

Chapter 4: Design & Construction of Bridges & Major Culverts

This chapter describes key activities and practices related to addressing safety, environmental, structural and professional responsibility issues in the design and construction of bridges, major culverts and retaining structures on Forest Service roads (FSRs). The topics covered include:

- professional responsibilities and considerations;
- design requirements and considerations;
- types of structures;
- site data and survey requirements;
- estimating design discharge for streams;
- construction drawings and specifications;
- construction materials, quality assurance, and fabrication; and
- statement of general conformance and construction documentation.

4.0.1 Definitions

- Coordinating Registered Professional (CRP), Professional of Record (POR) and specialists are defined in the *Guidelines for Professional Services in the Forest Sector - Crossings V. 2*
- Bridge means a temporary or permanent crossing structure carrying a road above a stream or other opening and includes a log stringer/gravel deck structure with i) a span length equal to or greater than 6 m or ii) an abutment height of 4m or greater.
- Major culvert means a culvert i) having a pipe diameter of 2,000 mm or greater; ii) a pipe arch with a span greater than 2,130 mm; iii) an open bottom arch having a span greater than 2,130 mm, iv) has a design discharge of 6 m³/sec or greater. or v) is a log stringer/gravel deck structure (log culvert) with a span less than 6 m and a design discharge of 6 m³/s or greater.
- Retaining structure means any retaining structure greater than 1.5 m high.
- Portable bridge superstructure is a bridge superstructure that is designed and fabricated, in accordance with the Forest Service Bridge Design and Construction Manual, for ease of movement and installation.
- Permanent materials: steel, concrete or treated wood.
- Temporary materials: untreated logs or untreated timbers.
- Permanent bridge is a bridge that has its stringers or girders and abutments comprised of permanent materials (even though it may have an untreated timber deck or untreated timber sills bearing on an abutment comprised of permanent materials). Rail car structures are an exception to the foregoing and will be considered a temporary bridge regardless of the abutment type.
- Temporary bridge is a bridge that has its stringers or girders, or abutments, comprised of temporary

materials.

The Forest Service Bridge Design and Construction Manual (B.C. Ministry of Forests, 1999) provides further discussion on planning, design, and construction of forest road bridges.

Note: Log / wood box culverts, defined as those with gravel decks, spans less than 6m and abutment heights less than 4m, are covered in Chapter 3: Road Survey & Design and Chapter 5: Road Construction of this manual.

4.0.2 Policy

All bridges, major culverts and retaining structures on Forest Service roads will be designed and constructed to:

- be safe for users;
 - minimize the impacts on forest and other resources;
 - be cost-effective; and
 - be appropriate for the site.
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4.1 Mandatory Procedures and Best Practices

4.2 Structure Design & Construction Professional Responsibilities & Considerations

- 4.2.1 General
- 4.2.2 CRP Skill Sets for Crossings

4.3 Design Requirements for Retaining Structures

- 4.3.1 General Design Requirements
- 4.3.2 Factors to Consider in Selecting Facing Materials for MSE & GRS Retaining Structures
- 4.3.3 Geotechnical Report
- 4.3.4 Detailed Design Drawings & Specifications
- 4.3.5 Ministry Review of Externally Prepared Designs

4.4 Design Requirements for Crossings, Including Bridges & Major Culverts

- 4.4.1 Project & Design Responsibility & Considerations
- 4.4.2 Skill Set for CRP for Simple Crossings
- 4.4.3 Development & Use of Professional Engineer Forest Road General Arrangement Bridge Design Aids
- 4.4.4 Typical Bridge Design Approach
- 4.4.5 Design Opening

4.5 Types of Bridge Structures

- 4.5.1 Bridge Superstructures
- 4.5.2 Bridge Substructures

4.6 Types of Major Culvert Structures

4.7 Site Data & Survey Requirements for Bridges & Major Culverts

4.8 Design Discharge Criteria

- 4.8.1 Factors Affecting Runoff
- 4.8.2 Methodologies to Estimate Design Flood Discharge
- 4.8.3 Comparing Discharges Using Hydrological Information

4.9 Agency Referrals

4.10 Construction Drawings & Specifications

- 4.10.1 General Bridge Arrangement Drawing Requirements
- 4.10.2 Bridge Superstructure Drawing Requirements
- 4.10.3 Bridge Substructure Drawing Requirements
- 4.10.4 Log Bridge Superstructure on Log Crib Drawing Requirements
- 4.10.5 Major Culvert Drawing Requirements
- 4.10.6 Portable Bridge Superstructures

4.11 Bridge & Major Culvert Materials Acquisition

4.12 Bridge & Major Culvert Materials Quality & Fabrication

- 4.12.1 In-Plant Inspection of Bridge Materials & Fabrication
- 4.12.2 Structural Field Welding
- 4.12.3 Structural Field Grouting

4.13 Major Culvert Construction

4.14 Use & Role of Environmental Monitors

4.15 Construction Documentation

4.16 Resources & Suggestions for Further Reading

4.17 Appendices

- 4.17.1 Project Tracking Checklist
- 4.17.2 Forest Service Bridge Design Checklist
- 4.17.3 Acceptance of Bridge & Major Culvert Drawings & Specifications