



## SECTION VIII

### PRELIMINARY DESIGN

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#### DESIGN CRITERIA

As described in Section I of this manual, the engineer of record will be considered responsible for determining the appropriate design parameters for the project using good engineering judgment based on the specific site conditions, local agency needs and guidance provided in this Section. The design criteria selected by the engineer of record shall be noted on the plans. The local agency and the engineer of record shall be responsible for keeping the design justification on file for all federal-aid projects, and the records shall be available for review by MoDOT and FHWA if requested. The current edition of the following publications or any local ordinances should be followed as a guide with modifications as considered appropriate by the engineer of record and to be in keeping with good engineering practice:

*Project Development Manual*, by MoDOT

*A Policy on Geometric Design of Highways and Streets*, by AASHTO

*Guidelines for Geometric Design of Very Low-Volume Local Roads (ADT < 400)*, by AASHTO

*Roadside Design Guide*, by AASHTO

*Highway Capacity Manual* *Manual for Railroad Engineering*, by AREMA

Traffic control devices shall be governed by the Manual on Uniform Traffic Control Devices (MUTCD).

The National Cooperative Highway Research Program (NCHRP) has issued guidance, Report 350, on the standards for guardrail and bridge railing design. This new guidance is required by FHWA to be incorporated into projects that are located on the National Highway System (NHS), and may be considered for use by the local agency for projects located off of the NHS. (See “Bridge Rail System” in this Section for additional information).

The Americans with Disabilities Act (ADA) require that all facilities must be designed to current accessibility standards. The FHWA is concerned with the design of the pedestrian environment in the public right of way as it relates to disabled individuals. Curb cut ramps for wheelchair users have been required at pedestrian crossings on Federal-aid projects for many years. The *Americans With Disabilities Act Accessibility Guidelines (ADAAG)* have been adopted as standards by the Department of Justice and the Department of Transportation. The publication is available free of charge on the Internet at [www.access-board.gov/adaag/html/adaag.htm](http://www.access-board.gov/adaag/html/adaag.htm). The following publications may be referenced for additional guidance on the design of bicycle and pedestrian facilities:

*MoDOT General Pedestrian and Bicycle Guide*



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*Guide for the Development of Bicycle Facilities*, by AASHTO

*Guide Specifications for the Design of Pedestrian Bridges*, by AASHTO

*A Policy on Geometric Design of Streets and Highways*, by AASHTO

Currently these accessibility standards are for buildings and sites. Standards for pedestrians in the public right of way are yet to be developed, but the ADAAG guidance shall be applied to the maximum extent feasible for sidewalks, crosswalks, grades, etc.

#### ACCURACY

**Figure VIII-3** lists detail design information for the accuracy of plan dimensions. This chart is a guide to assist users in the transition to metric plans production, and can be varied as needed.

#### PRELIMINARY SUBMITTALS

For all projects submittal of preliminary plans to MoDOT-District Offices is required. MoDOT's review will be limited to ensuring the project meets the intent of the federal-aid program. Specific questions should be provided by the engineer or local agency in writing on their cover letter with the preliminary submittals.

For projects involving bridges or culverts, submittal of preliminary bridge plans, hydraulic studies, etc. to MoDOT-Bridge Division are not necessary. However, if the engineer or local agency has specific questions regarding project eligibility that they would like MoDOT to address at the preliminary stage then MoDOT-Bridge Division is receptive to this information. Specific questions should be provided by the engineer or local agency in writing on their cover letter with the submitted package to the MoDOT district office.

The Environmental Impact Statement, Categorical Exclusion, or Environmental Assessment must be approved by FHWA prior to 35% plan completion. (Note that the Section 106 (Archaeological) clearance must also be approved before right of way acquisition can begin).

#### TRAFFIC SIGNAL WARRANTS

When the project is on MHTC Right of Way the Local Agency should submit signal warrants prior to the preparation of traffic signal plans. Signal warrant forms are available at the MoDOT district office. Traffic counts which are recorded for time intervals of less than one hour should be subtotaled for each hour in order to facilitate proper review of warrants.

The engineer of record shall determine signal warrants based on the MUTCD for all other projects.



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#### **RAILROAD CROSSINGS**

If the proposed improvements are on or cross railroad right of way, the railway company must be contacted. Railway company approval will be necessary to receive construction authorization. The Local Agency must contact the affected railway company directly.

#### **UTILITY RELOCATION**

The Local Agency has the ultimate responsibility of negotiating with local utility companies, cross-state pipelines and other utility facilities for right of way, easement and adjustment agreements for utility relocations. The Local Agency is encouraged to work with each utility to minimize impacts to the utility facilities. Refer to Figure III-2 for an example of a Utility Scoping Checklist that can be utilized.

The Local Agency should, in the preliminary phase, identify existing utility locations and determine if any adjustments will be required. Local Agencies should consult *Program Guide – Utility Adjustments and Accommodations on Federal-Aid Highway Projects*, published by FHWA, for assistance regarding utilities within the highway corridor. This publication can be found on the FHWA web site at [www.fhwa.dot.gov/reports/utilguid](http://www.fhwa.dot.gov/reports/utilguid).

All utility adjustments located on MHTC right of way shall conform to the Code of State Regulations, Division 10, Chapter 3 – Utility and Private Line Location and Relocation. Refer to the following website for further information: <http://www.sos.mo.gov/adrules/csr/current/7csr/7c10-3.pdf>.

The cost of necessary utility relocations for which the Local Agency is responsible is eligible for federal participation. If the Local Agency elects to receive federal participation, utility agreements must conform to 23 CFR Section 645A, which is the applicable Federal Regulation regarding utility relocation on federally funded highways. MoDOT can assist the Local Agency with information about the above regulation.

Actual Cost Agreements are utilized when certain costs are unknown and the actual amount for the adjustment will be reimbursed. Lump Sum Agreements are used when costs are static and can be determined ahead of time. Provisions for the audit should be stated in the agreement between the utility and local agency. See <http://modot.gov/business/manuals/localpublicagency.htm> for sample Utility Agreements on Lump Sum and Actual Cost.

Utility relocations that impact MHTC right of way require prior MoDOT approval for the plan(s) of adjustment(s). Each plan of adjustment must be submitted to the District Liaison Engineer for review and approval prior to final PS&E approval. The utility company will be required to acquire the necessary MoDOT permits prior to any work being performed.



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MoDOT is not a member of Missouri One-Call (800 Dig Rite). Some work on projects that affect MoDOT right of way may be in the vicinity of MHTC/MoDOT utility facilities, which included but is not limited to traffic signal cable, highway lighting circuits, ITS cable, cathodic protection electric cable, etc.

### **BRIDGE REPLACEMENT AND REHABILITATION PROJECTS**

#### ***Design Parameters***

As described in Section I of this manual under “Federally Funded Bridge Projects”, the engineer of record will be considered responsible for determining the appropriate design parameters chosen for the project using good engineering judgment based on the specific site conditions, local agency needs and guidance provided in this Section.

The current edition of the following publications should be followed as a guide with modifications as considered appropriate by the engineer of record and to be in keeping with good engineering practice:

*A Policy on Geometric Design of Highways and Streets,*  
by AASHTO.

*Guidelines for Geometric Design of Very Low-Volume Local Roads (ADT ≤ 400),* by  
AASHTO.

*Highway Drainage Guidelines,* by AASHTO.

*Standard Specifications for Highway Bridges,* by AASHTO.

*Manual for Railroad Engineering,* by AREMA.

#### ***Funding***

Rehabilitation will be considered for HBRRP funding when that option of improvement provides the best value while meeting the needs of the Local Agency. If determined at the Program Eligibility Review project stage that structure improvements are eligible only for partial federal participation in funding as needed to rehabilitate the structure, the Local Agency may still elect to replace the structure, rather than to rehabilitate the existing structure. However, the amount of eligible federal funding will be limited to that which will not exceed the rehabilitation cost estimate unless appropriate justification is provided by the local agency that a new structure represents the best value. If the rehabilitation cost is at least 68% of the replacement costs, it can generally be assumed that the new replacement structure will provide a better value than the rehabilitation of the existing structure and therefore a better use of federal bridge funds.



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#### *Deficiencies*

The following provides the engineer more detail concerning the 2<sup>nd</sup> criteria given in Section I of this manual under “Federally Funded Bridge Projects”. For existing bridges, the bridge deficiencies are indicated by the bridge inspection report. The inventory criteria will be based on the current edition of the *Bridge Inspection Rating Manual*, by MoDOT as well as the latest version of the FHWA publication *Recording and Coding Guide for the Structural Inventory and Appraisal of the Nation's Bridges*. (The above publications can be accessed at <http://www.modot.mo.gov/business/manuals/bridgeinspectrating.htm> and [www.fhwa.dot.gov/bridge/mtguide.pdf](http://www.fhwa.dot.gov/bridge/mtguide.pdf) , respectively). An inventory item is considered deficient when the condition/appraisal rating meets the definition as given below.

Definition of Deficiencies:

1.	Item 58	Deck Condition	≤ 4
2.	Item 59	Superstructure Condition	≤ 4
3.	Item 60	Substructure Condition	≤ 4
4.	Item 62	Culvert Condition	≤ 4
5.	Item 67	Structural Evaluation rating	≤ 3
6.	Item 68	Deck Geometry	≤ 3
7.	Item 69	Under Clearance	≤ 3
8.	Item 71	Waterway Adequacy rating	≤ 3 and last digit for
	Item 42	Type of Service	= 0, 5-9
9.	Item 72	Approach Roadway Alignment	≤ 3

The bridge improvements should remove any deficiency as listed above and shall be designed to provide an increased life expectancy of at least 25 years before significant deficiencies develop unless the proposed deficient item may remain based on MoDOT’s approval. For a proposed deficient item, the engineer of record is required to provide documentation as to why the proposed parameter should be used and MoDOT will forward as appropriate to FHWA for their approval.

#### *Structure Type*

The structure type shall be determined by the engineer of record for all span type bridges or culvert type bridges and shall be based on economic comparisons, site specific conditions and local agency needs.

Although not all inclusive, the following gives the engineer of record additional guidance regarding some of the design parameters that generally have a major influence on the eligibility of a bridge project.



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#### ***Truck Loading***

For rehabilitations and replacements, variations from AASHTO HS20 design loadings are permissible provided, the minimum load capacity of the superstructure is designed or strengthened such that item no. 67 Structural Evaluation from the FHWA coding guide will not be considered deficient.

#### ***Bridge Width***

The bridge width, as a minimum, shall be improved or built to at least a width where the bridge would not be considered functionally obsolete due to deck geometry based on the number of traffic lanes and future design year ADT or type of roadway classification. This minimum width shall be verified by the engineer of record prior to submittal in accordance with the FHWA coding guide.

#### ***Bridge Rail System***

The appropriate bridge rail and approach railing may be determined by the engineer of record based on site specific conditions such as accident history, ADT, speed, sight distances, roadway width, etc.

For  $ADT \leq 400$ , the use of standard height and/or crash-tested railing is optional. For discussion of the subject, AASHTO's Guidelines for Geometric Design of Very Low-Volume Local Roads may be consulted. The local agency and engineer of record may select from a variety of curbing or railing types deemed to be suitable for use based on site specific conditions such as accident history, geometric alignment, height of bridge, etc.

#### ***Seismic Requirements***

The level of seismic protection for a particular project is optional and should be determined by the engineer of record and local agency based on agency needs and site-specific conditions such as emergency route status, ADT, functional classification, structure importance, etc.

#### ***Hydraulics for New Structures***

The engineer of record with the local agency's assistance is considered responsible for the investigation of field conditions related to the hydraulic design of the structure, investigation for FEMA design restrictions as related to the National Flood Insurance Program, and investigation for scour potential, embankment protection and potential channel modification requirements. Impacts on upstream properties should always be considered along with other investigations that may also be found to be appropriate. It is advisable for the waterway opening of the new structure to be designed so as to not result in more adverse flooding conditions from those that would occur with the existing structure, assuming the existing structure is already performing adequately.



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As a minimum, the bridge should also be sized appropriately so that the hydraulic performance will not result in a deficient NBI item no. 71 “waterway adequacy” rating and the new structure will not be susceptible to future significant damage caused by flooding based on the engineer’s scour and drift assessment. It is generally not necessary for the engineer of record to submit the hydraulic calculations and report to MoDOT. However, the local agency should keep this information for their own records and make available to MoDOT and/or FHWA if requested.

#### ***Federal Emergency Management Agency (FEMA) and Required Certifications***

Local Agencies that participate in the National Flood Insurance Program (NFIP) have the responsibility to ensure that floodplain developments meet the regulations established by the NFIP as identified in the Title 44, Code of Federal Regulations, Parts 59 through 78. (Parts 59 and 60 contain the most applicable information for a typical project). These regulations are made available on the Internet by the National Archives and Records Administration and can be found at the following address: [www.gpoaccess.gov/cfr/index.html](http://www.gpoaccess.gov/cfr/index.html)

The engineer of record with assistance from the local agency’s floodplain administrator is responsible for ensuring that FEMA NFIP requirements are being met. In addition, the engineer of record will be responsible for attaining all required certifications before construction of the project begins. It is advisable that the engineer of record investigate this in the early stages of the project as the requirements of the NFIP may control the hydraulic design of the project. A current list of communities for which FEMA Flood Insurance Studies have been performed is available in the Community Status Book (CSB), available on the Internet at: [www.fema.gov/cis/mo.pdf](http://www.fema.gov/cis/mo.pdf)

**For the convenience of the Local Agencies and engineers in investigating FEMA Flood Insurance Studies and Flood Maps pertaining to a project site, FEMA Flood Insurance Studies and Maps can be viewed on the Internet at the following address by selecting “FEMA Flood Map Store”:** [www.fema.gov](http://www.fema.gov) (Hardcopies of the FEMA Flood Insurance Studies and Flood Maps can also be ordered at the same site.)

#### ***Channel Modification***

1. Channel changes alter the conditions of the natural waterway. These changes may cause an increase in velocity of the flowing water, sometimes enough to cause damage to the highway embankment near the stream or excessive scour around footings of structures. A channel change should be minimized to the fullest extent practical. Where it is unavoidable, an evaluation should be made to include consideration of the environment, hydraulic, legal and geomorphic aspects involved. The investigation should determine the effect on peak flow downstream and the effected flow area.
  
2. The new channel should duplicate the existing stream and flood plain characteristics as nearly as possible. These characteristics should include the stream width, depth, slope, flow regime, sinuosity, bank cover, side slopes and flow and velocity distribution.



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3. Major channel modification may be constructed if the average channel velocity would not be increased beyond the scour velocity of the predominant soil type at the project site.

#### ***Geotechnical Investigation***

The geotechnical investigation of the project should be as determined by engineer of record in order to adequately perform the foundation design and determine side slope and spill slope requirements at bridge abutments.

#### ***National Highway System (NHS)***

In the event of a non-state bridge project being located on the NHS, the design standards given in the federal-aid policy guide Title 23, Subchapter G, Part 625-Design Standard for Highways shall be followed with the following exception. A design vehicle truck loading of 1.25 X the AASHTO HS20 loading is required (HS25) unless suitable justification is provided by the local agency and engineer of record for a reduced loading.

#### ***State Owned Right of Way***

When a state owned roadway is to be crossed by a bridge, the applicable MoDOT requirements should be followed with vertical and horizontal clearances subject to approval by MoDOT's District Engineer. It is recommended that the proposed vertical and horizontal clearances be submitted for MoDOT review and acceptance as soon as possible in the early stages of the project.

#### ***Sidewalks***

Sidewalks are an eligible feature on bridge structures where such access currently exists for pedestrian or combined pedestrian and bikeway use.

### **RETAINING WALLS**

For installations which are permitted to be located on state owned right of way, guidance from the current edition of the *Standard Specification for Highway Bridges* by AASHTO along with applicable MoDOT requirements should be followed. For local agency owned routes, the above may be used as guides or local building codes and ordinances may be used as considered appropriate by the engineer of record to be in keeping with good engineering practice.



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#### **PEDESTRIAN BRIDGES**

##### *Design Parameters*

The engineer of record shall determine all design parameters based on consideration of published AASHTO guidelines and/or local building codes and ordinances except as discussed below.

##### *State Owned Right of Way*

When a state-owned roadway is to be crossed by a pedestrian structure, guidance from the applicable AASHTO documents and MoDOT requirements should be followed with vertical and horizontal clearances subject to approval by MoDOT's District Engineer. . It is recommended that the proposed vertical and horizontal clearances be submitted for MoDOT review and acceptance as soon as possible in the early stages of the project.