

Directive for Design, Construction, and Inspection of Vehicular and Pedestrian Bridges



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DEFINITIONS

Bridge	A structure that provides a means for the passage of vehicles, pedestrians, cyclists, or equestrians across an obstruction, gap, or facility and that is ≥ 3 m in clear span.
Culvert	A structure that forms an opening through soil that provides a means for the passage of pedestrians, cyclists, or equestrians, or the passage of a watercourse, that is < 3 m in clear span. Culverts > 3.0 m shall be treated as bridges.
Design	The process of planning, analyzing, proportioning, drawing, and specification writing required for the construction of a structure.
Evaluation	The process of determining the load carrying capacity of a structure.
Permit Load	A vehicle with weight and/or dimensions that are not in accordance with the regulatory limits.
Posting	Signing of a structure for load restrictions according to the Canadian Highway Bridge Design Code (CHBDC).
Professional Engineer	A Professional Engineer licensed or registered in a Canadian province or territory.
Qualified Engineer	A Professional Engineer with directly related experience in design, inspection, construction and evaluation of bridge structures, licensed or registered in a Canadian province or territory where the bridge is located and when dealing with inspections meets the provincial requirements for inspections.
Rehabilitation	A modification, alteration, or improvement to the existing condition of a structure or bridge subsystem that is designed to correct deficiencies for a particular design life and live load level.
Trained Personnel	A person holding certification from either a Parks Canada certificate program for routine maintenance bridge inspections or an equivalent certified training program recognized by a province.
Span	The horizontal distance between the centerlines of adjacent piers or abutments; or, where bearings are provided, between bearing centerlines; or, for rigid frames, including culverts, the clear opening width.

Vehicle	A motor vehicle, trailer, traction engine, car, truck, farm tractor, road building machine, or any device drawn or propelled by power other than that of the driver or operator, but not including the cars or engines of electric, diesel, or steam railways.
Zones	<p>Land use areas as defined in the Park Management Plans and Interim Management Guidelines.</p> <p>Zone 1: Special Preservation</p> <p>Zone 2: Wilderness</p> <p>Zone 3: Natural Environment</p> <p>Zone 4: General Outdoor Recreation</p> <p>Zone 5: Townsite</p>

ACRONYMS

BIM	Public Works and Government Services Canada (PWGSC) Bridge Inspection Manual, latest edition.
CHBDC	Canadian Highway Bridge Design Code CSA/CAN S6, latest edition.

1.0 INTRODUCTION

1.1 BACKGROUND

Parks Canada has in excess of 1000 bridges, ranging from multi-lane, multi-span highway structures to single span creek crossings on backcountry trails. Prior to the development of this Directive, Parks Canada had no formal inspection policy on the frequency or detail of inspections for highway bridges. In most cases, the relevant provincial or territorial inspection policies were adopted. Trail bridges were governed by the *Design, Construction and Inspection of Trail Bridges, February 1991*, but this document is now out of date and is superceded by this directive.

1.2 PURPOSE

The purpose of this Directive is to guide Parks Canada in the management of its structures by providing consistent, national guidelines for the design, construction and inspection of bridges owned by Parks Canada. Bridges owned by Parks Canada and maintained by others must, as a minimum, meet the requirements of this Directive.

1.3 SCOPE

This Directive addresses all highway and trail bridges. For the purpose of this Directive, viewing platforms and towers have also been included since they are high-risk structures. Structures with clear spans < 3.0 m, culverts, wharves, retaining walls, snowsheds, and tunnels are not included as part of this Directive.

1.4 USE OF THE DIRECTIVE

Safety is paramount, and the health and safety of the public using the bridge structures must be ensured at all times. Requirements identified in this Directive are minimum requirements.

The Parks Canada Asset Management Policy is the umbrella document covering all Parks Canada assets. This Directive provides direction for the design, construction and inspection of bridges owned by Parks Canada and as such, must not be used as a stand-alone document but rather, is meant to compliment the overall objectives of the national policy while also complying with the Parks Canada's mandate.

This Directive encompasses a wide cross-section of bridge types and loading conditions and has been written for use at a national level. Local or regional conditions may dictate specific requirements unique to that area. Sound, experienced engineering judgment must be applied in conjunction with the direction provided in this Directive.

1.5 RELATED POLICIES

This Directive has been developed in consideration of several other Parks Canada policies, guidelines and manuals. The Directive also supercedes several manuals currently in use. The following is a summary of the reference and rescinded documents.

National Reference Policies, Directives, and Standards (most current edition)

- Asset Management Policy;
- Trail Manual;
- Standards and Guidelines for the Conservation of Historic Places;
- Canadian National Parks Act;
- Canadian Heritage River Systems;
- Navigable Waters Protection Act;
- Canada Shipping Act;
- Department of Fisheries and Oceans Act;
- Fisheries Act;
- Canadian Environmental Assessment Act;
- Canadian Environmental Protection Act;
- PWGSC BIM;
- Canadian Highway Bridge Design Code CAN/CSA S6.

The summary above is not intended to be a complete listing of all relevant documents; rather, it is intended to provide a starting point for reference in the design, construction, and inspection of Parks Canada bridges.

Rescinded Policies, Directives, and Standards

- Architecture and Engineering EA-PC 82-34 (1991 Version) Design, Construction and Inspection of Trail Bridges, February 1991.

2.0 BRIDGE CLASSIFICATION

2.1 INTRODUCTION

For the purposes of this Directive, bridges have been divided into two classifications: vehicular bridges and pedestrian bridges. Subdivisions of the two classifications are discussed below, and are summarized in Table 1.

2.2 VEHICULAR BRIDGES

Vehicular bridges are defined as any bridge that supports any vehicular loading other than off-road recreational vehicles (ATV, snowmobile, etc) and equestrian loads. Although many of Parks Canada's bridges are conventional structure forms (such as slab-on-steel girder, slab on concrete girder, reinforced concrete solid slab, and post-tensioned concrete), some of the more unique types of vehicular bridges owned by Parks Canada include modular panel (Bailey) bridges, prefabricated steel truss bridges with timber wearing surfaces, moveable bridges (such as lift, swing, and bascule bridges), and timber bridges. Vehicular bridges range in loading patterns and function from structures on national Canadian highways, historic bridge structures crossing canals to single lane, single span timber bridges.

2.3 PEDESTRIAN BRIDGES

Pedestrian bridges are defined as any bridge, viewing platform or tower subject to pedestrian, equestrian, ATV, ski, and snowmobile loadings. Similar to vehicular bridges, the types and loading patterns on pedestrian bridges are extremely varied. For the purposes of this directive, pedestrian bridges are further sub divided into Class A1, A2 and Class B bridges in order to distinguish between structures based on frequency of use, hazard, risk of injury to the user, contextual setting as well as other factors.

2.3.1 Class A Pedestrian Bridges

Failure of a key primary element in single load path structures, such as cable and truss structures, can result in catastrophic failure as the structure does not have any redundant primary load carrying members (on multi-girder bridges, a girder may fail, but the load can be redistributed to the other girders, and complete collapse is unlikely). The hazard and consequences associated with failure of a primary component in a single load path structure is high and therefore cable and truss bridges are classified as Class A1 bridges regardless of location, setting, height or any other condition.

Other Class A bridges that are not “single load path” must have a change in elevation between the walking surface and the adjacent surface or streambed of more than 2.4 metres, or have a dangerous site condition such as:

- a. Fast flow during all or part of the year,
- b. Deep water,
- c. Hazardous streambed,
- d. The adjacent surface within 1.2m of the walking surface being of a slope of more than 1 in 2
- e. Any other condition deemed as being dangerous by the Parks Canada Professional Engineer having jurisdiction

Class A bridges are categorized as either an A1 or A2 designation to provide further differentiation based on frequency of use, hazard, risk of injury to the user, contextual setting as well as other factors.

Class A1 bridges are typically subject to loads greater than 50% of their design load on a regular basis and/or are located on a trail designed to accommodate persons with limited hiking experience or high volume day use. These trails are typically found in popular tourist areas such as townsites, day use areas, urban foot trails, campground pathways, access to picnic areas, beaches or other trails typically found in zones 4 or 5.

Class A2 bridges comprise the remainder of Class A bridges and typically:

- The trails served by these bridges are located on wilderness and backcountry trails that experience limited yearly pedestrian traffic;
- Experienced hikers who are aware of the nature of the trail and who wish to hike in extreme wilderness settings typically use the trails served by these bridges. By using these trails, the hikers have accepted the risks and higher potential for personal injury in exchange for a wilderness experience. In most situations the trails are typically found in zones 2 or 3;
- Given the remoteness of the structures, there is infrequent visitor use. The risk of structure collapse while being used is significantly less than that of vehicular or other pedestrian bridges;
- Design loading on these bridges is typically not due to pedestrian loading, but rather snow or animal loading;

2.3.2 Class B Pedestrian Bridges

Class B bridges are not suspension bridges, truss bridges nor viewing platforms or towers. They have a drop in elevation between the walking surface and the adjacent surface or streambed of 2.4 metres or less. They do not have a dangerous site condition such as:

- a. Fast flow during all or part of the year,
- b. Deep water,

- c. Hazardous streambed,
- d. The adjacent surface within 1.2m of the walking surface being of a slope of more than 1 in 2
- e. Any other condition deemed as being dangerous by the Parks Canada Professional Engineer having jurisdiction.

Class B bridges have low risk of injury due to collapse or if a person should fall from the bridge.¹The Flow Chart in Figure 1 details the steps for identification of bridge types. Classification is important in that this subsequently influences design criteria and inspection frequency.

¹ . The height of 2.4 meters was chosen based on the Canadian Labour Code which states that fall protection is required when an unguarded structure is greater than 2.4 metres above a surface that could cause injury to a person on contact (section 12.10 (1)a – CLC Regulations 2006).

Table 1 – Structure Classification		
Type	Classification	Description
Vehicular	N/A	<ul style="list-style-type: none"> All vehicular bridges; Loading in accordance with CHBDC and load posted as required.
Pedestrian	A1	<ul style="list-style-type: none"> Has a drop in elevation between the walking surface and the adjacent surface or streambed of more than 2.4 metres, or Has a dangerous site condition as defined in 2.3.1 or Is a suspended bridge or truss bridge or viewing platform or tower. Typically found in zones 4 or 5 (General outdoor recreation and townsite, respectively);
	A2	<ul style="list-style-type: none"> Has a drop in elevation between the walking surface and the adjacent surface or streambed of more than 2.4 metres, or Has a dangerous site condition as defined in 2.3.1 and; Located on wilderness and backcountry trails that see a small amount of yearly pedestrian traffic and; Typically used by experienced hikers who wish to hike in extreme wilderness settings and; Information is available to hikers as to the nature of the trail. Typically found in zones 2 or 3 (Wilderness and Natural Environment, respectively); Is NOT a suspended bridge or truss bridge or viewing platform or tower.
	B	<ul style="list-style-type: none"> Has a drop in elevation between the walking surface and the adjacent surface or streambed less than or equal to 2.4 metres and; Does not have a dangerous site condition as defined in 2.3.1 Is NOT a suspended bridge or truss bridge or viewing platform or tower.

2.4 ABANDONMENT AND DOWNGRADING OF BRIDGES

Although it is Parks Canada's mandate to maintain its infrastructure, there may arise a situation where a structure may be abandoned. The loss of many Class A2 and Class B bridges due to structure collapse or washout will, in many cases, not significantly affect the continued use of the trail. In the event of collapse, immediate replacement of the structure may not be required. Abandonment may also occasionally occur on vehicular and Class A1 pedestrian bridges. Some of the reasons that a structure may be abandoned are as follows:

- Trails or roadways are relocated so the bridge is no longer required; or
- A catastrophic event (such as a flood, hurricane, etc) removes the bridge entirely and the decision is made not to reconstruct; or
- Closure of a bridge to an environmentally sensitive area to limit public access in an effort to preserve the ecosystem.

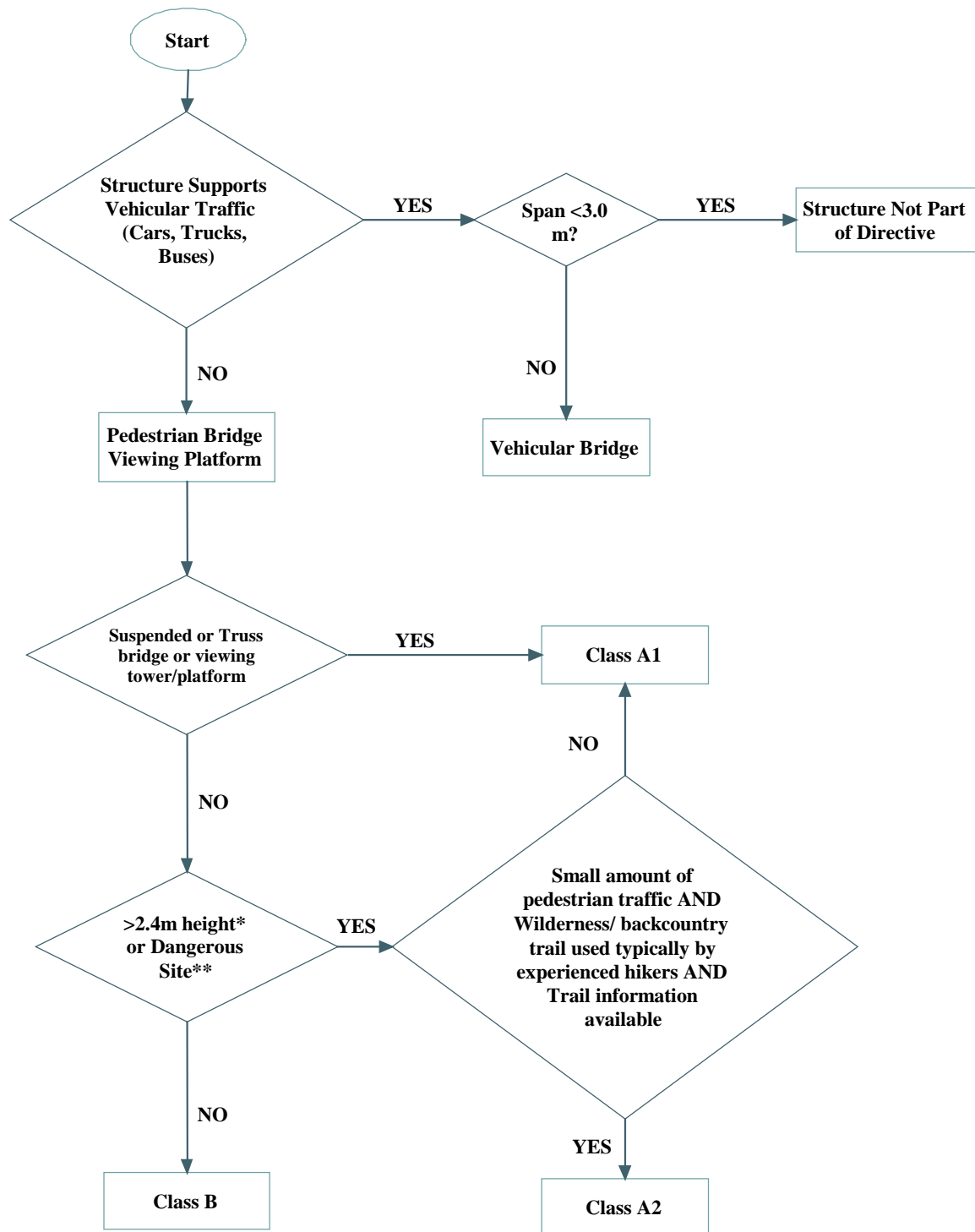
In such cases, the Field Unit Superintendent based on the recommendation from a Professional Engineer may decide to eliminate the asset from the inventory based on the recommendation of a Professional Engineer. Steps must be taken to ensure that the site is made safe.

Similarly, a bridge can be downgraded in class as the use and requirements of the bridge change, such as:

- Vehicular heritage structures that cannot be repaired without significantly compromising the historical integrity of the components may be downgraded to pedestrian bridges to preserve the integrity of the components by limiting the loading on the structure;
- Pedestrian trails with structures that are currently overdesigned for the trail experience (such as extensive handrailing systems on wilderness trail structures);
- Closure of a road to vehicular traffic or load posting of a bridge, resulting in a change of use and requirements of a structure.

In cases where bridges are abandoned or downgraded, the present and future functional and aesthetic requirements of the structure should be examined, and the rationale and engineering requirements for the revision in classification should be clearly detailed. The Field Unit Superintendent based on recommendation by a Professional Engineer will make such decisions. The decision to downgrade in class will be recorded in the bridge file maintained in the Field Unit. The decision must be relayed so that modifications can be made to the regional and national bridge inventories.

In all cases where bridges are downgraded from vehicular to pedestrian use, permanent barriers shall be erected across the ends of the bridge to prevent use by vehicles. Steps must be taken to ensure that the site is made safe for pedestrian use.



* Has a drop in elevation between the walking surface and the adjacent surface or streambed of more than 2.4m

** Has a dangerous site condition such as:

Fast flow during all or part of the year, deep water, hazardous streambed, an adjacent surface within 1.2m of the walking surface being of a slope of more than 1 in 2 or any other condition deemed as being dangerous by the Parks Canada Professional Engineer having jurisdiction

Figure 1 – Flowchart for Bridge Identification

3.0 DESIGN

3.1 DESIGN GUIDELINES AND CONSTRAINTS

There is no single national publication that covers the design of both vehicular and pedestrian bridges. Design requirements for highway bridges are the responsibility of the provincial and territorial governments. Recently, many provincial and territorial governments have been adopting the CHBDC as the design standard, with loadings modified to suit provincial requirements. Similarly, Parks Canada vehicular and Class A pedestrian bridges shall be designed in accordance with the most recent version of the CHBDC by a Qualified Engineer, with loadings modified as required to suit provincial requirements and local conditions.

Public safety is the most important requirement in the design of any structure. Structures must be safe and cost effective to construct and maintain. There are also design constraints that are unique to Parks Canada that must be considered during the design process, as discussed below. These are applicable primarily to pedestrian bridges, but may have applications to vehicular bridges.

Adherence to all environmental and socio-economic constraints, as identified in environmental assessments for the work and as dictated by the relevant regulatory agencies, must be ensured.

Any “context sensitive” design requirements and the extent of the application shall be established at the onset of a design project. An overview of the some of the components to be considered during design is discussed in Appendix A – Design Considerations.

3.2 LOADS

Vehicular and Class A Bridges will be designed by a Qualified Engineer in accordance with the CHBDC, modified as required to suit provincial requirements or local conditions. A discussion on some of the conditions that may require modification to the CHBDC loading may be found in Appendix A – Design Considerations.

The CHBDC states that designers shall obtain permission from the regulatory authority before using any design loads other than those specified in the CHBDC. Any loadings other than those specified in the CHBDC on vehicular and Class A pedestrian structures must only be used with the approval of the Parks Canada Director, Real Property Services.

3.2.1 Railing Loads

Railing loads on vehicular bridges will be in accordance with the CHBDC. Railing loads on Class A1 pedestrian bridges will be in general conformance with the CHBDC, with revisions to loading as approved by the Parks Canada Director, Real Property Services, based on needs within a park zone. Table 2 below summarizes railing requirements based on location.

Bridge Class	Railing Requirements		
	Required	Loading	Dimensions
Vehicle	Yes	CHBDC	CHBDC
A1	Yes	CHBDC	CHBDC
A2	Yes	Qualified Engineer	Qualified Engineer
B	Field Unit Superintendent*	Field Unit Superintendent*	Field Unit Superintendent*

* Field Unit Superintendent based on the recommendation of a professional engineer.

3.3 BRIDGE BARRIER SYSTEMS

The CHBDC specifies the use of crash-tested railing systems for vehicular bridges. Accordingly, most of the existing railing systems on Parks Canada structures do not meet current code requirements, regardless of their condition. However, upgrading of all railings systems to meet current code requirements within the short term would impose a significant financial burden on Parks Canada. Replacement of a bridge barrier system with a crash-tested system may be deferred until the next major deck rehabilitation if the following conditions are met:

- Existing barrier system has been designed to a previous accepted bridge design guide (CAN/CSA S6, OHBDC, etc);
- Barrier system does not exhibit significant deterioration; and
- There is no significant accident history at the site.

4.0 CONSTRUCTION

4.1 CONSTRUCTION GUIDELINES AND CONSTRAINTS

Construction (both new construction and rehabilitation) will be influenced by many of the same constraints detailed in Section 3.0 – Design and in Appendix A – Design Considerations. However, there are other considerations unique to Parks Canada, and these are discussed in Appendix B – Construction Considerations.

Safety of the public and of the workers is paramount, and all construction will be undertaken in accordance with all applicable health and safety acts and regulations.

During construction, all mitigation measures identified in the environmental assessment and as required by the relevant governing agency or regulatory authority (NWP, Fisheries, etc) must be implemented.

5.0 INSPECTION

The goal of structural inspections for bridges is to ensure an acceptable standard of care in terms of public safety, comfort, and convenience. Bridge inspections are undertaken to:

- Provide the Owner with a status report on the current state of the assets and the potential risk associated with the condition of the assets;
- Determine the physical and functional condition of the structure;
- Initiate maintenance actions;
- Form the basis and provide information for the evaluation and load rating of the bridge;
- Help to establish priorities and budgets for repair and maintenance, rehabilitation, and replacement programs; and
- Provide a continuous record of the condition of a structure and the rate of deterioration.

5.1 TYPES OF INSPECTIONS

The inspection methods and rating system for Parks Canada bridges shall be undertaken in accordance with the PWGSC BIM, except as modified herein.

The types of inspections and the nomenclature, as detailed in the PWGSC BIM, are classified as Routine, General Annual, Comprehensive Detailed, Non-Routine, and Emergency Inspections. For the purposes of this Directive, Routine and General Annual Inspections shall be renamed Routine Maintenance, Visual Detailed Inspections, respectively. The remainder of the PWGSC nomenclature shall remain unchanged.

The focus of this Directive will be on Routine Maintenance, Visual Detailed, and Comprehensive Detailed Inspections; however, a description of Non-Routine and Emergency Inspections has been included in Table 3 for information purposes.

The BIM inspection policy applies primarily to vehicular structures and as such, has been modified and expanded to better suit the needs of Parks Canada. To provide unified terminology for all inspections, the types of inspections for both vehicular and Class A pedestrian bridges are the same; however, the frequency of inspections and qualifications of inspectors varies depending on the type and use of a structure.

5.1.1 Routine Maintenance Inspections (RMI)

Bridge maintenance is an ongoing activity, which may require constant review of the condition of the structure to ensure that Parks Canada's investment in the asset is protected, and that the signs and safety devices installed for the public

are properly maintained. RMI consist of a visual overview of the structure, on foot, of the deck surface and superstructure components, below the deck, and along the embankments. The RMI shall be performed on all bridges.

5.1.2 Visual Detailed Inspections (VDI)

VDI are the “workhorse” inspections, and provide most of the information required for effective structure management. They provide the basis for prioritizing repair and rehabilitation work, and can identify the need for detailed inspections or testing. Thorough, regular VDI can also significantly reduce or completely eliminate the requirements for CDI, which in turn reduces long term inspection costs. The VDI must also validate the frequency of VDI and CDI and revise the frequency or type of inspection as required, and shall include a review of any Audits to date (see Section 5.5 – Audits).

VDI include an inspection of all components. On smaller single span structures, a structure can be effectively and inexpensively inspected with the use of step or extension ladders and binoculars, and by wading inspections. Large structures with in-water piers may require specialized access equipment or pontoon boats to complete the inspection. The VDI shall be performed on all vehicle and Class A pedestrian bridges.

5.1.3 Comprehensive Detailed Inspections (CDI)

CDI are typically undertaken for one of three reasons:

- As a precursor to rehabilitation, replacement, or closure;
- As a result of deficiencies identified in a VDI; or
- As scheduled as part of an inspection policy.

Most rehabilitation projects will be based on the recommendations in the CDI. Accordingly, CDI will include detailed observations and measurements on component deterioration to the extent that will permit design of the rehabilitation and calculation of quantities for repair.

Most of the specialized component testing will be done as part of the CDI. Half-cell corrosion potential and covermeter surveys on concrete components, magnetic particle and liquid penetrant testing on fatigue critical components in steel structures, and timber coring may be included as part of a CDI.

If there is evidence of major defects or signs of severe distress, Field Unit Superintendents will be notified immediately concerning emergency repairs, bridge closures, and load posting. The CDI shall be performed on all vehicle and Class A pedestrian bridges.

Table 3 – Definitions of Types of Inspections	
Inspection Type	Definition
Routine Maintenance Inspection (RMI)	<ul style="list-style-type: none"> • Typically done as part of routine maintenance on roadway and structure; • General observations on wearing surface, deck drainage, bridge and approach railing systems, embankment stability; • Visual examination from the ground of structural components for significant defects (wide cracks, differential settlement, significant rotations or deflections); • No specialized access equipment required; • Length of inspection = 15 to 30 minutes per structure.
Visual Detailed Inspection (VDI)	<ul style="list-style-type: none"> • Visual inspection of all above-water components; • Review of previous RMI; • Specialized access equipment may be required to view girders, main structural members, tops of piers and abutment bearing seats; • Length of inspection = 2 hours to 2 days, depending on size of structure and access requirements.
Comprehensive Detailed Inspection (CDI)	<ul style="list-style-type: none"> • Visual inspections of all components, including underwater inspections if specified; • Specialized access equipment as required to provide access to all components; • Destructive testing as required, including: <ul style="list-style-type: none"> ○ Concrete and timber coring; ○ Asphalt and waterproofing sampling; ○ Half-cell corrosion potential survey; • Non-destructive testing as required, including: <ul style="list-style-type: none"> ○ Concrete cover meter survey; ○ Concrete and asphalt delamination survey; ○ Liquid penetrant, magnetic particle, ultrasonic testing; • Typically undertaken within 5 years of a planned major rehabilitation to determine in detail the condition of the structure; • On large highway structures, CDI can take up to one week to complete depending on the scope of testing required. On smaller bridges, such as Class A pedestrian bridges, the CDI could be completed in just over 2 hours.
Non-Routine Inspection	<ul style="list-style-type: none"> • Visual inspections due to the occurrence of a significant event such as: <ul style="list-style-type: none"> ○ Vehicle/vessel collision with structure; ○ Unusually high spring run-off; ○ Heavy rainfall event in the catchment area; ○ Prolonged periods of extreme temperature; ○ Fatigue prone and fatigue critical elements; ○ Sizeable earthquakes.
Emergency Inspection	<ul style="list-style-type: none"> • Inspection due to the failure of a structural component contributing to the overall stability of the structure; • Any situation that poses immediate danger to the public.

5.2 FREQUENCY OF INSPECTIONS

No inspection policy can completely remove the risk of bridge collapse or closure; however, regular inspections will help ensure that the potential for serious problems is minimized.

One of the key factors driving inspection policies in general is the availability of funds for inspections. Frequent CDI will decrease the potential for serious problems to go undetected, but are not usually feasible given the costs. It is generally accepted within the industry that by increasing the frequency of RMI and VDI, the rate of deterioration of a structure can be more accurately determined, and the frequency of the more expensive CDI can be decreased and/or the timing of inspections can be determined more accurately.

Lifecycle cost analyses generally indicate that it is less expensive over the lifetime of a structure to maintain the structure through regular maintenance and rehabilitation than to let the structure deteriorate and undertake fewer, more expensive rehabilitations. Accordingly, the frequency of inspections must ensure that structural defects are observed and reported in a timely manner such that the defect can be addressed before it becomes critical. In addition, timely inspections permit the development of a realistic model of the infrastructure such that the chance of unanticipated repairs for which funding may not be available is minimized.

The frequency of inspections for both vehicular and pedestrian bridges is summarized in Table 4, showing the maximum lengths between inspections. However, on new bridges, once an initial VDI has been done and the condition of a new bridge has been established, it is unlikely that a new bridge will require repeat detailed inspections for the first 10 years of service. In this case, the frequency of inspection may be decreased. Conversely, older bridges exhibiting severe defects in primary components may require detailed inspections at a greater frequency.

A decision to increase inspection frequency rests with the Field Unit Superintendent. Decisions to decrease the maximum frequency of inspections, as detailed in this Directive, is the responsibility of the Parks Canada Director, Real Property Services.

Table 4 – Frequency and Qualifications of Inspectors			
Category	Inspection Type	Inspection Frequency	Inspector Qualifications
Vehicular	RMI	Annual	Trained personnel directed and audited by an individual meeting 5.3.1. Audited by a Qualified Engineer during VDI
	VDI	Every 5 years	Qualified Engineer
	CDI*	As required, or within 5 years prior to a major rehabilitation	Qualified Engineer
Pedestrian Class A1	RMI	Annual	Trained personnel directed and audited by an individual meeting 5.3.1. Audited by a Qualified Engineer during VDI
	VDI	Every 5 years	Trained structural inspectors directed by a Qualified Engineer
	CDI*	As required	Qualified Engineer
Pedestrian Class A2	RMI	Every 2 years	Trained personnel directed and audited by an individual meeting 5.3.1. Audited by a Qualified Engineer during VDI
	VDI	Every 5 years	Trained structural inspectors directed by a Qualified Engineer
	CDI*	As required	Qualified Engineer
Pedestrian Class B	RMI	Every 3 to 5 years	Trained personnel directed and audited by an individual meeting 5.3.1.

* In years that a CDI is undertaken, a VDI is not required

5.3 QUALIFICATIONS OF INSPECTORS

Qualified personnel, as detailed in the subsections below, shall undertake inspections. In all cases, inspection personnel will have access to engineering advice as the need arises.

5.3.1 Routine Maintenance Inspections (RMI)

Certified personnel will perform all RMI inspections. The certification must be from either a Parks Canada certificate program for routine maintenance bridge inspections or an equivalent certified training program recognized by a province. Personnel directing and auditing RMI Inspectors shall be a Professional Engineer with Park Canada or shall have a minimum Asset Manager position of PM 6 or above.

5.3.2 Visual Detailed Inspections (VDI)

The qualifications to undertake VDI inspections, as detailed in Table 4 of Section 5.2.1 shall be:

- A Qualified Engineer; or
- Trained structural inspectors reporting to or under the supervision of a Qualified Engineer.

5.3.3 Comprehensive Detailed Inspections (CDI)

Qualifications for Engineers for CDI shall be defined in the Terms of Reference for the inspection at the time of tender.

In addition, Audits (see Section 5.5) of inspections by non-engineering personnel will be undertaken by Qualified Engineers to confirm the effectiveness and completeness of the inspections during subsequent VDI or CDI.

5.4 INSPECTION REPORTS

The proper documentation of the results of an inspection is as important as the inspection itself. Inspection reports provide the basis for all future inspection, maintenance and rehabilitation of a structure. Inspection records prepared in a clear, concise manner will ensure that the most appropriate type and frequency of future inspection is selected.

The inspection reports have been established such that the same format of report is required for both vehicular and pedestrian bridges. It should also be noted that the formats of the reports are not static, and will likely evolve with time to better suit the requirements of the different types of structures.

5.4.1 RMI Reports

RMI reports have been set up as “checklist” reports. The purpose of the inspection, and subsequently the report, is to confirm that there have been no major changes in the condition of the structure since the previous inspection. As such, the inspection report provides a checklist of items to be inspected as required and commented upon as required. Any work required shall be identified as preventive or corrective maintenance work.

Photographs are not required for RMI Reports unless notable defects are observed, or unless the inspector wishes to document and highlight the condition of a component for consultation with a Professional Engineer.

5.4.2 VDI Reports

The basic format of the VDI reports will be as shown in Bridge Inspection Forms of the PWGSC BIM - Appendix B. The identification of components to be inspected, the Condition Ratings, and the Priority Codes are all as specified in the BIM.

The recommendations section in the report will include recommendations for repairs, maintenance, and additional engineering investigations and testing, and shall include timelines for the recommended work. The report will also include a review of the inspection frequency and confirmation or proposed revision, as required.

The use of the BIM forms for material and condition ratings (MCR/PCR Forms) should be used at the discretion of the Field Unit. In most cases, these forms will not be necessary, as the item of critical importance in the VDI Report is the Priority Code. However, the BMI MCR/PCR Forms provide a detailed record of the deterioration of a component, and may be useful on larger structures.

For all work undertaken by external consulting firms, the final reports shall be signed and sealed by a Professional Engineer or Engineering firm registered or licensed in the province or territory where the bridge is located.

5.4.3 CDI Reports

In addition to the information included for VDI reports, CDI reports shall include the following:

- Recommendations and estimated costs for repair and maintenance including, in tabular form, a list of regular inspections and maintenance to be undertaken as part of the RMI; and
- Recommendations and estimated costs, in tabular form, for all rehabilitation work identified from the inspections. The priority of each project shall be qualified for category of project, degree of risk, and class of estimate according to “Capital, Remedial and Major Maintenance Projects”.

For all work undertaken by external consulting firms, the final reports will be signed and sealed by a Professional Engineer or Engineering firm registered or licensed in province or territory where the bridge is located, who has taken part in the actual inspection in the field.

5.5 AUDITS

Accuracy and consistency of the data collected during structure inspections is important since the inspection process is the foundation of the management of the structure. Information obtained during the inspection is used for determining needed maintenance and repairs; for prioritizing repairs, rehabilitations and improvements; for allocating resources; and for evaluating bridges. The accuracy and consistency of inspections is vital because it not only impacts funding appropriations, it also affects public safety. Further to Section 5.3, some of the inspection personnel may be non-engineering staff trained in the basics of structure inspection. For these reasons, a compliance audit review process of the RMIs will be done twice, first on completion of the RMI, secondly by a Qualified Engineer as the time of the VDI to ensure that inspections are being undertaken in accordance with the requirements of this Directive. Some of the items to be reviewed by the QA process are as follows:

- Ensuring that a bridge file has been established for each structure;
- Review of the general information in the bridge file to confirm the information is complete, accurate, and up-to-date;
- Confirmation of the classification of the structure. If the structure has been re-classified, downgraded or abandoned, confirm that the required documentation to support the reclassification is complete and accurate;
- Review of inspection reports to ensure completeness and accuracy of information in accordance with the requirements of this Directive, and to confirm that the recommendations for further inspections, maintenance, and rehabilitation work are in conformance with Parks Canada requirements; and
- Review of future inspection frequency for a structure based on the inspection results and recommendations. If the inspection frequency has been decreased, review documentation to support frequency revision to accuracy and completeness.

In the case of disagreement between the findings of the inspection and the Audit, an inspection may be required by a Qualified Engineer to confirm the results.

Subsequent Audits will review the recommendations of the previous audit and will ensure that the recommendations have been implemented to the satisfaction of the auditor.

- Table 4 identifies the audits that shall be undertaken on vehicular and Pedestrian bridges

Additional Audits of the process and compliance with this Directive shall be done on sampling basis by the Parks Canada Director, Real Property Services.

6.0 LOAD EVALUATION

A load evaluation is required for vehicle and Class A pedestrian bridges. Bridge evaluation involves not only the inspection of a bridge to assess its physical condition and functional capability, but also structural analysis and calculations to determine its load capacity and rating and to review overload permit applications. Prior to a structural evaluation, an inspection of the structure must be undertaken. The scope of the inspection must be sufficient to provide the data necessary for load capacity evaluation of primary members and connections in their deteriorated state. Measurements of section loss in members will be required to determine the actual section properties of members.

There are two major issues with respect to specifying requirements for load evaluation and rating of Parks Canada structures: the difference in legal loads between provinces; and the wide variation in the types and uses of structures within the Parks Canada infrastructure and the resultant loading on these structures. As such, a thorough knowledge of the structures and the actual loadings is critical.

The need for a load evaluation is based on the following:

- A minimum of one (1) load evaluation shall be undertaken on each bridge;
- Changes in the physical condition of bridge components as identified from the visual or comprehensive inspections;
- Prior to a major rehabilitation (such as deck replacement);
- Prior to a revision to structure articulation (removal of expansion joints and conversion to a semi-integral abutment structure, or introduction of flex-link slabs);
- The review of overload permits (vehicular bridges only);
- Revisions to the applicable design codes (e.g. CHBDC).

Evaluations of vehicular bridges, and load postings as required, will be undertaken in accordance with Chapter 14 of the CHBDC.

Evaluations of Class A pedestrian bridges will be in general conformance with Chapter 14 of the CHBDC, with live loadings as specified in Chapter 3 of the CHBDC, modified as required to suit local conditions.

Load evaluations shall be undertaken on vehicular bridge every 10 years. The requirements for load evaluations on Class A pedestrian bridges shall be reviewed on a bridge-by-bridge basis, and load evaluations undertaken as required.

7.0 INVENTORY AND DOCUMENTATION

Updated inventory and complete information, in a good useable form, is vital for structural evaluation, and for effective overall management of bridges. It is the responsibility of each Field Unit to maintain an updated inventory of the types and classifications of all vehicular and Class A bridges located within their Field Unit.

Parks Canada will maintain a complete, accurate and current record of each structure under its jurisdiction. The components of bridge records will include, but not be limited to, original drawings, shop drawings, as-constructed drawings, specifications, correspondence, photographs, material certification/test data, maintenance and repair history, accident history, posting actions, permit loads, flood data, traffic data, inspection history, inspection requirements, and rating records. This information will cover the bridge, and all utilities, communication systems and other appurtenances supported or on the bridge. In cases where there are no existing drawings for a structure, it will be the responsibility of the Field Unit to obtain measurements in sufficient detail to permit inspection and evaluation of a structure.

The National inventory of all vehicular, Class A and Class B bridges with a replacement value over \$10k shall be entered into the Realty Property Management System, will include, but not be limited to:

- Bridge name;
- Bridge location;
- Road Category
- Asset number;
- Date of construction;
- Bridge type;
- Overall dimensions of bridge;
- Current Replacement value
- Last inspection and type of inspection; and
- Current rating

APPENDIX A

DESIGN CONSIDERATIONS

For Vehicle and Class A Pedestrian Bridges

A1 DESIGN GUIDELINES AND CONSTRAINTS

The following is a discussion of some of “context sensitive” issues to be considered during design.

A1.1 Structure Configuration

For most short and medium span bridges, the use of single load path structures (trusses and cable bridges) is discouraged by most bridge owners and design engineers, as structures with built-in redundancy (such as slab-on-girder bridges) provide a greater degree of safety. However, cable bridges are used in national parks to improve the visitor experience. In cases such as these, the design of single load path structures may be preferable within the context of a given park.

Access to the site, available space, and constructability may also influence the type and configuration of structure. Timber and steel components are often more easily transported to remote locations than pre-cast concrete components.

A1.2 Culverts

The designer shall investigate the use of large culverts in place of standard structures. Large culverts are typically used over watercourses, but can also be used for pedestrians and smaller service vehicles. Some of the advantages of using large culverts in place of bridges are as follows:

- Lower initial construction costs;
- Elimination of long term maintenance and deterioration associated with decks;
- Increased safety (no bridge deck icing);
- Reduced visual impact:
 - Vegetated slopes cover most of the visible components;
 - Elimination of the visual delineation of bridge limits by continuation of the approach guiderail across the top of culvert.

Many of the large culvert systems are proprietary, and manufacturers have standard span/load tables, which assist designers in approximating culvert dimensions prior to detailed design. In addition, manufacturers will supply design software and/or complete the design in-house for a client. This significantly reduces design time and costs.

Proprietary large culverts systems are segmental, and can be lengthened as required in the future with minimal additional design. This would result in additional cost savings over the use of standard bridges.

However, culverts can have greater impacts on fisheries and the environment. The designer shall consider the impacts when selecting a structure configuration.

A1.3 Aesthetics

Similarly, truss bridges (primarily wood trusses) can enhance the aesthetics of a setting or road through a park and are preferable to standard, more economical structure forms.

Most bridge design codes have minimum freeboard requirements for structures to avoid washout during exceptional floods and damage due to ice (the CHBDC specifies a minimum freeboard of 0.3 m above high water level and 1.0 m above normal water level). On watercourses where water levels are controlled (such as canals) or where water levels historically do not fluctuate significantly between high and low periods, a reduction in freeboard may lessen the visual impact of a structure on the surrounding environment. Reduction in freeboard requirements shall only be made with the approval of the Parks Canada Director, Real Property Services.

The designer will ensure that the reduced freeboard meets the requirements of the CHBDC and the Navigable Waters Protection Act.

A1.4 Durability and Materials

The CHBDC specifies a design service life of 75 years for new structures. With materials such as reinforced concrete and structural steel, and with timely maintenance and rehabilitation, the service life can be easily achieved. The use of less durable materials such as timber (deck wearing surfaces and superstructures, timber cribs, bridge railing systems) and steel or synthetic mesh gabions (retained earth structures, abutments) may be more applicable in remote settings. The designer shall evaluate the appearance of the structure against the reduced durability to determine which materials are most appropriate.

A1.5 Heritage/Cultural Assets

Many of Parks Canada's assets have historical and cultural significance. This may necessitate design using non-standard materials such as masonry and hydraulic lime mortars. The rehabilitation of existing structures may require the use of design parameters that do not meet current code requirements to ensure compatibility with the surroundings (many of the entrance bridges to historic structures and swing bridges over canals do not meet CHBDC requirements for lane widths). All design shall be in general conformance with the Parks Canada document "*The Standards and Guidelines for the Conservation of Historic Places in Canada*".

A1.6 Bridge Barrier Systems

Similar to the above design constraints, bridge barrier systems (vehicular and pedestrian barriers and railings) must be “context sensitive”. Elaborate railing systems on backcountry Class A2 pedestrian bridges may not be necessary, and will detract from the visitor experience.

Conversely, railing systems that have functioned effectively to date may no longer be adequate for current or future uses of a structure. The increase in popularity of mountain biking trails may require higher railings on structures to meet the safety requirements for cyclists.

Some of the factors to be considered by the designer when reviewing the requirements for the rehabilitation of a bridge barrier system shall include, but not be limited to, the following:

- The current and future requirements of the railing system with respect to type and magnitude of loading;
- Costs associated with rehabilitation;
- Collision history;
- Risk associated with maintaining an existing substandard bridge barrier system.

Similar to bridge barrier systems, many of the approach safety systems (steel and box beam guiderail, cable guiderail, guiderail connections to structures, etc) are no longer in conformance with current safety practices/standards/guidelines due to revisions to the standards/guidelines but may be functioning effectively. Factors used to determine the timing and scope of rehabilitation of bridge barrier systems shall also be applied to approach safety systems.

A2 LOADS

A2.1 Vehicular Loads

Non-standard loading conditions may arise:

- On interprovincial bridges where adjacent provinces use different standard live loadings;
- On bridges that frequently see permit or non-standard loads such as logging trucks;
- Rehabilitation of load-posted structures;
- On park roads that are not accessible to the public and that are used for maintenance and emergency vehicles only, access roads to day use facilities, and special attraction roads. Structures on these roads may not require design for unrestricted highway loading (however, it should be

noted that if these bridges are used for fire routes, a fully loaded pump truck has axle loads similar to full CHBDC truck loading).

A2.2 Pedestrian Loads

Some examples of exceptions to the CHBDC are as follows:

- Snow loading, particularly on mountain trails, may exceed the ice accretion loads specified in the CHBDC and may be the governing load condition;
- The CHBDC provides guidance towards minimizing aeroelastic instability (wind sway) due to wind loads, which results in stiff or rigid superstructures. On cable stayed pedestrian bridges, these restrictions may be less stringent, based on location and usage of the bridge;
- Pedestrian loads, as specified in the CHBDC, vary between 1.6 kPa and 4.0 kPa. On backcountry bridges, this loading may be in excess of actual loading conditions;
- Similarly, railing loadings on Class A2 pedestrian bridges may be significantly less than those specified in the CHBDC.

APPENDIX B

CONSTRUCTION CONSIDERATIONS

B1 CONSTRUCTION GUIDELINES AND CONSTRAINTS

Scheduling of the work will be given careful consideration. Construction in off peak seasons, at night, or on weekends will minimize the disturbance to persons using the facility. The impacts of construction must be balanced against the increase in costs associated with these construction periods.

The construction of the majority of Parks Canada vehicular bridges will not differ significantly from that of other public bridge owners. Construction of pedestrian bridges, especially those in more remote locations, will have constraints unique to the surroundings.

Methods of construction will require careful planning. The use of heavy construction equipment can result in significant damage to the environment surrounding the structure, which may require extensive site remediation. The use of smaller equipment and/or increased manual labour may be preferable, despite the potential for increased construction costs and longer durations of construction.

The locations of staging areas will also be investigated prior to the start of construction. Storing equipment and materials away from structures during non-working hours on structures with high visibility will lessen the impact of construction.

The use of context specific construction materials on historic structures, as identified during the detailed design, must be ensured.

Traffic staging of both vehicular and pedestrian traffic during construction must be considered. If traffic volumes are low, closure of the bridge to the public during off-peak hours and overnight will decrease construction durations.