Road & Bridge Design Publications

Monthly Update – January 2013

Revisions for the month of **January** are listed and displayed below. The special detail index for **October** will remain in effect. Please contact Wayne Pikka (pikkaw@michigan.gov) for questions regarding the road changes. Contact Vladimir Zokvic (zokvicv@michigan.gov) for questions related to the bridge changes.

Road Design Manual

3.06: Design Speed: In order to reflect recent changes in FHWA policy, a paragraph was added to indicate that the design speed used for 3R freeway projects may be the design speed approved at the time of original construction or a subsequent reconstruction, whichever is most recent. Also, the approving authority for Design Exceptions was revised from the Engineer of Design to the Engineer of Design Programs.

3.11: Freeway 3R/4R: A paragraph was added to reflect recent changes in FHWA policy to indicate that design values for certain elements on 3R freeway projects may match the standards approved at the time of original construction or a subsequent reconstruction, whichever is most recent.

3.12 H: Underclearances: The approving authority for Design Exceptions was revised from the Engineer of Design to the Engineer of Design Programs.

7.02: Impact Attenuators: Deleted the first sentence regarding the temporary status of this section. Questions regarding attenuators should be directed to the Geometric Unit of the Design Division.

Bridge Design Manual

7.01.08 A. (LFD & LRFD), 12.03 & Appendix 12.02.01: Updated the Design Exception process to send Design Exceptions to Engineer of Design Programs.

7.02.19 B. (LFD & LRFD): Updated guides related to overhangs.

Updates to MDOT Cell Library, Bridge Auto Draw Program, etc., may be required in tandem with some of this month's updates. Until such updates to automated tools can be made, it is the designer's/detailer's responsibility to manually incorporate any necessary revisions to notes and plan details to reflect these revisions.

3.05

Section deleted.

3.06 (revised 1-14-2013)

DESIGN SPEED

Design speed is a selected speed used to determine the various geometric design features of the roadway. Once selected, all of the pertinent design features of the highway should be related to the design speed to obtain a balanced design.

Design speeds shown in Appendix 3A are applicable for 4R projects. The design speed used for freeway 3R projects (interstate and non-interstate) may be the design speed approved at the time of original construction or reconstruction, whichever is most recent. The design speeds used for non-freeway 3R projects are shown in Section 3.09.02. See Section 3.08.01C for information on combined 3R and 4R work.

It is MDOT practice under most circumstances to design roadway geometrics based on a recommended project design speed 5 mph greater than the posted speed (See Appendix 3A, Geometric Design Elements and Section 3.09.02A, 3R Minimum Guidelines, Non-Freeway NHS). This practice is founded in research that shows actual operating speeds are typically greater than the posted speeds. Posted speed is generally used as project design speed only for non-freeway, non-NHS 3R design (Section 3.09.02B). The designer should strive to meet the standards for all geometric elements based on the prescribed MDOT recommended design speeds. This is the project design speed to be recorded on the title sheet.

3.06 (continued)

Design elements not meeting standards based on MDOT recommended design speeds require a Safety Review, Crash Analysis and documented justification (use Design Exception Form FC26). If the highest attainable design corresponds to criteria for speeds less than the posted speed (except where permitted in Section 3.09.02B for non-NHS 3R), a design exception must be submitted to the Engineer of Design Programs for approval.

For designs meeting criteria for a speed greater than or equal to the posted speed but less than MDOT recommended design speed, the project manager must still document the basis for not meeting standards for MDOT recommended design speed. This internal documentation (including Form FC26 signed by the Project Manager, Safety Review and Crash Analysis) must be retained in the project files and in the final document retention when closing out the project files. A copy of the documentation must also be sent to the Design Division's Geometrics Unit.

It should be indicated on Form FC26 if subsequent approval by the Engineer of Design Programs is required or if the documentation is for file retention only.

Documentation must be for each geometric element and not a blanket statement applying to all geometric elements. A design speed reduction for individual geometric elements does not redefine the overall "project design speed".

3.11 (revised 2006)

FREEWAY RESURFACING, RESTORATION, REHABILITATION AND RECONSTRUCTION / NEW CONSTRUCTION (3R/4R) DESIGN CRITERIA

3.11.01 (revised 1-14-2013)

General

The 3R/4R program applies to freeways, which are defined as divided arterial highways with grade separated intersections and full control of access. Design criteria for Interstate freeways are established in the AASHTO publication, ***A Policy on Design Standards-Interstate System***. Design criteria for non interstate freeways are established in the AASHTO publication ***A Policy on Geometric Design of Highways and Streets***.

Current freeway standards are shown in Appendix 3A. The standards used for design speed, horizontal alignment, vertical alignment, and widths of median, traveled way and shoulders for freeway 3R projects may be the standards that were approved at the time of original construction or reconstruction, whichever is most recent. See Section 3.08.01C for information on combined 3R and 4R work.

3R/4R freeway projects should be reviewed to determine need for safety improvements such as: alignment modifications, superelevation modifications, sight distance improvements, lengthening ramps, widening shoulders, flattening slopes, increasing underclearances, upgrading guardrail and bridge railings, shielding of obstacles, and removing or relocating obstacles to provide a traversable roadside. (Also see Section 3.08.01F.)

3.11.02 (revised 11-28-2011)

Freeway 3R/4R Checklist

A. Section Deleted

B. Geometrics and Signing

The Project Manager should also contact the Geometrics Unit in the Design Division and the Region Traffic and Safety Engineer to identify desirable enhancements prior to refining the project cost estimate. The Design Division – Traffic Sign Unit should be consulted to identify and coordinate plan preparation for sign upgrading needs.

C. Section Deleted

D. Design Exceptions

Design Exceptions are required whenever the design criteria given in Section 3.11.01 cannot be met for controlling design elements (See Section 3.08.01E.)

3.12 (continued)

UNDERCLEARANCES

H. Design Exception Requirements for Vertical Clearances

Design Exception Requirements
Vertical Clearance

Type of Project	Design Exception Required	Coordination with MTMCTEA Required	MDOT Approval Required by Engineer of Design Programs	FHWA Approval
New and 4R reconstruction work on interstate greater than $1 million	Yes	Yes	Yes	Yes
New and 4R reconstruction work on Interstate freeways less than $1 million.	Yes	Yes	Yes	No
New and 4R reconstruction work on Non Interstate freeways greater than $1 million.	Yes	No	Yes	Yes
New and 4R reconstruction work on Non Interstate freeways less than $1 million	Yes	No	Yes	No
New and 4R reconstruction work on NHS routes other than freeways greater than $1 million.	Yes	No	Yes	Yes
New and 4R reconstruction work on NHS routes other than freeways less than $1 million.	Yes	No	Yes	No
New and 4R reconstruction on Non-NHS Routes	Yes	No	Yes	No
3R work on Interstate System.	Yes	Yes	Yes	*Only when negotiated oversight is assigned to FHWA on NHS projects > $5 million.*
3R work on Non- Interstate System.	Yes	No	Yes	
3R work on Non-freeway Routes.	Yes	No	Yes	
Preventative Maintenance Work	No	No	No	No

MTMCTEA - Military Traffic Management Command Transportation Engineering Agency

7.02 (1-14-2013)

IMPACT ATTENUATORS

Questions regarding impact attenuators should be directed to the Geometric Unit of the Design Division.

7.01.08

Vertical Clearance

A. Requirements

The desired vertical bridge underclearances should be provided as indicated below. If the desired underclearances cannot be provided, then the minimum underclearances shall be met. Where it is considered not feasible to meet these minimums, a design exception shall be requested from the Engineer of Design Programs and subsequently to the FHWA Area Engineer on "FHWA Oversight" (non exempt) projects and from MDOT Engineer of Design Operations - Structures Section on "MDOT Oversight" (exempt) projects (see Section 12.03 also). See the vertical clearance design exception matrix in Appendix 12.02.01. Requests to further reduce the underclearance of structures with existing vertical clearance less than indicated in the chart below should be made only in exceptional cases. (12-5-2005)(1-14-2013)

VERTICAL CLEARANCE REQUIREMENT TABLE (8-20-2009)

Route Classification Under the Structure	All Construction	New Construction	Road 4R Construction	Bridge 4R Construction	3R Construction
	Desired	Min	Min	Min	Min
Freeways	16'-3"	16'-0" *	16'-0" *	16'-0" *	16'-0" *
NHS Arterials (Local & Trunkline)	16'-3"	16'-0" *	Maintain Existing 14'-6" Min*	16'-0" *	14'-0" *
Non NHS Arterials (Local & Trunkline)	16'-3"	14'-6" *	Maintain Existing 14'-6" Min*	Maintain Existing 14'-6" Min*	14'-0" *
Collectors, Local Roads & Special Routes(1)	14'-9"	14'-6" *	Maintain Existing 14'-6" Min*	Maintain Existing 14'-6" Min*	14'-0" *

3R = Rehabilitation, Restoration, Resurfacing **4R = Reconstruction**

* Minimum Vertical Clearance must be maintained over complete usable shoulder width.

Information on the NHS systems can be obtained by contacting the Statewide Planning Section, Bureau of Transportation Planning or found on the MDOT website at: http://www.michigan.gov/mdot-nfc (11-28-2011)

(1) Special Routes are in Highly Urbanized Areas (where little if any undeveloped land exists adjacent to the roadway) where an alternate route of 16'-0" is available or has been designated. Bridges located over Special Routes in Highly Urbanized Areas can be found on the MDOT website at: http://mdotwas1.mdot.state.mi.us/public/design/englishbridgemanual/Exempt Structures.pdf

Ramps and roadways connecting a Special Route and a 16'-0" route require a vertical clearance minimum of 14'-6" (14'-9" desired). Ramps and roadways connecting two 16'-0" routes require a vertical clearance minimum of 16'-0" (16'-3" desired). (8-20-2009)

Pedestrian bridges are to provide 1'-0" more underclearance than that required for a vehicular bridge. For Freeways (Interstate and non Interstate), including Special Route Freeways, the desired underclearance shall be 17'-3" (minimum 17'-0"). (8-20-2009)

A vertical underclearance of 23'-0" is required for highway grade separations over railroads when constructing a new bridge or removing the existing superstructure. For preventative maintenance, rehabilitation and deck replacement projects the existing railroad vertical underclearance does not need to be increased unless requested by the Railroad. (11-28-2011)

Clearance signs are to be present for structures with underclearance of 16'-0" or less (show dimensions 2" less than actual). See http://mdotwas1.mdot.state.mi.us/public/tands/plans.cfm for additional information and guidelines. (8-20-2009) (11-28-2011)

7.01.08

Vertical Clearance

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NHS Arterials (Local & Trunkline)	16'-3"	16'-0" *	Maintain Existing 14'-6" Min*	16'-0" *	14'-0" *
Non NHS Arterials (Local & Trunkline)	16'-3"	14'-6" *	Maintain Existing 14'-6" Min*	Maintain Existing 14'-6" Min*	14'-0" *
Collectors, Local Roads & Special Routes(1)	14'-9"	14'-6" *	Maintain Existing 14'-6" Min*	Maintain Existing 14'-6" Min*	14'-0" *

3R = Rehabilitation, Restoration, Resurfacing **4R = Reconstruction**

* Minimum Vertical Clearance must be maintained over complete usable shoulder width.

Information on the NHS systems can be obtained by contacting the Statewide Planning Section, Bureau of Transportation Planning or found on the MDOT website at: http://www.michigan.gov/mdot-nfc (11-28-2011)

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7.02.19

Slabs

For information on Ride Quality on new slabs see section 7.02.32

A. Design (8-20-2009)

MDOT standard LRFD slab is designed using the following criteria:

1. The design loads for decks and deck systems should be specified depending on the method of analysis. When the approximate strip method is used, force effects should be determined on the following basis:

   a. Where primary strips are transverse and their span does not exceed 15.0 ft., the transverse strip shall be designed for the wheels of the 32.0-kip axle.

   b. Where primary strips are transverse and their span exceeds 15.0 ft., the transverse strip shall be designed for the wheels of the 32.0-kip axle and the lane load together.

   c. Where primary strips are longitudinal, the transverse strips shall be designed for all loads specified above, including the lane load.

2. The design truck shall be positioned transversally such that the center of any wheel load is not closer than:

   a. One foot (1.0 ft.) from the face of the curb or railing for the design of the deck overhang.

   b. Two Feet (2.0 ft.) from the edge of the design lane for the design of all other components.

3. Where the strip method is used, the extreme positive moment in any deck panel between girders shall be taken to apply to all positive moment regions. The extreme negative moment over any girder shall be taken to apply to all negative moment regions.

7.02.19 (continued)

4. Top 1½" of slab is considered a wearing surface and is not included in the design depth.

Design of deck slabs using the Empirical Design Method according to A 9.7.2 AASHTO LRFD is an approved or allowed alternative.

B. Overhang

Design overhang according to A 9.7.1.5 AASHTO LRFD. If the deck overhang with cantilever does not exceed 6.0 ft. from the centerline of the exterior girder to the face of a structurally continuous concrete railing, the outside row of wheel loads may be replaced with a uniformly distributed line load of 1.0 klf intensity, located 1.0 ft. from the face of the railing. (8-20-2009)

For standard overhang, see various guides in Bridge Design Guides 6.29 Series.(1-14-2013)

Overhangs greater than standard should be avoided, if possible. If not, the slab design shall be checked in this region for negative movement.

C. Slab Haunches

Plans are to provide for the deck slab to be haunched at each beam to provide for variance in actual top of beams. The design should normally make allowance for a 1" uniform haunch for steel beam bridges and a 2" minimum haunch for prestressed concrete beam bridges; however, the details should show the haunch as variable. A nominal 2" haunch should be used on structures with span lengths exceeding 100'-0". To aid in the construction of the haunched slab, the plans should include bottom of slab elevations over each beam and at equal intervals across the spans. These elevations should apply at the time that all structural steel has been erected, but no other loads applied; however, they should include allowance for additional deflection due to forms, steel reinforcement, deck concrete, and railing. For additional criteria when the haunch exceeds 6" see section 7.02.20 G. and Bridge Design Guide 6.42.03A. (5-6-99) (4-23-2012)

7.02.19

Slabs

For information on Ride Quality on new slabs see section 7.02.32

A. Design

Our standard slab (see Bridge Design Guide 6.41.01) is designed using the following criteria:

1. HS20-44 loading (16kip wheel).
2. Continuous over three or more beams of similar structural capacity.
3. Load Factor design method. (5-6-99)
4. Top 1½" of slab is considered a wearing surface and is not included in the design depth.

B. Overhang

For standard overhang, see various guides in Bridge Design Guides 6.29 Series.(1-14-2013)

Overhangs greater than standard should be avoided, if possible. If not, the slab design shall be checked in this region for negative movement.

C. Slab Haunches

Plans are to provide for the deck slab to be haunched at each beam to provide for variance in actual top of beams. The design should normally make allowance for a 1" uniform haunch for steel beam bridges and a 2" minimum haunch for prestressed concrete beam bridges; however, the details should show the haunch as variable. A nominal 2" haunch should be used on structures with span lengths exceeding 100'-0". To aid in the construction of the haunched slab, the plans should include bottom of slab elevations over each beam and at equal intervals across the spans. These elevations should apply at the time that all structural steel has been erected, but no other loads applied; however, they should include allowance for additional deflection due to forms, steel reinforcement, deck concrete, and railing. For additional criteria when the haunch exceeds 6" see section 7.02.20 G. and Bridge Design Guide 6.42.03A. (5-6-99) (4-23-2012)

7.02.19 (continued)

D. Slab Thicknesses

Slab thicknesses are to be according to Bridge Design Guide 6.41.01 and are to be uniform thickness with beams stepped to follow the crown of the roadway.

E. Slab Under Sidewalk

If the roadway slab extends underneath the sidewalk, it should be designed for full highway loading.

F. Nighttime Casting of Superstructure Concrete

All bridge deck pours are to be designated nighttime casting of superstructure concrete on all bridge decks. (5-6-99)

G. Bridge Crown/Slope

Use 2% cross-slope on all projects with a deck replacement or greater scope except those that have compelling reasons to meet the existing cross-slope. Maintain constant slope across lanes of travel and shoulders, including bridges with full superelevation and ramp bridges. This will allow for ease of construction and deck screeding.

Bridge overlays and railroad and bridge approach projects may use 1.5 %. Local roads over may also use 1.5% unless the road approaches are or may become 2%.

Parabolic crowns being overlayed should be corrected to a minimum of 1.5%; otherwise a design exception must be submitted. Deck replacement bridges with parabolic crowns shall be corrected to a 2% cross-slope.
(12-5-2005)

The road approach shoulder slope shall be transitioned to meet the bridge shoulder slope. The transition shall be based on superelevation transition slope (Δ%) from Standard Plan R-107 Series. The procedure is outlined in section 6.05.05 of the Road Design Manual. (8-20-2009) (11-28-2011)

Design Exception Requirements - Vertical Clearance (8-20-2009) (1-14-2013)

Design Exceptions are needed where proposed vertical clearance does not meet the minimum clearance requirements provided in Section 7.01.08

Type of Project	Design Exception Required	Coordination with SDDCTEA Required	MDOT approval required by Engineer of Design Programs	FHWA Approval Required
New and 4R reconstruction work on Interstate greater than $1,000,000	Yes	Yes	Yes	Yes
New and 4R reconstruction work on Interstate less than $1,000,000	Yes	Yes	Yes	No
New and 4R reconstruction work on Non Interstate Freeways greater than $1,000,000	Yes	No	Yes	Yes
New and 4R reconstruction work on Non Interstate Freeways less than $1,000,000	Yes	No	Yes	No
New and 4R reconstruction work on NHS Routes other than Freeways greater than $1,000,000	Yes	No	Yes	Yes
New and 4R reconstruction work on NHS Routes other than Freeways less than $1,000,000	Yes	No	Yes	No
New and 4R Reconstruction on Non-NHS Routes	Yes	No	Yes	No
3R Work on Interstate System	Yes	Yes	Yes	Only if negotiated oversight is assigned to FHWA on NHS projects > $5 million.
3R Work on Non Interstate Freeways	Yes	No	Yes	
3R Work on Non-Freeway Routes	Yes	No	Yes	
Preventative Maintenance Work	No	No	No	No

SDDCTEA - Surface Deployment and Distribution Command Transportation Engineering Agency

12.03

DESIGN EXCEPTIONS

Design Exceptions shall be identified and completed during the Scope Verification Process. Submittals of Design Exceptions on a timely basis are essential to maintain the project schedule and provide an approved design where conditions may inhibit designers from meeting the required design criteria. (8-20-2009)

(9-1-88) When a proposed structure rehabilitation financed by federal funds will not upgrade the structure to minimum standards (design criteria), the Project Manager should complete the appropriate portions of the Design Exception Request Form FC-26 (see http://mdotwas1.mdot.state.mi.us/public/webforms/public/FC26.pdf and http://mdotwas1.mdot.state.mi.us/public/webforms/public/FC26INST.pdf). For projects with "FHWA Oversight" (formerly known as non-exempt projects) submit this form to the Engineer of Design Programs and subsequently to the FHWA Area Engineer. For projects with "MDOT Oversight" (formerly known as exempt projects) submit the form to the Engineer of Design Programs. If approved, the appropriate entity will return a copy, signed and dated. Reference to this approval should be made in our subsequent transmittal of preliminary plans. A signed copy of the Design Exception Request form should be placed in the project file. (12-5-2005)(1-14-2013)

When a proposed road rehabilitation project financed by federal funds contains a bridge not conforming to minimum standards, and no work is proposed for the bridge, the road Design Engineer/Project Manager will prepare the design exception request for transmittal to the Engineer of Design and subsequently to the FHWA Area Engineer. This includes non interstate bridges not being altered on road projects which do not meet new/reconstruction criteria (standards). (8-20-2009)

12.03.01

Requests for Traffic Volumes and Crash Histories

(9-1-88) When requesting traffic volumes and crash histories, the Design Engineer should advise the appropriate Division or Support Area as to when the response is needed to meet the schedule for plan preparation. The request should also identify any other work included within the project limits, e.g., additional bridges or road construction.

A. Traffic Volumes

Send requests for traffic volumes to the Bureau of Transportation Planning, Project and Plan Development Division using MDOT form 1730 (see http://mdotwas1.mdot.state.mi.us/public/webforms/public/1730.pdf or Appendix 12.03.01 A.) (5-1-2000)

B. Crash Histories

Send requests for crash histories to the appropriate Region or Lansing Traffic and Safety personnel. (See sample submittal in Appendix 12.03.01 B.) (9-2-2003)

Where underclearance is the only design exception, however, the concern about crashes is limited to impacts from high loads. This history and the approximate traffic volume are most expeditiously obtained from the Bridge Management Unit of Design Division. (8-6-92) (3-26-2012)