# Forest Service Handbook
# National Headquarters – Washington Office
# Washington, DC

## Forest Service Handbook 7709.56b – Transportation Structures Handbook
## Chapter 20 - Structure Location

**Amendment:** 7709.56b-2014-1

**Effective date:** November 24, 2014

**Duration:** This amendment is effective until superseded or removed.

**Superseded Directive:** 7709.56b,contents, Amendment 7709.56b-94-1, July 27, 1994; 7709.56b, 0 Code Contents, Amendment 7709.56b-94-1, July 27, 1994; 7709.56b, 0 Code, Amendment 7709.56b-94-1, July 27, 1994; 7709.56b, 1 Contents, Amendment 7709.56b-94-1, July 27, 1994; 7709.56b,1 Amendment, 7709.56b-94-1, July 27, 1994; 7709.56b, 2 Contents, Amendment 7709.56b-94-1, July 27, 1994; 7709.56b,2, Amendment 7709.56b-94-1, July 27, 1994; 7709.56b, 3 Contents, Amendment 7709.56b-94-1, July 27, 1994; 7709.56b,3, Amendment 7709.56b-94-1, July 27, 1994; 7709.56b, 4 Contents, Amendment 7709.56b-94-1, July 27, 1994; 7709.56b,4, Amendment 7709.56b-94-1, July 27, 1994; 7709.56b, 5 Contents, Amendment 7709.56b-94-1, July 27, 1994; 7709.56b,5, Amendment 7709.56b-94-1, July 27, 1994; 7709.56b, 6 Contents, Amendment 7709.56b-94-1, July 27, 1994; 7709.56b,6, Amendment 7709.56b-94-1, July 27, 1994; 7709.56b_7, Amendment 7709.56b-2005-1, August 26, 2005; 7709.56b_8, Amendment 7709.56b-2005-2, August 26, 2005; 7709.56b, 9 Contents, Amendment 7709.56b-94-1, July 27, 1994; 7709.56b,9, Amendment 7709.56b-94-1, July 27, 1994

**Approved by:** Gregory Smith, Acting Associate Deputy Chief, NFS

**Date approved:** November 18, 2014

**Responsible Staff:**

**Explanation of changes:** Following is an explanation of the changes throughout the directive by section.

**7709.56b:** The entire Handbook has been revised; refer to the digest for a summary of the revisions.

**Zero Code:** Makes minor technical and editorial changes, removes obsolete direction and terminology, and updates the coding system by changing from the one-digit to the two-digit coding system.



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**10:** Recodes, reorganizes, and updates direction throughout the chapter. Makes minor technical and editorial changes, removes obsolete directions, and updates the coding system by changing from the one-digit to the two-digit coding system.

**11:** Recodes, reorganizes, and updates this section in its entirety. Replaces discussion of forest plans, ecosystem management, and least total cost method decisions with subsections on travel analysis and travel management decisions. Updates direction on road management to include direction on Trail Management Objectives and recodes the direction to section 11.3. Reduces scope of direction on alternatives to stay within limits of travel management decisions and the Road and Trail Management Objectives and recodes the direction to section 11.4. Recodes the remainder of the section to new section 11.5 entitled, "Project Development Process."

**13:** Sets forth new direction on inspection reports for existing structures and evaluation of load-carrying capacity of existing structures to listing of required design information.

**20:** Makes minor technical and editorial changes, removes obsolete direction, adds direction to meet Road and Trail Management Objectives, and updates the coding system by changing from the one-digit to the two-digit coding system throughout the chapter.

**23:** Adds direction to consider roadway widening needed to accommodate off-tracking of large trucks when curves are constructed close to bridges, to consider construction access to both sides of a stream, and to consider measures needed to maintain existing road traffic when replacing existing bridges.

**30:** Makes minor technical and editorial changes, removes obsolete direction, and updates the coding system by changing from the one-digit to the two-digit coding throughout the chapter.

**34:** Revises direction to conform to stream simulation requirements and to reference chapter 60.

**35.4:** Adds direction for identification of construction staging areas.

**40:** Makes minor technical and editorial changes and updates the coding system by changing from the one-digit to the two-digit coding throughout the chapter. Removes obsolete direction referencing economic analysis methods and flood insurance.

**43.5:** Updates direction to allow previously used materials only when they have been inspected, determined to be structurally adequate, economical and approved by the Regional Director of Engineering.

**50:** Changes chapter caption from "Hydrology" to "Hydrology and Geomorphology" and adds direction to require stream simulation and aquatic organism passage. Makes minor technical



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and editorial changes and updates the coding system by changing from the one-digit to the two-digit coding system.

**60:** Changes chapter caption from “Hydraulics” to “Hydraulics and Watershed Protection” and adds direction to require stream simulation and aquatic organism passage. Makes minor technical and editorial changes and updates the coding system by changing from the one-digit to the two-digit coding system throughout the chapter. Removes obsolete direction.

**70:** Changes chapter caption from “Structural Design” to “Road Bridge Design” and updates the coding system by changing from the one-digit to the two-digit coding system throughout the chapter. Adds new direction and revises, reorganizes, and recodes direction throughout the entire chapter. Changes various section captions to be applicable for road bridge designs and sets forth new direction throughout the chapter. Removes obsolete direction.

**80:** Changes chapter caption from “Operations” to “Trail Bridge Design” and updates the coding system by changing from the one-digit to the two-digit coding system throughout the chapter. Sets forth direction for planning, design, and construction of trail bridges and other engineered trail structures.

**90:** Changes chapter caption from “Construction” to “Road Bridge Operation” and updates the coding system by changing from the one-digit to the two-digit coding system throughout the chapter. Revises, reorganizes, and recodes entire chapter. Major changes are: 1) removes the distinction and inspection requirements between bridges formerly known as NBIS and non-NBIS (National Bridge Inspection Standards), 2) removes all trail bridge references and guidance and 3) incorporates culvert guidance.

**100:** Establishes code, chapter “Trail Bridge Operation”, and sets forth direction for maintenance, inventorying, and operation of trail bridges and other engineered trail structures.



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**20.2 - Objectives**

To place bridges and culverts in locations that will be cost-effective and best meet road management objectives (RMOs) for roads and trail management objectives (TMOs) for trails.

**20.3 - Policy**

Locate roadway alignments and fit structure sites in accordance with preliminary studies that have been coordinated with RMOs, TMOs, and travel management decisions.

**21 - Reconnaissance**

Make a reconnaissance of the area to determine the most promising structure site(s) that meet overall transportation needs (FSH 7709.56, sec. 22). Involve Resource Specialists as needed. Use information about topography, soils, geology, hydrology, and vegetation to identify sites for field review. Visit each proposed site to gather specific information for evaluating each site.

**22 - Site Selection**

Conduct detailed studies of the most promising sites. Select an appropriate site where the road or trail and drainage structure will achieve the RMOs or TMOs. Also consider the following:

1. Avoid sites where changes in hydraulic characteristics affect the adjacent resources and downstream non-Forest Service owned lands.

2. Place the crossing on a straight stretch of stream. However, in valleys where stream channels meander, do not rule out sharp bends as possible structure sites; because they often indicate the presence of erosion resistant material and a stable point in the stream reach.

3. Use a 90-degree crossing where possible.

4. Avoid curves and steep grades in road or trail alignment.

5. Cross at a narrow stream channel section.

6. Select sites with stable soils and slopes.

7. Select sites where rock is at or near the surface.

8. Avoid locations that require a channel change.

9. Avoid stream crossings where channels are subject to channel degradation, shifting, aggradations, or excessive scour. For example, determine if the following conditions apply:



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a. The stream banks and streambed are erodible. Also determine the depth of erodible material.

b. The stream reach at the site location has been stable in both the horizontal and vertical direction in recent history.

c. Any upstream or downstream manmade structures are planned that might affect stream stability.

d. The crossing is in an alluvial fan, as they are subject to aggradation and sudden shifts in alignment. Preferably, cross near the apex or head of the fan.

10. Avoid locations downstream from slope failures, debris jams, and ice jams.

**23 - Fitting the Structure to the Site**

Fit structures to proposed sites during preliminary design. Prepare conceptual plans of each site being considered. Study and compare the various road alignments, gradients, possible locations for abutments and piers, height of bridge decks, clearances, the possible outline of the toe of approach fills, and any other factors pertinent to the specific design. Prepare a rough cost estimate for each alternative site to assist in making a final selection.

Obtain an appropriate balance between the bridge cost and the road cost. Include construction, maintenance, and user costs.

Align the structure with the road so that earthwork is balanced and cuts and fills are minimized. Consider the following criteria:

1. Locate bridges and culverts consistent with RMOs/TMOs, stream degradation effects, and esthetics.

2. Use straight approaches to bridges of at least 50 to 100 feet if possible.

3. Minimize curvature of the approaches. Limit any curves entering or leaving a road bridge to a minimum radius of 100 feet if possible, or at least within the horizontal curve criteria established for the design speed of the road. Remember that widening to accommodate off-tracking of large trucks on curves near a structure will require wider roadway widths than necessary on a straight alignment (FSH 7709.56, ch. 40, sec. 42.45).

4. Design the structure and approaches on a constant gradient where possible. Sudden changes in grade at a bridge can increase the live load impact forces on the bridge.

5. Place bridges on a slight grade where the road or trail geometry permits. Avoid bridge deck profile grades greater than 5 percent.

6. Ensure adequate clearance under a bridge to allow flood waters, floating ice, or debris to pass during high runoff.



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7. Locate bridge substructures out of stream channels where possible. This will tend to lower costs and reduce potential for scour and damage from debris.

8. Avoid constricting waterways with approach fills, abutments, or piers. This will mitigate potential failures that may result from scour during floods.

9. Protect fish habitat and fish passage by minimizing streambed disturbance and limiting changes in water velocity and depth.

10. Evaluate the advisability and cost of using longer span bridges with less costly abutments, such as spill-through and stub abutments, in lieu of shorter structures that use retaining wall abutments. Cantilever wall type abutments reduce superstructure costs but are significantly offset by increased abutment costs.

11. Consider construction access in bridge location decisions. A contractor will generally need equipment on both sides of a stream to build a bridge. Providing such access can have significant cost and environmental impacts.

12. When replacing an existing bridge, consider any requirements in the travel management decision and the RMOs/TMOs regarding maintenance of traffic during construction. The cost and environmental effects of any necessary temporary crossings for public access and the costs of any necessary detours must be considered.



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