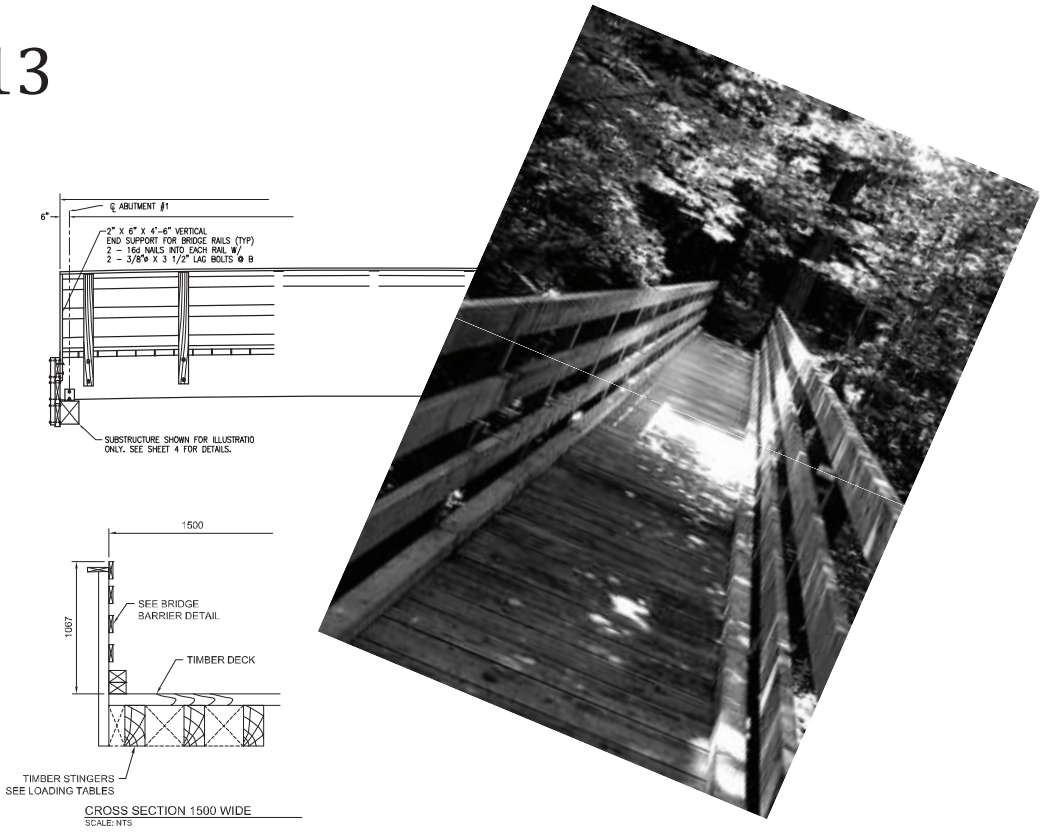
# Standards and Guidelines for the Construction of OHV Trail Bridges on Crown land

2013






NOVA SCOTIA

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# 1.0 INTRODUCTION

The Nova Scotia Department of Natural Resources has a long history of granting access to Crown lands to various groups for the purpose of recreational use. The majority of recreational use of Crown lands is in the form of trails. Often, trails will encounter a waterway which requires crossing. A culvert or bridge is installed to cross the waterway so that the waterway will not be negatively impacted. The Department of Health and Wellness and the Department of Natural Resources through the services of a professional engineer have established a set of standards for the design and construction of trail bridges on Crown land.

This document provides the standards for the design and construction of the superstructure of single span trail bridges up to 15.25 m (50 ft.) in length to be erected on Crown lands in the province of Nova Scotia. Bridges on forest access or public roadways are beyond the scope of this document. While some guidance will be provided in construction techniques for supporting structures, their selection and final construction is on a case-by-case basis to be approved by DNR staff or supervising engineer.

A set of engineered drawings and tables based on these standards are provided for the convenience of those wishing to build a trail bridge on Crown land. Due to the variable nature of individual site conditions (topography, soil conditions, stream flow, etc.) and the intended use of the bridge structure, this manual is **NOT** to be used as the sole document for the design and construction of a bridge structure, but as a reference document only.

This manual deals with the bridge superstructure only. There are many other aspects of the bridge construction project which require addressing. This includes, but may not be limited to, appropriately determining the bridge span for individual sites, determining the required area under the bridge to accommodate stream flow, bridge foundations, regulatory approvals, etc.

Disclaimer: This document is subject to review. Users are to check with DNR to determine if updates or revisions are available.

## **2.0** DEFINITIONS

For the purposes of the document the following definitions are to be employed.

**Abutment** – A substructure that supports the ends of a bridge. Such as a retaining structure wall or crib work .

**Active Surface** - The portion of the deck surface between the inside faces of the curbs or railings, on which traffic is in direct contact.

**Approach –** The area of trail surface immediately preceding bridge deck that provides a transition from the trail to the bridge.

**Approach Flairs** - Structures erected at the outside edge of the bridge approaches to provide guidance on the structure and define or separate a hazard from the trail user.

**Bearing –** Component of bridge used to transfer load from the bridge superstructure to substructure.

**Curbs** – Horizontal component of the bridge intended to delineate structure at the edge of the active surface constructed to deflect wheeled traffic away from the side edge of the bridge structure.

**Deck** - The flat horizontal platform which accommodates the active or travelled surface of the bridge. It usually consists of timber, concrete or metal spanning perpendicular to and connected to supporting longitudinal beams, trusses or girders.

**Dimensions**

- **Length (Overall/Total)** - The longitudinal distance from one end of the bridge to the other measured along the decking in the direction of the traffic flow.
- **Width (Overall)** - The distance measured perpendicular to the travel direction laterally across the bridge the between the outside edges of the deck.
- **Active Width** - The distance measured perpendicular to the travel direction between the inside of the railings or to the inside of the curbs, whichever is lesser.
- **Height –** the greatest perpendicular distance measured from the top of the deck to the streambed directly below the structure.

**Drag** - A sledge like attachment comprised of a weighted frame, blades and pan pulled by a groomer to even out the active surface of a trail.

**Fill** - Earth, stone or other material used to raise the ground level, form an embankment or contained within fill the inside of an abutment a crib.

**Gabion** - A galvanized wire box filled with stone used to form an abutment or retaining wall structure.

**Groomer** - A wheeled or tracked machine used to prepare the trail surface for recreational riding. It includes the tractor, operator, blade, and permanently affixed devices. It does not include a towed, self-powered or independently supported implement.

**Ballast Wall/Headwall** – The upper portion of an abutment above the bearings used to retain approach fill behind and beside the abutment. The device placed at the end of a bridge that comprises a large portion of the abutment. Headwalls are used to retain the road formation soil around and above the abutments and prevent erosion at the abutment.

**Load -** A force, deformation or volumetric change that is imposed externally on or internally within a structure. Several types of loads must be considered in bridge design and construction.

- **Dead Load -** The static load imposed by the weight of materials that make up the components of the bridge structure itself.
- **Live Load -** A load imposed by vehicles, pedestrian, equestrians, all-terrain vehicles (ATV), snowmobiles, equipment or components that are subject to movement.
- **Snow Load -** Part of the Live load attributed to a portion of the ground snow load for the bridge location region as recognized under the National Building Code of Canada.
- **Posted Load –** maximum live load allowed on the bridge. Either the designed live load or less as determined by the most recent bridge assessment or evaluation.
- **Vehicular Load -** Vehicular traffic, external factors. Live load associated with the maximum load for the vehicle intended to be used on the bridge. The minimum vehicular load for trail bridges is shown in Section 3.2 of this document.

**Pier** – A substructure located between abutments used to transfer superstructure loads from the spans it supports to the foundation.

**Project Supervisor –** Person responsible for the overall supervision of the project to ensure construction is carried out in accordance with the plans provided and meets the safety requirements as set by the Province of Nova Scotia. This individual may be the Supervising Engineer.

**Railings -** A fence-like horizontal bar(s) running at the outer edge of the active surface for the length of the structure. Usually consists of timber or metal fastened to supporting posts affixed to the deck or longitudinal beams. It is not intended to serve as a barrier to resist lateral loads imposed by vehicular live loads.

**Rip Rap** - Gabions, stones, blocks of concrete or other protective covering material of like nature deposited upon river and stream banks, lake, tidal or other shores to prevent erosion and scour by water flow or wave action.

**Sacrificial (Wear) Surface** - A surface layer placed over the structural deck of the bridge between the curbs to protect the deck from traffic wear.

**Span** - The horizontal distance between two supports of a structure.

- **Clear span** - The horizontal distance between the inside faces of vertical supports.
- **Effective span** -The center to center distance between the bearing points of two supports.

**Stringer** - A beam aligned with the length of a span which supports the deck.

**Substructure** - Components that support the superstructure and may consist of the abutments, piers, footings, pilings, sills and blocking.

**Superstructure** - Components that actually span the obstacle the bridge is intended to cross. It includes bridge deck, structural members, stringers, railings, and other features supported by the structural members above the underside of beams or girders.

**Supervising Engineer –** A qualified professional engineer retained by trail groups to oversee and provide direction in the installation and construction of a bridge to be constructed on Crown land. This individual is to:

- Be a member in good standing with the Association of Professional Engineers of Nova Scotia (APENS) or a member in good standing with a professional association recognized by APENS.
- Have demonstrated experience in the design of bridge structures in accordance with application of the Canadian Highway Bridge Design Code, CSA-S6.
- Provide proof of professional insurance coverage for errors or omissions for a minimum of $2,000,000.

# 3.0 BRIDGE CONSTRUCTON

## 3.1 PERMISSION /APPROVALS

This document will form the basis for the superstructure design of all trail bridges to be constructed on Crown lands in the province of Nova Scotia. Anyone wishing to build a bridge on Crown land is to submit their design proposal to the DNR Area Supervisor for approval. No work is to begin without expressed approval from DNR Area Supervisor.

A number of regulatory approvals are required prior to beginning the construction of bridges or other water crossing structures. These approvals include but may not be limited to:

- Department of Natural Resources
- Nova Scotia Environment
- Transport Canada (Navigable Waters Protection Act)
- Fisheries and Oceans Canada

Before construction begins, relevant permits (e.g. - NSE required Watercourse Alternation Notification or Permit) must be obtained. The dimensions of the structure and the resulting opening below the structure (width and height) are to be determined by either a Certified Watercourse Alteration Installer or by other qualified professionals acceptable to Nova Scotia Environment. If the person is not certified or the work is to be done outside the approved period, then an additional application and permit may be required.

## 3.2 SUPERVISION

Prior to beginning construction, the proponent trail group is to appoint a competent Project Supervisor with the skills necessary to manage the bridge construction. This person is responsible for the overall supervision of the project to ensure construction is carried out in accordance with the plans provided and that work site safety meets the requirements of the Occupational Health & Safety Act and regulations as set by the Province of Nova Scotia. During construction, there must be a competent person on site with the necessary skills and knowledge to construct and oversee the construction of the bridge as well as be knowledgeable of the Occupational Health & Safety Act and regulations.

## 3.2 DESIGN STANDARD

The Canadian Highway Bridge Design Code, CSA-S6, was used as the basis for preparing this manual and is to be used as a basis for the construction of trail bridges on Crown land. Loading conditions covered under this manual deal with vertical loads from pedestrians, equestrians or motorized vehicles described below. Lateral loads on the bridge railing structures is beyond the scope of this manual as full scale crash testing of railing systems are required for conformance to the Canadian Highway Bridge Design Code.

The design of the superstructure of all trail bridges to be built on Crown lands shall conform to:

(i) the pre-approved drawings included in this document, or

(ii) a suitable alternative design completed by a qualified professional engineer licensed to practice engineering in the Province of Nova Scotia, which is to be submitted, to and approved by, DNR Area Supervisor prior to start of construction.

It is important that the quality of workmanship used to construct trail bridges must be in accordance with the drawings.

For instances where a trail group wishes to use designs other than the pre-approved designs, or to construct multi-span bridges or structures greater than 15.2 m (50 ft.) in length they will have to submit stamped design drawings, covering all bridge components, to DNR Area Supervisor for approval. Prior to opening the bridge for use the group will be required to have the design engineer inspect the completed bridge and submit a letter to DNR stating bridge conforms to the DNR approved design.

### 3.2.1 Substructures

The design and construction of the supporting substructure and approaches are beyond the scope of and intent of this document. Substructures are determined on a case by case basis and must be installed under the supervision of the CWA Installer or a qualified professional and some instances may require an engineer to design the structure for DNR or NSE approval. Generally speaking, where the decking of structure will be resting less than 1.2 m above the streambed and resting on stable substructure of either pressure-treated wood sills, timber crib work or, a single tier of pre-cast concrete an engineered design **may not** be required.

All substructure designs are to be approved by the qualified installer and DNR prior to beginning construction of the bridge superstructure. During construction any modifications or alterations to the bridge or its substructures outside the scope of the pre-approved designs must be approved by the Department of Natural Resources before construct can continue. The group must submit “as-built” drawings to the DNR Area Supervisor before the finished structure is open for public use.

### 3.2 .2 Small Bridges (span < 4.8 m and < 1.2 m, and above stream bed)

A supervising or design engineer is not required for the construction of bridges in this category if built from one of the pre-approved designs. Modifications or alterations to the bridge outside the scope of the pre-approved drawings must be submitted to DNR for approval. Construction is not to begin until the structures design has been approved by the certified WA installer and DNR staff. Upon completion and before opened for public use, the bridge is to be inspected by DNR staff to verify it has been built in accordance with the approved “as built” plans and specifications.

### 3.2.3 Larger Bridges ( span $\geq$ 4.8 m or any bridge more than 1.2 m above the stream bed)

Prior to construction of bridges greater than 4.8m (16ft) in span, trail groups who use the DNR pre-approved designs, may be required to engage the services an engineer to design bridge foundations, i.e. abutments, crib work etc. Trail groups shall contact the local office of DNR who will determine whether supplementary design drawings will be required for the bridge foundations.

Field changes or improvements to the specifications provided in the original drawings or plans approved by the Department of Natural Resources are to be endorsed by an engineer with relevant experience in the design and construction of bridge structures. Any changes made during construction are to be recorded on the plans and are to be labeled as “As-Built” Drawings.

Upon completion of the bridge, the Supervising (design) Engineer is to review the completed project. The Supervising (design) Engineer is to provide written confirmation that the bridge has been constructed in accordance with the plans and specifications. The group responsible for the bridge construction is to forward a copy of the engineer’s letter and “As-Built” Drawings, if applicable, to the Department of Natural Resources. The Department is to approve the submitted drawings **prior to** using or opening the bridge for public use.

## 3.3 DRAWING STANDARDS

Any bridge structure proposed for construction on Crown lands requires the submittal of the following information for review by the Department of Natural Resources: (See Appendix 1 for details)

- Name and location of water crossing or road system crossing.
- Plan of the bridge to scale with adequate dimensions.
- Cross section of the bridge to scale with adequate dimensions.
- Bearing details if required.
- Typical connection details as appropriate.
- Loading used for design of the bridge.
- Foundation details.
- Deck details.
- Sacrificial wear surface details (Optional).
- Railing details.
- Approach railing details.

Alternate solutions may be provided to the Department of Natural Resources for consideration. These solutions shall be submitted to the Department of Natural Resources in a detailed drawing format meeting the requirements of the section above and prepared by a professional engineer registered in the Province of Nova Scotia. All designs must be in accordance with the latest edition of CSA-S6, Canadian Highway Bridge Design Code. The Department of Natural Resources reserves the right to accept or reject any alternate solution for a bridge structure.

# 4.0 BRIDGE DESIGN LOADING

Design loading for off highway vehicle trail bridges is separated into two broad categories: those subjected to snow mobile groomers and those not subjected to groomers. The loading associated with the weight of a groomer is different than the loading of pedestrians, snowmobiles or all-terrain vehicles. Another category of loading consideration is maintenance vehicles.

The loading associated with each category is the minimum loading required by the Nova Scotia Department of Natural Resources. It is the responsibility of the individual groups to determine the intended use of the structure and select the design loading accordingly. The design loading on some structures may be greater than the categories in this standard.

Examples of this loading include: heavy equipment, loaded dump truck, emergency vehicles, etc. in which case a professional engineer is to be consulted.

## 4.1 BRIDGES WITHOUT GROOMER LOADING

Loading on bridges which will not be used by groomers may include:

- Pedestrian
- Equestrian
- All-Terrain (ATVs)
- Snowmobile

Pedestrian, equestrian, or all-terrain vehicle load cases may be expected at any time of the year, therefore snow on these bridges may or may not be present during its use. The snowmobile load case requires snow for the loading condition to exist. Even though some trails may be designed and constructed for summer use only, future changes within a particular trail organization may see the trail used year round thereby exposing it to an increased loading of snow.

All bridges must be designed with snow loading in combination with an individual principal load. For bridges with groomers, the snow load shall be 50% of the ground snow load for the region as found in the latest edition of the National Building Code of Canada. For bridges without groomers, the snow load shall be 75% of the ground snow load for the region as found in the latest edition of the National Building Code of Canada.

Because trail uses change, the design of a bridge in accordance with this manual shall be the greatest load effect of either, pedestrian, equestrian, all-terrain vehicle or snowmobile loading in combination with snow loading.

Bridges within this manual have been designed for the greatest load effect of either, pedestrian, equestrian, all-terrain vehicle or snowmobile loading in combination with snow loading.

## 4.2 BRIDGES WITH GROOMER LOADING

At the time of preparing this manual, many differing groomers are in use on trail bridges in the province of Nova Scotia. Each of these groomers has different geometric configurations and weights. Many of the groomers are conventional farm tractors with the wheels replaced with a track system.

To properly prepare a standard, a design groomer must be established for use on all bridges. Even though some trail bridges use small groomers, there may be a need to upgrade at some time in the future.

The design groomer for this manual is a John Deere 7430 Premium Cab Tractor with a gross weight of 6,620 kg (15,600 lb). The distribution of the axle loads are shown below in Figure 1.

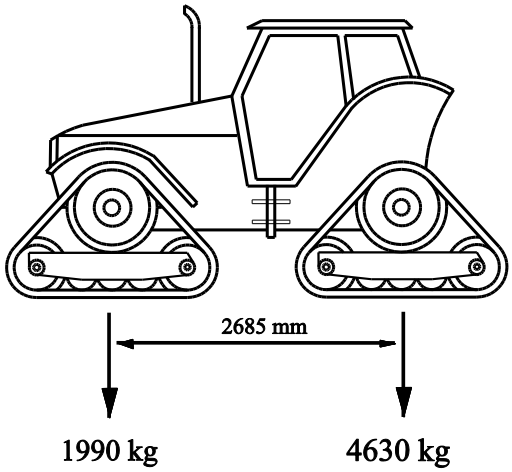


Figure 1 – Design Groomer Axle Load

The effects of vehicular impact are to be taken into consideration on bridge structures. An impact factor of 0.30 for two axle loads is to be used. All bridges with groomers must be designed with snow loading in combination with the groomer load. The snow load shall be 50% of the ground snow load for the region as found in the latest edition of the National Building Code of Canada.

## 4.3 MAINTENANCE VEHICLES

Maintenance vehicles can be many variations of weight and dimensions. Each trail group has access to different maintenance equipment. This along with the many possible different groomer types makes it very difficult to establish a standard maintenance vehicle.

Based on this, maintenance vehicles are permitted to use the bridges designed to this standard. The gross vehicle weight and maximum axle load of the maintenance vehicle must not exceed that of the Design Groomer Axle Load shown in Figure 1. The axle spacing must not be closer than that of the Design Groomer Load. Any other maintenance vehicle is not permitted on the bridge unless a written report can be provided by a professional engineer registered in Nova Scotia stating that the bridge can safely carry the load of the maintenance vehicle in question.

## 4.4 OTHER LOADING

Trail bridges with loading different from those discussed above or groomer loads greater than the Design Groomer Load are not included in this manual. Bridges with different load types or groomer loads greater than the Design Groomer Load are to be designed by a professional engineer registered in the Province of Nova Scotia and submitted to the Department of Natural Resources for review.

# 5.0 BRIDGE WIDTHS

Differing trail groups have different requirements for width of a bridge. Bridge width is defined as the horizontal distance between the inside face of the railings, or in the absence or railings the horizontal distance between the inside face of the curbs, or whichever measurement is less. Bridges on pedestrian (i.e. hiking), and off-road motorcycle trails (single track) shall be 900 mm or greater. Other trail bridges where off highway vehicles will be used must be a minimum of 1500 m wide curb to curb.

To standardize bridges constructed on Crown lands, OHV trail bridges (double track) widths must be one of the following:

- 1.5 m wide
- 2.4 m wide
- 3.0 m wide
- 3.6 m wide

Bridges to be wider than 3.6 m or not conforming to the design drawings provided by DNR (DHW) must be pre-approved by DNR and designed by a qualified engineer at the proponent's expense. OHV trail bridges with a travel surface narrower than 1.5 m will not be permitted.

# 6.0 CONSTRUCTION MATERIALS

New standards have been put in place for the pressure treated materials required for structural components of trail bridges. This material may not be readily available from retail outlets and have to be ordered from appropriate sources. All timber used in the construction of bridges on Crown lands shall conform to the following specifications:

## 6.1 TIMBER

All timber used in the construction of bridges on Crown lands shall conform to the following specifications:

- Timber framing for stringers, deck and wearing surface shall be No. 1 grade Spruce Pine Fir or better in accordance with CSA-O86.
- Timber framing for railing system shall be No. 1 grade Spruce Pine Fir or better in accordance with CSA-O86.
- All timber except wearing surface shall be preservative treated in accordance with the use categories set out in CSA-O80.1, Specification of Treated Wood:

| Component | Exposure |
|---|---|
| Stringers | Ground Contact |
| Decking | Above Ground |
| Rail system | Above Ground |
| Sill foundation | Ground Contact |
| Crib foundation, no groundwater contact | Ground Contact |
| Crib foundation, fresh water contact | Freshwater |
| Crib foundation, brackish or salt water contact | Marine |

- Timber for wearing surface does not require preservative treatment.
- Pre-drill all bolt and lag bolt holes prior to installing bolts.
- Boreholes for machine bolts to be same diameter as bolts.
- Boreholes for the lag bolts are to be same diameter as shank for unthreaded portion and 0.70 times the shank diameter for the threaded portion.
- Threaded portion of lag bolts will be installed using a wrench, not by driving.
- Timber will be protected during handling, shipping, offloading and field handling by use of suitable equipment and procedures. Use rope or fabric strap slings for moving bundles or individual timbers, rather than metal grabs, chains or cables.
- Treat in field spike holes, boreholes, plugged holes, cuts and any damage to treated material using an approved waterborne preservative. Fill all unused bored holes and any other holes with tight fitting treated wooden plugs prior to any exposure to water.
- Ensure no spillage or excess application of field preservative. Workers to have sufficient training and protective gear to properly and safely handle the treated materials and to apply field treatment so as to prevent undue hazard to themselves, others or the environment.

## 6.2 HARDWARE

All hardware used in the construction of bridges on Crown lands shall conform to the following specifications:

- Machine bolts, lag bolts, nuts and round plate washers to ASTM A307.
- Spikes to CSA B111.
- All hardware will be galvanized.
- Hot dip galvanized hardware, bolts, nuts, washers and spikes to CSA G164, minimum coating of 600 g/m2.

## 6.3 STRUCTURAL STEEL

All structural steel used in the construction of bridges on Crown lands shall conform to the following specifications:

- Material, drawings, fabrication, workmanship and erection of structural steel work shall conform to the requirements of CSA-S16.1, CSA S37 and all subsequent revisions.
- All structural steel material including rolled sections and plates shall be conform to the requirements of CAN/CSA-G40.20/G40.21 grade 350W.
- All holes in structural steel shall be drilled.
- Structural steel sections shall be precision cut.
- No cutting or creation of holes in structural steel using a torch is permitted.
- No holes shall be cut in structural members without the consent of the engineer.
- Structural steel shop drawings shall be stamped by a Professional Engineer registered to practice in the Province of Nova Scotia, who will be responsible for the design of connections.
- Hot-dip galvanize all components in accordance with CSA G164 after fabrication and prior to assembly.
- All welding shall conform to the requirements of CSA W59 Welded Steel Construction with all subsequent revisions.
- Welding contractor shall be certified under the requirements of CSA W47.1 and by the Canadian Welding Bureau (CWB).
- Welding electrodes shall conform to the requirements of CSA W48.1.
- All welds shall be in accordance with procedures approved by the CWB.

All structural steel components are to either be hot dip galvanized to 600 g/m2 or be painted with a three coat system to include one prime coat and two top coats. In locations along or close to the coast, the coating process will have to be upgraded to withstand the harsher environment.

# 7.0 BRIDGE CONSTRUCTION

## 7.1 DECKING AND SACRIFICIAL SURFACES - GENERAL

Decking is to be placed perpendicular to the direction of travel. In the absence of a permanent wear surface there shall be no gap between individual deck planking members. In the presence of a permanent wear surface the maximum gap permitted between deck planking is 20 mm. Sacrificial wear surfaces are strongly recommended optional features applied over the decking. However there are maintenance issues as well as safety concerns when sacrificial wear surfaces are used on multi-use trail bridges.

## 7.2 DECKING AND SACRIFICIAL SURFACES – MULTI-USE TRAIL BRIDGES **(INCLUDING MOTORIZED USE)**

The wear surface can be placed parallel to or at 45-degree angle to the direction of travel. To offer safety for cyclists, sacrificial wear surfaces on multi-use trail bridges are to be full width to within 300 mm of the curbing or rail, full length (abutment to abutment) and to be constructed with materials that would ensure an even surface throughout. The lumber must be planed and fastened with spiral nails or screws or equivalent and without gaps. Steel plate or rubber matting may also be approved. Leading edges to be beveled back or bull nosed to minimize tripping or tear out.

## 7.3 DECKING AND SACRIFICIAL SURFACES – OHV TRAIL BRIDGES (NON-MULIT-USE)

Sacrificial wear surfaces are strongly recommended. The sacrificial wear surface is to run uninterrupted the full length of structure and placed coincide with the vehicle contact surfaces. These strips should be no less than 50 cm wide. On bridges greater than 3.5 m wide there may be two or more strips to accommodate two-way traffic. On OHV trail bridges less than 3.5 m wide, there can be one wear surface centered between the curbs. The sacrificial strips are to be made of dressed lumber securely fastened with spiral nails, screws or equivalent and with gaps less than 10 mm, steel plate or rubber matting may also be approved. Leading edges are to be beveled back or bull-nosed to minimize tripping or tear out.

## 7.4 BRIDGE BARRIERS (RAILS)

On multi-use and pedestrian trail bridges barriers (rails) shall be placed on both sides of all bridges where the deck is more than 600mm above the ground or streambed at any location along the span. The minimum barrier height shall be 1.37 m. The height of the barrier is the vertical distance from the top of the barrier to the top of the sacrificial surface. If a sacrificial surface is not present, the vertical distance shall be measured to the top of the deck.

Openings in multi-use barriers shall not exceed 150mm in the least direction of shall be covered with chain link mesh. Openings in chain link mesh shall not be larger than 50 x 50mm. The wires making up the mesh shall have a minimum diameter of 3.5mm.

All other trail bridges are to be assessed on a case-by-case basis to determine the need and extent of barriers or rails to be erected. Conditions for application will be based upon the height of the active

surface or deck of the bridge above the surface of the ground or streambed below the structure, and the nature of the activity below the structure i.e., roadway. It is recommended that all bridges 600 mm or more above the ground or stream bed have railings installed.

All trail bridges without rails are to have a curb or bumper running both sides for the entire length of the bridge. The bumper is to be a minimum of 150 mm high and 150 mm wide. The leading ends of the curb are to be bull-nosed or beveled vertically.

All trail bridges are to have the corners of the travel surface delineated by reflective markers 1.3 m above the active surface. The markers are mounted on the ends of the railings or on substantial posts directly adjacent to or affixed to the structure.

## 7.5 APPROACH RAILS (FLAIRS)

Approach flairs are intended to provide a visual transition and visual warning of a potential hazard prior to crossing a bridge. Approach flairs are not intended to be crash barriers. The application of bridge approach flairs is to be assessed on a case-by-case basis to determine the need and extent of flairs to be erected. Conditions for application will be based upon the degree of slope or embankment, height of trail surface above the surface of the ground or water below the structure, the depth and flow of water below the structure, and the nature of the activity below the structure, i.e. roadway. Approach flairs will be designed and constructed to same standards as the bridge rails.

Approach flares shall be constructed with safe transitions to the bridge barrier. The approach flairs must be flush with the bridge railing to provide an even transition between the approach to the bridge and the bridge itself. As a minimum, the last two posts of each flair must be marked with reflective chevrons approved by the Department of Natural Resources.

Posts used in construction of approach flairs shall be a minimum 150 mm x 150 mm embedded to a minimum depth of 1040 mm. Material used for backfill must be compacted.

Where soil conditions warrant, posts shall be braced and anchored to provide adequate support. Maximum deflection of the flair from the direction of travel shall not exceed 15°.

The last post on the trail end of the flair shall be installed 450mm outside the active surface of the trail and marked with a reflective chevrons approved by the Department of Natural Resources.

# 8.0 ENVIRONMENTAL PROTECTION

The Department of Natural Resources is committed to the protection of the environment. During bridge construction activities, the work must be performed is such a way as to minimize the effects on the environment. The following must be included in the bridge construction project:

- Ensure that all members of the construction project are committed to minimize environmental impacts.
- Stabilize all disturbed areas by means appropriate for slope condition. This will include seeding and/or sodding and/or mulching, and /or rip rap.
- Document environmental concerns and appropriate protection measures taken.
- Hazardous materials will be used only by personnel who are trained and qualified in the handling of these materials and only in accordance with the manufacturer's instructions and government regulations.
- All hazardous materials, when required, will be removed and disposed of in an acceptable manner in accordance with government regulation and requirements.
- All waste material generated will be disposed of in accordance with all applicable provincial regulations. Do not bury or burn waste on site.
- Control disposal or run-off of water containing suspended materials or other harmful substances in accordance with provincial regulations.
- Do not dump excavated fill, waste material or debris in waterways.

# 9.0 ONGOING MAINTENANCE AND INSPECTIONS

Bridges are used by the public and it is implied that these bridges are safe for public use not only immediately after construction, but years after construction is completed. Inspection schedule of trail bridges by the group, Department of Natural Resources staff and a qualified engineer will be established as part of the operating group's Letter of Authority.

Inspections by appropriately trained group staff are to occur twice annually and after major events that may possibly cause damage to the bridge. The purpose of these inspections is to detect significant changes in the structure resulting in the need for further evaluation by a qualified professional engineer. A detailed checklist for inspection schedules will be developed by the Department of Natural Resources in the future.

Beginning five years after construction, or earlier if structural damage has been detected, inspections must be done by an engineer registered in the province of Nova Scotia who has experience in the design, construction and inspection of bridge structures. Any areas of concern found during the inspection are to be forwarded in writing to the trail group. The trail group is to implement repairs as directed by the engineer.