2:1 absolute max
MAX. SUPERELEVATION RATE **(see Note 8)**	FDM 11-10-5 Figure 9	6% Superelevation table	6% Superelevation table	6% Superelevation table	6% Superelevation table	6% Superelevation table	6% Superelevation table
SUPERELEVATION TRANSITION **(see Note 9)**	FDM 11-10-5 Figure 9	## --- See FDM	See FDM	## --- See FDM	See FDM	## --- See FDM	See FDM
VERTICAL ALIGNMENT							
MAX. GRADE	FDM 11-10-5, Figure 2	3%	3%	## --- 5%	5%	## --- 5%	5%
MIN. CONTINUOUS GRADE **(see Note 10)**	FDM 11-10-5, p.22	## --- 0.50% desirable; 0.30% minimum	0.50% desirable; 0.30% minimum	## --- 0.50% desirable; 0.30% minimum	0.50% desirable; 0.30% minimum	## --- 0.50% desirable; 0.30% minimum	0.50% desirable; 0.30% minimum
MIN. K VALUE FOR CREST VERTICAL CURVES--based on design speeds above **(see Note 11)**	Appendix A & GDHS, p. 272	247 rural; 84 urban	See Exhibit A	**Directional ramps:** 151 rural; 44 urban; **Loop ramps:** 19	See Exhibit A	**Diamond ramps:** 114 rural; 44 urban; **Loop ramps:** 12	See Exhibit A
MIN. K VALUE FOR SAG VERTICAL CURVES--based on design speeds above **(see Notes 11 & 12)**	FDM 11-10-5, Figure 4 & GDHS, p. 277	181 rural; 96 urban	See Exhibit A	**Directional ramps:** 136 rural; 64 urban; **Loop ramps:** 37	See Exhibit A	**Diamond ramps:** 115 rural; 64 urban; **Loop ramps:** 26	See Exhibit A
MINIMUM VERTICAL CLEARANCE (Desirable / Minimum)							
* CLEAR OVER FREEWAY, EXPRESSWAY OR STH ARTERIAL	FDM 11-35-1, Fig. 8 & 9	16'-0"	16'-9" / 16'-4"	16'-0"	16'-9" / 16'-4"	16'-0"	16'-9" / 16'-4"
* CLEAR OVER ARTERIAL CTH OR LOCAL RD w/ Interchange **(see Note 13)**	FDM 11-35-1, Fig. 8 & 9	15'-3"	16'-9" / 16'-3"	15'-3"	16'-9" / 16'-3"	15'-3"	16'-9" / 16'-3"
* CLEAR OVER ARTERIAL CTH OR LOCAL RD without Interchange **(see Note 14)**	FDM 11-35-1, Fig. 8 & 9	14'-0"	15'-3" / 14'-9"	14'-0"	15'-3" / 14'-9"	14'-0"	15'-3" / 14'-9"
* CLEAR OVER RAILROAD **(see Note 15)**	FDM 11-35-1, Fig. 8 & 9	23'-0"	23'-0"	23'-0"	23'-0"	23'-0"	23'-0"
* CLEAR UNDER PEDESTRIAN BRIDGE--ARTERIAL CTH, EXPRESSWAYS & FREEWAYS **(see Notes 16 & 17)**	FDM 11-35-1, Fig. 8 & 9; AASHTO IH Policy, p. 5	17'-0"	17'-9" / 17'-4"	17'-0"	17'-9" / 17'-4"	17'-0"	17'-9" / 17'-4"
* CLEAR UNDER SIGN BRIDGE--FREEWAY, EXPRESSWAY OR ARTERIAL STH **(see Note 18)**	FDM 11-35-1, Fig. 8 & 9; AASHTO IH Policy, p. 5	17'-0"	18'-4" / 18'-0"	17'-0"	18'-4" / 18'-0"	17'-0"	18'-4" / 18'-0"
STRUCTURAL CAPACITY							
STRUCTURAL CAPACITY	FDM 11-44-1, Bridge Manual Ch 3, Sec 3.1; New AASHTO Load and Resistance Factor Design Specification (LRFD), Chapter 17	HS-20 / Rated Oper Cap Safely Serv Sys for 20yr / in or added to 6-year Imp Prog	HL-93	HS-20 / Rated Oper Cap Safely Serv Sys for 20yr / in or added to 6-year Imp Prog	HL-93	HS-20 / Rated Oper Cap Safely Serv Sys for 20yr / in or added to 6-year Imp Prog	HL-93
CROSS SECTION ELEMENTS							
LANE WIDTH **(see Note 19)**	FDM 11-15-1, Fig. 1; AASHTO IH Policy, p. 3	12'	12'	____	____	____	____
* 1-LANE RAMP	FDM 11-30-5, p. 1	____	____	15'	15'	15'	15'
* 2-LANE RAMP	FDM 11-30-5, p. 1	____	____	24'	24'	24'	24'
TOTAL SHOULDER WIDTH **(RIGHT / LEFT)**--Also **see Note 19**	FDM 11-15-1, Fig. 1; FDM 11-44-1, page 3; AASHTO IH Policy, p. 3	**4-lane:** 10' / 6'; **6-lane:** 10' / 10'	**4-lane:** 12' / 6'; **6-lane:** 12' / 12'	____	____	____	____
* 1-LANE RAMP **(see Note 20)**	FDM 11-15-1, Fig. 7; FDM 11-30-1, Figures 2 & 3	____	____	## --- 8' / 4'	8' / 4'	8' / 4'	8' / 4'

= If existing values are less than minimums to remain in place, then perform operational safety analysis to determine if deficiency should be allowed to remain in place. Deficiency report documentation required.

TABLE 1
ROADWAY DESIGN CRITERIA

Preliminary Draft for FHWA Review

11/28/08

Item	Reference	Freeway Mainline		System Interchanges & Ramps		Service Interchanges & Ramps	
		Existing, Min to Remain in Place	Reconst Reqd to Meet IH Criteria (ie Pvmt Replace, Add lanes)	Existing, Min to Remain in Place	Reconst. Reqd to Meet IH Criteria (I.e. Pvmt Replace, Add Lanes)	Existing, Min to Remain in Place	Reconst. Reqd to Meet IH Criteria (I.e. Pvmt Replace, Add Lanes)
* 2-LANE RAMP (see Note 21)	FDM 11-30-1, Figures 2 & 3; GDHS, pp. 838-840	—	—	## --- 10' / 6'	10' / 6'	8' / 4'	8' / 4'
* 3-LANE RAMP (see Note 22)	FDM 11-30-1, Figures 2 & 3; GDHS, pp. 838-840	—	—	## --- 10' / 10'	10' / 10'	8' / 4'	8' / 4'
PAVED SHOULDER WIDTH (RIGHT / LEFT)--see Note 23	FDM 11-15-1, Figures 1 & 5; AASHTO IH Policy, p. 3	4-lane: 10' / 4'; 6-lane: 10' / 10'	4-lane: 12' / 4'; 6-lane: 12' / 12' (see Note 24)	—	—	—	—
* 1-LANE RAMP (see Note 20)	FDM 11-15-1, Figures 5 & 7; FDM 11-30-1, Figures 2 & 3	—	—	## --- 8' / 4'	8' / 4'	5' / 3'	5' / 3'
* 2-LANE RAMP (see Note 21)	FDM 11-30-1, Figures 2 & 3; GDHS, pp. 838-840	—	—	## --- 10' / 6'	10' / 6'	5' / 3'	5' / 3'
* 3-LANE RAMP (see Note 22)	FDM 11-30-1, Figures 2 & 3; GDHS, pp. 838-840	—	—	## --- 10' / 10'	10' / 10'	5' / 3'	5' / 3'
BRIDGE SHOULDER WIDTHS	—	—	—	—	—	—	—
* NORMAL BRIDGES (RIGHT / LEFT)	FDM 11-44-1, p. 4; FDM 11-35-1; AASHTO IH Policy, p. 5; GDHS, Exhibit 10-67, p. 839	10' / 3.5'	See total shoulder widths from previous page. Also see Note 25.	See total shoulder widths from previous page	See total shoulder widths from previous page. Also see Note 25.	See total shoulder widths from previous page	See total shoulder widths from previous page. Also see Note 24.
* MAJOR LONG BRIDGES (RIGHT/LEFT)--See Note 26	FDM 11-44-1, p. 4; FDM 11-35-1; AASHTO IH Policy, p. 5; GDHS, Exhibit 10-67, p. 839	3.5' / 3.5'	See total shoulder widths from previous page. Also see Note 26.	3.5' / 3.5'	See total shoulder widths from previous page. Also see Note 26.	3.5' / 3.5'	See total shoulder widths from previous page. Also see Note 25.
BRIDGE CURBS & PARAPETS on MAINLINE	FDM 11-44-1; Bridge Manual	No curbs more than 9" wide, Parapet meets NCHRP 350 TL-3 Criteria	Current Design Criteria	No curbs more than 9" wide, Parapet meets NCHRP 350 TL-3 Criteria	Current Design Criteria	No curbs more than 9" wide, Parapet meets NCHRP 350 TL-3 Criteria	Current Design Criteria
BRIDGE CURBS & PARAPETS AT SIDEROAD OVER MAINLINE (see Note 27)	FDM 11-44-1; Bridge Manual	No curbs more than 9" wide. Parapet meets appropriate NCHRP 350 TL-3 criteria based on posted speed.	Current Design Criteria	No curbs more than 9" wide. Parapet meets appropriate NCHRP 350 TL-3 criteria based on posted speed.	Current Design Criteria	No curbs more than 9" wide. Parapet meets appropriate NCHRP 350 TL-3 criteria based on posted speed.	Current Design Criteria
MEDIAN WIDTH (For mainline locations not on structure)	FDM (Offset plus barrier width); A Policy on Design Standards--Interstate System, p. 4	36' min. without barrier; 26' with single-faced concrete barrier (both sides)	New FDM requirements	—	—	—	—
CURBS	FDM 11-20-1, p. 5; 11-44-1	4" sloped mountable at outside edge of shoulder	No curbs	4" sloped mountable at outside edge of shoulder	No curbs	4" sloped mountable at outside edge of shoulder	No curbs
LATERAL CLEARANCE -- See Note 28 for definition	—	—	—	—	—	—	—
*ALONG ROADWAY	FDM 11-15-1, Page 9 (table 1); AASHTO IH Policy, p. 4; AASHTO Roadside Design Guide	Finished shoulder width (w/ roadside barrier); finished shoulder width + 2' (w/o roadside barrier).	Finished shoulder width (w/ roadside barrier); finished shoulder width + 2' (w/o roadside barrier).	Finished shoulder width (w/ roadside barrier); finished shoulder width + 2' (w/o roadside barrier).	Finished shoulder width (w/ roadside barrier); finished shoulder width + 2' (w/o roadside barrier).	Finished shoulder width (w/ roadside barrier); finished shoulder width + 2' (w/o roadside barrier).	Finished shoulder width (w/ roadside barrier); finished shoulder width + 2' (w/o roadside barrier).
*UNDER STRUCTURES	FDM 11-35-1, Fig. 1, 2, 3, 5 and 7; AASHTO IH Policy, p. 5; AASHTO Roadside Design Guide	For lateral distance to fixed object of 2.5' or less, provide vertical wall concrete barrier. For lateral distance to fixed object between 2.5' and 4', provide safety shape concrete barrier. See note 29.	For lateral distance to fixed object of 2.5' or less, provide vertical wall concrete barrier. For lateral distance to fixed object between 2.5' and 4', provide safety shape concrete barrier. See note 29.	For lateral distance to fixed object of 2.5' or less, provide vertical wall concrete barrier. For lateral distance to fixed object between 2.5' and 4', provide safety shape concrete barrier. See note 29.	For lateral distance to fixed object of 2.5' or less, provide vertical wall concrete barrier. For lateral distance to fixed object between 2.5' and 4', provide safety shape concrete barrier. See note 29.	For lateral distance to fixed object of 2.5' or less, provide vertical wall concrete barrier. For lateral distance to fixed object between 2.5' and 4', provide safety shape concrete barrier. See note 29.	For lateral distance to fixed object of 2.5' or less, provide vertical wall concrete barrier. For lateral distance to fixed object between 2.5' and 4', provide safety shape concrete barrier. See note 29.
NORMAL PAVEMENT CROSS SLOPE	FDM 11-20-1, p. 1, FDM 11-15-1, p. 2 & FDM 11-44-1	1.5%	2%	1.5%	2%	1.5%	2%
NORMAL SHOULDER CROSS SLOPE (See Note 30)	FDM 11-15-1, p. 2 & 11-44-1	2%	4%	2%	4%	2%	4%
SUPERELEVATED SHOULDER CROSS SLOPE	—	—	—	—	—	—	—
* LOW SIDE	FDM 11-15-1, pp. 2-3	## --- Match pavement superelevation, 4% min.	Match pavement superelevation, 4% min.	## --- Match pavement superelevation, 4% min.	Match pavement superelevation, 4% min.	## --- Match pavement superelevation, 4% min.	Match pavement superelevation, 4% min.
* HIGH SIDE	FDM 11-15-1, pp. 2-3	## --- See Note 31	See Note 31	## --- See Note 31	See Note 31	## --- See Note 31	See Note 31
CROSS SECTION ELEMENTS- Continued							
MAX. CROSS SLOPE BREAK - Pavement to Pavement (See Note 32)	FDM 11-10-5, p. 21, GDHS, pp. 309-310	## --- 4%	4%	## --- 4%	4%	## --- 4%	4%
MAX. CROSS SLOPE BREAK - Pavement to Shoulder	FDM 11-10-5, p. 21,	## --- 8%	8%	## --- 8%	8%	## --- 8%	8%
FORESLOPES WITHOUT TRAFFIC BARRIER (see Note 33)	FDM 11-15-1, Fig. 7; AASHTO Roadside Design Guide	4:1 max, or 3:1 max w/ adequate recovery area to meet clear zone requirements	6:1 to clear zone, 3:1 max. beyond	4:1 max, or 3:1 max w/ adequate recovery area to meet clear zone requirements	6:1 to clear zone, 3:1 max. beyond	4:1 max, or 3:1 max w/ adequate recovery area to meet clear zone requirements	6:1 to clear zone, 3:1 max. beyond
CLEAR ZONE DISTANCES	FDM 11-15-1, Fig. 10; FDM 11-44-1; AASHTO Roadside Design Guide; AASHTO IH Policy, p. 4	30 ft.	Refer to FDM	## --- Refer to FDM	Refer to FDM	## --- Refer to FDM	Refer to FDM

= If existing values are less than minimums to remain in place, then perform operational safety analysis to determine if deficiency should be allowed to remain in place. Deficiency report documentation required.

USH 41 Corridor Conversion To Interstate Highway
Milwaukee - Green Bay, Wisconsin

TABLE 1
ROADWAY DESIGN CRITERIA

Preliminary Draft for FHWA Review

11/28/08

Item	Reference	Freeway Mainline		System Interchanges & Ramps		Service Interchanges & Ramps	
		Existing, Min to Remain in Place	Reconst Reqd to Meet IH Criteria (ie Pvmt Replace, Add lanes)	Existing, Min to Remain in Place	Reconst. Reqd to Meet IH Criteria (i.e. Pvmt Replace, Add Lanes)	Existing, Min to Remain in Place	Reconst. Reqd to Meet IH Criteria (i.e. Pvmt Replace, Add Lanes)
ENTRANCE RAMP DESIGN							
ENTRANCE RAMP TERMINAL DESIGN	Use FDM 11-30-1, Fig. 1	---	---	## --- See Note 34	See Note 34	## --- See Note 34	See Note 34
ENTRANCE RAMP - LANE DROP TAPER - (Parallel type Only)	Use FDM 11-30-1, Fig. 1	---	---	## --- See Note 35	See Note 35	## --- See Note 35	See Note 35
ENTRANCE RAMP - LANE DROP TAPER - Taper Style Design Only (Desirable Value / Minimum Value)	FDM 11-30-1 Figure 3; GDHS pg. 845-847	---	---	## --- Typical 70:1 / 50:1	70:1 / 50:1	## --- Typical 70:1 / 50:1	70:1 / 50:1
ENTRANCE RAMP - AUXILIARY LANE LENGTH (parallel type only)	GDHS pp. 814-816; ITE Freeway and Interchange Geometric Design Handbook, p. 127 (Figure 4-12)	---	---	## --- 2500 feet typical (See Note 36)	2500 feet --- See Note 36	## --- 2500 feet typical (See Note 36)	2500 feet --- See Note 36
EXIT RAMP DESIGN							
EXIT RAMP - TERMINAL DESIGN	FDM 11-30-1 Figure 2; GDHS pp. 849-852	---	---	## --- See Note 37	See Note 37	## --- See Note 37	See Note 37
EXIT RAMP - DIVERGENCE TAPER RATE	FDM 11-30-1, Figure 2; GDHS pp. 849-852	---	---	## --- See Note 38	See Note 38	## --- See Note 38	See Note 38
EXIT RAMP - AUXILIARY LANE LENGTH (parallel type only)	GDHS pp. 814-816; ITE Freeway and Interchange Geometric Design Handbook, p. 127 (Figure 4-12)	---	---	## --- 2500 feet typical (See Note 36)	2500 feet --- See Note 36	## --- 2500 feet typical (See Note 36)	2500 feet --- See Note 36
EXIT RAMP - LENGTH IN ADVANCE OF STOP CONDITION	GDHS, Exhibits 10-71 and 10-73	---	---	---	---	## --- Deceleration length in advance of queue.	Deceleration length in advance of queue.
DESIGN AT RAMP CROSS STREET TERMINALS	FDM 11-30-1, Figures 4, 5 and 6	---	---	---	---	## --- Refer to FDM	Refer to FDM
LANE ARRANGEMENTS							
BASIC NUMBER OF LANES	GDHS, pp 810-811	See Note 39	See Note 39	See Note 39	See Note 39	See Note 39	See Note 39
LANE BALANCE--see Note 40	GDHS pg. 811-817; ITE Freeway and Interchange Geometric Design Handbook, pp. 126, 260-262	## --- Applies to design of all ramp terminals	Applies to design of all ramp terminals	## --- Applies to design of all ramp terminals	Applies to design of all ramp terminals	## --- Applies to design of all ramp terminals	Applies to design of all ramp terminals
ROUTE CONTINUITY	GDHS Exhibit 10-46	See Note 41	See Note 41	---	---	---	---
AUXILIARY LANES	GDHS, pp. 814-818	## --- Add and drop on the right. Terminate properly.	Add and drop on the right. Terminate properly.	---	---	---	---
RAMP TERMINAL SPACING	ITE Freeway and Interchange Geometric Design Handbook, p. 127 (Figure 4-12); AASHTO IH Policy, p. 4	---	---	## --- Variable--see reference; also see Note 42 for minimum interchange spacing	Variable--see reference; also see Note 42 for minimum interchange spacing	## --- Variable--see reference; also see Note 42 for minimum interchange spacing	Variable--see reference; also see Note 42 for minimum interchange spacing
LANE DROP TAPER (Desirable/Minimum)	GDHS, p. 818	## --- Typical 70:1 / 50:1	Typical 70:1 / 50:1	---	---	---	---
LANE ADD TAPER	GDHS, Exhibit 10-52, p. 816	## --- 300 feet typical (@25:1 for 12 feet)	300 feet typical (@25:1 for 12 feet)	---	---	---	---
ACCESS CONTROL							
ACCESS CONTROL	FDM 11-5-5 & 11-44-1	Full Access Control	Full Access Control	Full Access Control	Full Access Control	Full Access Control	Full Access Control
INTERCHANGES	AASHTO IH Policy, p. 4			Full System (See Note 43)	Full System	Full Service (See Note 43)	Full Service
LOCKED GATES	FHWA Policy	See Note 44	See Note 44	---	---	See Note 44	See Note 44

References:
GDHS '04: A Policy on Geometric Design of Highways and Streets (a.k.a. AASHTO Green Book)
FDM: Facilities Development Manual (WisDOT)
Intelligent Transportation Systems Design Manual (WisDOT)
A Policy on Design Standards - Interstate System, 2005 (a.k.a. AASHTO IH Policy)
MUTCD: Manual on Uniform Traffic Control Devices, 2003 Edition
State of Wisconsin Bridge Manual
AASHTO Roadside Design Guide, 2006
Highway Capacity Manual, 2000
ITE Freeway and Interchange Geometric Design Handbook, 2005 edition

Notes:
1. The selected design speed at the point where the ramp taper is 12 feet from the edge of mainline will be at least 80% of the adjacent mainline speed. Design speeds on ramps may require proration of speeds in 10 mph increments.
2. Wherever prudent and reasonable, maintain mainline design speed between major merge and diverge areas (i.e. system split, forks) of two freeways.
3. For "K" value analysis, urban is defined within Milwaukee County. Rural is outside Milwaukee County. K200 closely depicts SEWRPC (Southeast Wisconsin Regional Planning Commission) traffic forecasts from its demand model, thus WisDOT will be adopting K200 for all future interstate project traffic analysis within Milwaukee County. See Appendix B for further discussion and documentation.
4. For level of service (LOS) analysis, use same definitions of urban and rural as "K" value analysis (see Note 3). Highway Capacity Manual (HCM) methodologies required. K100 may be used for rural conditions to evaluate sensitivity. Higher design hourly volumes (DHV) may be justified when the level of service (LOS) using K30 cannot be achieved because of social, environmental or financial constraints. For rural locations that cannot achieve minimum LOS C and urban locations that cannot achieve minimum LOS D, written justification

= If existing values are less than minimums to remain in place, then perform operational safety analysis to determine if deficiency should be allowed to remain in place. Deficiency report documentation required.

TABLE 1
ROADWAY DESIGN CRITERIA

Preliminary Draft for FHWA Review

11/28/08

Item	Reference	Freeway Mainline		System Interchanges & Ramps		Service Interchanges & Ramps	
		Existing, Min to Remain in Place	Reconst Reqd to Meet IH Criteria (ie Pvmt Replace, Add lanes)	Existing, Min to Remain in Place	Reconst. Reqd to Meet IH Criteria (i.e. Pvmt Replace, Add Lanes)	Existing, Min to Remain in Place	Reconst. Reqd to Meet IH Criteria (i.e. Pvmt Replace, Add Lanes)

will be required. Peak hour factor (PHF) = 1.0 will be used for mainline LOS analysis per WisDOT/FHWA draft policy agreement. Additional traffic modeling studies to validate HCM results are desirable. See Appendix B for further discussion and documentation.

5. WisDOT will use FDM standards established during plan development of various freeway majors' projects. Some elements of the 2001 GDHS standards have been adopted in these standards. See separate attachment (Appendix A) for standards on stopping sight and decision sight distances.
6. Based on e max = 6% superelevation tables.
7. Compound curves are not preferred and should be avoided. If used, compound curve guidelines based on travel in direction of sharper curve. For the acceleration condition (i.e. travel in direction of sharper to flatter curve), the absolute max ratio is not as critical and may be exceeded. For exit ramps, first compound curve should be flatter curve, and adequate deceleration length should be accommodated. For entrance ramps, second compound curve should be flatter due to acceleration needs. Avoid compound curves that require transition from normal crown to reverse crown or greater superelevation.
8. WisDOT policy is 6% maximum superelevation rate. FHWA would allow superelevation rates exceeding 6%, up to 8% max. Due to complexity of interchange designs and limited ROW availability, 8% maximum superelevation may be used for ramps and will be documented as a design exception.
9. Superelevation transition lengths may be lengthened to provide smoother, less-abrupt transition or meet existing superelevation transition conditions.
10. Applicable to bridges with parapets or other curbed sections. Flatter longitudinal gradient may be acceptable on rural, normal cross slope roadway sections. Superelevation transitions should be evaluated along flat longitudinal gradients.
11. The ramp vertical alignment, or K-value, shall meet or exceed the selected design speed utilized for the horizontal alignment and superelevation.
12. For sag vertical curves, the "comfort criteria" can be used on lighted roadways.
13. For non-arterial vertical clearance, desirable/minimum clearance for new construction may be reduced to 15'-9" and 15'-3" respectively
14. Vertical clearances also apply to non-arterial CTH, STH or local roads without interchanges.
15. Consult with the region railroad coordinator if the overpassing or underpassing facility is either a railroad or a "rails-to-trails" trail; or if a structure is owned by a railroad company. Discuss with Bureau of Rail & Harbors if < 23' vertical clearance is acceptable for existing conditions.
16. Clearance under pedestrian structures may be reduced to 17'-3" minimum for arterials and CTHs.
17. Vertical clearance under pedestrian bridge for non-arterials does not apply for this interstate conversion study.
18. Vertical clearance under sign bridge for arterial CTH and local roads & non-arterials do not apply for this interstate conversion study.
19. Wider lanes may be necessary on sharp curves. See GDHS, Exhibit 10-67 p. 839. Shoulder widths may need to be increased on structures to accommodate horizontal sight distance or request exception to standards.
20. Consideration should be given to widening the ramp shoulder(s) if additional width is needed for future rehabilitation staging needs, frequency of maintenance vehicles (including maintenance for lighting), distressed vehicles alongside long barrier (i.e. bridge) sections, increased sight distance, etc... Wider pullout embankment sections for additional shoulder width may be desirable for added safety and comfort adjacent to the ends of long ramp bridges. If wider shoulder widths are selected, the shoulder dimensions and reasons for the wider shoulders shall be documented in the DSR. As-built plans may indicate variable shoulder widths. Variable total and paved shoulder widths: 2' to 10' right; 2' to 8' left.
21. Use 12-foot right shoulder (12 feet paved) if truck DHV > 250 along ramp. As-built plans may indicate variable shoulder widths. Variable total shoulder widths: 6' to 12' right; 2' to 10' left. Variable paved shoulder widths: 3' to 12' right; 2' to 8' left.
22. Use 12-foot left and right shoulders (12 feet paved) if truck DHV > 250 along ramp. Three-lane ramps usually associated with major forks. As-built plans may indicate variable shoulder widths. Variable total shoulder widths: 6' to 12' right; 2' to 12' left. Variable paved shoulder widths: 3' to 12' right; 2' to 10' left.
23. Offset of 12' is to be provided to face of barrier or curb. A minimum 10' offset will be provided in isolated locations such as at sign bridges or on structures. Consider constructing total shoulder width one foot wider than paved shoulder width for added stability. See GDHS, Exhibit 10-67, p. 839 if barriers placed along edge of paved shoulder.
24. Use a 12-foot paved shoulder (right) on 4-lane freeways if truck traffic >250 DHV. Use 12-foot paved shoulders (left & right) on 6-lane freeways if truck traffic > 250 DHV. All bridges having three or more travel lanes in the same direction, including long bridges, should have 12-foot shoulders.
25. Full-width shoulders are preferred for safety and operations when constructing/replacing structures.
26. Long bridge defined as 200' length or greater. Long bridges may have a lesser width and need to be analyzed individually. Adequate sight distance may be dependent on shoulder width for structures located on curves. Minimum 4-foot shoulders required for new long bridges.
27. Side road overpasses/underpasses need to be evaluated for adequacy. Parapet meeting NCHRP 350 TL-2 criteria may be acceptable for posted speeds 40 mph and under. Concrete parapet preferred on structures.
28. Lateral clearance (a.k.a. operational offset distance) defined as an obstruction free area beginning at the edge of driving lane and extending a distance not to interfere with the operation of the roadway.
29. To the extent practicable, the piers and abutments of overcrossing structures should be designed to provide a horizontal clearance equal to the clear recovery area. On 4R projects, it is most important to provide full shoulder width. May need fillet concrete barrier between bridge columns so column is flush with face of concrete barrier.
30. AASHTO allows 2% shoulder cross slope. Construction techniques typically create a 2% monolithic paved shoulder. Use 2% on all structures.
31. WisDOT policy allows high-side shoulder to slope in direction of superelevated roadway. Shoulder cross slope typically matches roadway slope. Shoulder cross slope could be 2% at high side for flatter curves.
32. Cross slope break may be increased to 5% to address drainage issues where needed.
33. A recoverable slope is one on which most motorists can generally stop their vehicles or slow them enough to return to the roadway safely. Foreslopes of 6:1 or flatter are considered recoverable. Slopes as steep as 4:1 are considered recoverable if they are also relatively smooth. Foreslopes of 3:1 are not considered recoverable, but are usually traversable if they are relatively smooth. Barrier railing is usually warranted for foreslopes steeper than 3:1.
34. The parallel type of entrance ramp terminal is preferred.
35. A 50:1 taper is required within the length of the parallel entrance ramp. Provide a downstream merge taper of 360 feet (@ 30:1 taper).
36. Existing auxiliary lanes could be shorter and still provide adequate functionality and operational efficiency if traffic demands do not create weaving and other safety issues. Traffic capacity modeling may be required to justify shorter auxiliary lanes. Weaving segment lengths are measured from where ramps are 12' from the edge of the mainline.
37. The taper type of exit ramp terminal is preferred. WisDOT current design practices uses the tangent tapered exit ramp design versus the curvilinear tapered design. Parallel exit ramp designs are suitable for high-queuing ramps as well as other geometric considerations. Dual-lane system ramps will be designed on a case by case basis considering the speed and traffic volume to be accommodated.
38. Tangential tapered design divergence angles typically ranges between 2 and 5 degrees. WisDOT current practice is 12.5:1 exit taper (= 4 degrees, 34 minutes).
39. Based on level-of-service, operational and safety analyses. Does not include auxiliary lanes.
40. See ITE Freeway and Interchange Handbook for lane balance formulas.
41. US 41, when converted to interstate, will be considered the mainline and will control route continuity.
42. From *A Policy on Design Standards Interstate System,* a general rule of thumb for minimum interchange spacing is 1 mile in urban areas and 3 miles in rural areas.
43. Partial interchanges must be justified to remain.
44. Locked gate access points are primarily used to emergency, maintenance or land access needs. Locked gate locations must be approved based on the interstate access justification criteria and the IAJR process.

= If existing values are less than minimums to remain in place, then perform operational safety analysis to determine if deficiency should be allowed to remain in place. Deficiency report documentation required.