CFLHD SUPPLEMENT 9.1.3.4-1

9.1.3.4 Documenting Design Exceptions

Add the following:

This Supplement provides guidance on using the CFLHD Highway Design Standards form (Internal Version) and the CFLHD Highway Design Standards form (A/E Version).

9.1.3.4 Highway Design Standards Form

The purpose of the Highway Design Standards (HDS) form is to document the engineering judgment used in the decisions involving design standards and practices for each project.

9.1.3.4.1 Projects Requiring the HDS Form

The HDS Form is required on all projects, except for the following project type:

- Preventative maintenance projects that extend the roadway surfacing life without degrading any existing geometric aspects of the roadway. Refer to the PDDM Section 4.7.1.3, the FHWA Pavement Preservation memorandum of September 12, 2005, and the Federal-Aid Policy Guide NS CFR 23 625 for more information. Typically, the preventative maintenance work items include pavement repair, such as crack sealing, or minor resurfacing, such as chip sealing. Use the Preventative Maintenance Highway Design Standards Memorandum for design standard documentation.

9.1.3.4.2 Preparing the HDS Form

The HDS form is formatted as a Microsoft Word form. There are instructions on how to make any necessary formatting changes at the beginning of the form in hidden text. To see the hidden text, click on Show/Hide ¶ on the Standard toolbar or select Ctrl+Shift+*.

This section provides a summary of items to address, as applicable, in the Highway Design Standards form.

Project Design Controls

1. Provide project identification information, including project number and name.

2. Briefly describe the location of the project.

3. Select the type of project (i.e. new construction, reconstruction, or 3R). The 'Other' option includes bridge replacement or spot improvement projects.

4. Briefly describe the work included in the project. This description should be similar to what is shown on the project Title Sheet.

5. Select the type of roadway system that the project is on and the functional classification of the roadway. Refer to the PDDM Section 9.3.1.2

6. List the owner of the roadway.

7. Provide traffic information. Refer to the PDDM Section 9.3.1.5 and Section 8.6.1 for information on calculating the traffic data.

8. Select the design standards used on the project. Refer to the PDDM Section 4.4.

9. Select the appropriate type of terrain. Refer to the PDDM Section 9.3.1.3.

10. Designate a design vehicle. Refer to the PDDM Section 9.3.1.9.

Geometric and Bridge Criteria (The Thirteen Controlling Criteria)

1. Using the appropriate design standard, list the design criteria that apply to the project in the 'Standard' column. If a criteria does not apply to the project (e.g. bridge criteria on a project without a bridge), insert N/A.

2. List the design criteria used in the project in the 'As Designed' column. For projects where the existing geometry is incorporated into the final design without any changes, such as some 3R projects, document the known information as much as possible. When the existing information is not known, indicate that the project geometry matched the existing conditions.

3. Note any exceptions to the design criteria in the last column. Select 'Yes', 'No', or 'N/A' as appropriate.

Justification

Provide a narrative describing any design exceptions and reasons why a design exception is needed. Give reasons why the design standard should not be met in the proposed design and provide support to justify the proposed design criteria. Considerations which may warrant an exception to the design standard include:

- Social, economic, and environmental impacts
- Steep terrain
- Compatibility with adjacent sections on a route
- Excessive construction cost
- Right-of-way constraints
- Impacts during construction, including traffic control operations, detours and private property access
- Visual impact
- Geotechnical infeasibility
- Relationship to future improvements

If needed to support the justification, document the estimated costs to achieve the design standard and the estimated cost of the proposed design exception.

Risk Analysis and Mitigation

Provide a narrative describing risks associated with the design exception and any design features included in the project to mitigate the design exception.

Briefly describe crash data and summarize the safety analysis. If no crash data is available, describe any anecdotal evidence or field observations of safety issues. Consider using IHSDM (e.g. crash prediction module and design consistency module) to evaluate the effect of any design exceptions on predicted safety performance.

Consider the following when evaluating design exception risks:

- The effect of the design exception on the safety and operation of the facility and its compatibility with adjacent sections of roadway;
- The functional classification, the amount and character of the traffic, the type of project, and the accident history of the road;
- The anticipated improvement in safety performance of the roadway
- The degree to which a design criteria is being reduced and how the exception affects other guidelines; and
- The effect of the design exception on all users and stakeholders, including motorists, bicyclists, pedestrians, road owning or managing agency, and CFL.

Generally, lower risk is associated with low traffic volumes, low design speeds, or locations with little or no history of crashes.

In addition to safety risks, consider the other types of risks, including capacity, durability, operational, life cycle cost, and maintenance.

Evaluate the risks for each design exception individually. If multiple design exceptions are proposed, evaluate the risks in combination as well as individually.

Refer to the FHWA *Mitigation Strategies for Design Exceptions*, FHWA-SA-07-011 (2007). For RRR projects, the Transportation Research Board Special Report 214 may be used to help assess the risk and mitigation for design exceptions.

Use the information in Figure A as a guide in assessing risk for individual design criteria.

Figure B details some options that may be used on a project to mitigate design exceptions. Consider all potential mitigation options.

Figure A
Risk Assessment for Specific Design Criteria

Geometric and Bridge Criteria	Risk Assessment References
(1) Design Speed	• AASHTO *Guide for Achieving Flexibility in Highway Design* Section 1.5.1 • Interactive Highway Safety Design Model (IHSDM)
(2) Travel Way Width	• PDDM Section 9.3.8.5 • AASHTO *Guide for Achieving Flexibility in Highway Design* Section 3.6.1 • FHWA-RD-99-207 *Prediction of the Expected Safety Performance of Rural Two-Lane Highways* Chapter 5 Table 7. • IHSDM • *Highway Capacity Manual* Chapter 20
(3) Shoulder Width	• PDDM Section 9.3.8.5 • FHWA-RD-99-207 *Prediction of the Expected Safety Performance of Rural Two-Lane Highways* Chapter 5 Table 8. • IHSDM • *Highway Capacity Manual* Chapter 20
(4) Crown	• AASHTO *Green Book* Chapter 4 § Pavement Cross Slope
(5) Horizontal Curvature	• PDDM Section 9.3.5.3 • AASHTO *Guide for Achieving Flexibility in Highway Design* Section 3.2.2 • FHWA-RD-99-207 *Prediction of the Expected Safety Performance of Rural Two-Lane Highways* Chapter 5 Table 9. • IHSDM
(6) Superelevation	• FHWA-RD-99-207 *Prediction of the Expected Safety Performance of Rural Two-Lane Highways* Chapter 5 Table 10.
(7) Grade	• PDDM Section 9.3.6.10 • AASHTO *Guide for Achieving Flexibility in Highway Design* Section 3.3 • FHWA-RD-99-207 *Prediction of the Expected Safety Performance of Rural Two-Lane Highways* Chapter 5 Table 11. • IHSDM • *Highway Capacity Manual* Chapter 20
(8) Vertical Curvature (k value)	• PDDM Section 9.3.6.10
(9) Stopping Sight Distance	• PDDM Section 9.3.6.10 and Section 9.3.7.7 • AASHTO *Guide for Achieving Flexibility in Highway Design* Section 3.5.1.2

Geometric and Bridge Criteria	Risk Assessment References
(10) Horizontal Clearance to Structure (not clear zone)	• AASHTO *Guide for Achieving Flexibility in Highway Design* Section 3.7
(11) Vertical Clearance to Structure	• AASHTO *Guide for Achieving Flexibility in Highway Design* Section 3.7
(12) Bridge Width	• AASHTO *Guide for Achieving Flexibility in Highway Design* Section 3.7
(13) Bridge Loading	• AASHTO *Guide for Achieving Flexibility in Highway Design* Section 3.7

Figure B
Thirteen Controlling Criteria
Design Exception Mitigation Options

Geometric and Bridge Criteria	Potential Mitigation Options
(1) Design Speed	• Limit the difference in operating speed between curves to a maximum of 15 mph (preferably less than 10 mph). • Post warning signs. • Post speed advisory. • Install chevrons. • Install raised or recessed pavement markers. • Improve sight distance.
(2) Travel Way Width	• Improve pavement edge lines (e.g. wider stripe). • Install raised or recessed pavement markers. • Post delineators. • Provide consistency with adjacent roadway segments. • Restrict vehicle size. • Improve stopping sight distance. • Widen the roadway and clear zone as much as possible, including the shoulder.
(3) Shoulder Width	• Flatten roadside slopes. • Improve roadside slopes by adding shouldering material. • Construct paved ditches on a recoverable slope to replace graded ditches on steep or erodible slopes. • Provide occasional pullouts or turnouts. • Improve delineation. • Install shoulder rumble strips. • Post warning signs. • Provide consistency with adjacent roadway segments. • Provide curve widening. • Remove or relocate fixed objects. • Widen the roadway as much as possible. • Identify and post alternate bicycle route.

Geometric and Bridge Criteria	Potential Mitigation Options
(4) Crown	• Improve the surface friction with an open-graded surface course. • Improve crown/superelevation as much as possible. • Improve drainage.
(5) Horizontal Curvature	• Post warning signs. • Post speed advisory. • Install chevrons. • Add curve widening. • Improve sight distance. • Flatten roadside slopes. • Improve clear zone area. • Improve superelevation. • Install lighting. • Install guardrail. • Widen shoulders. • Apply pavement antiskid treatment. • Relocate driveway to a location with better sight distance. • Install raised pavement markers. • Post delineators. • Install shoulder rumble strips. • Restrict vehicle size.
(6) Superelevation	• Post warning signs. • Post advisory speed. • Install pavement antiskid treatment.
(7) Grade	• Post warning signs. • Consider truck climbing or passing lane. • Consider slow-moving vehicle turnout. • Use flatter radius horizontal curves at the bottom of steep downgrade.
(8) Vertical Curvature (k value)	• Post delineators. • Relocate driveway to a location with better sight distance. • Remove roadside obstacles. • Widen shoulder. • Install lighting. • Install raised pavement markers. • Close the roadway at night.
(9) Stopping Sight Distance	• Remove obstructions. • Post advisory speed. • Post warning signs. • Install lighting. • Relocate intersection. • Improve horizontal sight lines. • Install advance flashing warnings. • Widen shoulders. • Flatten roadside slopes.

Geometric and Bridge Criteria	Potential Mitigation Options
(10) Horizontal Clearance to Structure (not clear zone)	• Post warning signs. • Improve delineation (e.g. object markers). • Identify and sign alternate route. • Remove or relocate obstructions. • Consider barrier installation.
(11) Vertical Clearance to Structure	• Post warning signs. • Restrict vehicle size. • Mill pavement under structure. • Identify and sign alternate route. • Install clearance checking devices in advance.
(12) Bridge Width	• Increase stopping sight distance on the approach. • Post warning signs. • Improve delineation. • Post speed advisory. • Upgrade bridge barriers. • Restrict vehicle size. • Identify and post alternate bicycle route.
(13) Bridge Loading	• Post warning signs. • Post load limit signs. • Restrict vehicle size. • Identify and post alternate route.

FLH Supplemental Standards

In addition to the 13 principle design elements that are considered controlling criteria, there are 4 FLH supplemental standards that require formal approval and documentation, and a design exception each time they are not attained.

1. Clear Zone

   As described in the PDDM Section 8.5.2, use the following to determine the clear zone (as applicable):

   - AASHTO *Roadside Design Guide* Table 3.1 or Figure 3.1
   - AASHTO *Guidelines for Geometric Design of Very Low-Volume Local Roads (ADT ≤ 400)*

   The FLH *Barrier Guide for Low Volume and Low Speed Roads* is not intended to be used as a standard for determining the clear zone distance. The clear zone distances listed in the FLH *Barrier Guide* should only be used for analyzing the need to provide a barrier within the project clear zone.

2. Barrier Crashworthiness

   The FLH policy requiring barrier systems to meet the requirements of NCHRP 350 is described in the PDDM Section 8.5.3.2. In general, every attempt should be made to upgrade existing roadside barriers, especially where an existing safety concern exists.

3. Design Flood

   Refer to the PDDM Exhibit 7.1-A to determine applicable design standards, including design floods for culverts, roadside ditches, pavement drainage, storm drains, floodplain encroachments, bridges, longitudinal embankments, retaining walls, and low-water crossings.

4. Pavement Design Service Life

   Refer to the PDDM Section 11.2.1.1 to determine applicable pavement design service life standards.

Justification

Provide a narrative describing any design exceptions and reasons why a design exception is needed. Give reasons why the FLH design standard should not be met in the proposed design and provide support to justify the proposed design criteria.

Where new roadside barriers are warranted but not provided, document the locations and the safety history or extenuating circumstances surrounding the variance.

Risk Analysis and Mitigation

Provide a narrative describing risks associated with the design exception and any design features included in the project to mitigate the design exception.

Figure C describes where to find additional risk assessment information for each design criteria. Figure D describes potential design exception mitigation options.

Figure C
Risk Assessment
For Specific FLH Supplemental Design Standards

FLH Supplemental Design Standard	Risk Assessment References	Additional Information
(1) Clear Zone	• AASHTO *Roadside Design Guide* Chapters 3 and 5 • AASHTO *Guidelines for Geometric Design of Very Low-Volume Local Roads (ADT ≤ 400)*	Consider the traffic volumes, crash history, and adjacent roadway corridor template. Coordinate with the Safety Engineer.
(2) Barrier Crashworthiness	• AASHTO Roadside Design Guide Chapter 5 • FLH Barrier Guide For Low Volume and Low Speed Roads	Consider the traffic volumes and crash history. For existing roadside barriers: consider the barrier's performance in terms of construction, maintenance, and crash experience. Coordinate with the Safety Engineer.
(3) Design Flood	• PDDM Section 7.1.4	Consider the capacity, stability, durability, operational, and maintenance risks. Coordinate with the Hydraulics Engineer.
(4) Pavement Design Service Life	• PDDM Section 11.2.2 and Section 11.2.3 • FHWA Context Sensitive Roadway Surfacing Selection Guide Chapter 3	Consider the durability, operational, material variability, traffic load, life cycle cost, and maintenance risks. This information is typically provided by the Pavements Engineer.

Figure D
FLH Supplemental Design Standards
Exception Mitigation Options

FLH Supplemental Design Standard	Potential Mitigation Options
(1) Clear Zone	• Maintain consistency in geometric design features along a corridor. • Improve delineation. • Install shoulder rumble strips. • Post warning signs. • Add edge lines. • Tailor the roadside design to site-specific conditions, such as providing wider clear zone width at areas where there is evidence of vehicle encroachments (scarring of trees or utility poles). • Remove obstructions from the toe of non-recoverable foreslopes. • Refer to FLH Barrier Guide For Low Volume and Low Speed Roads Table 2.7: Strategies for Corrective Actions.
(2) Barrier Crashworthiness	• Improve delineation. • Install shoulder rumble strips. • Post warning signs. • Add edge lines. • Refer to FLH Barrier Guide For Low Volume and Low Speed Roads Table 2.7: Strategies for Corrective Actions.
(3) Design Flood	• Install signs, e.g., "Do Not Enter When Flooded". • Ensure structural integrity of roadway for discharge beyond capacity, e.g., design roadway embankment for stability during overtopping discharge. • Protect adjacent property from discharges beyond capacity, e.g., build berms, floodwalls; raise structures; purchase impacted property.
(4) Pavement Design Service Life	• Communicate maintenance and sedimentation concerns to project stakeholders. • Communicate reduced performance expectations to project stakeholders. • Program a future structural overlay. • Limit vehicle weight.

9.1.3.4.3 Review, Approval, and Distribution

Submit a draft HDS form at each preliminary design project milestone.

Present the completed form for signature at the 70% project milestone. Obtain signatures from the Lead Designer, Highway Design Manager (internal projects), Design Manager or Project Manager (A/E projects), CFLHD Project Manager, Project Management Engineer, and partner agencies at the 70% project milestone.

If any design changes occur after 70% that would be reflected in the HDS form (including design criteria, justification, or mitigation), revise the form and obtain signatures on the updated form. Attach the original form to the revised form to maintain documentation of design decisions.

Distribute the signed version of the HDS form according to the distribution list on the form (electronic Adobe .pdf format is preferred). Keep a copy of the HDS form with the project design records.