Section 6

Abandoned Rail Bridges

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Abandoned Rail Bridges 6

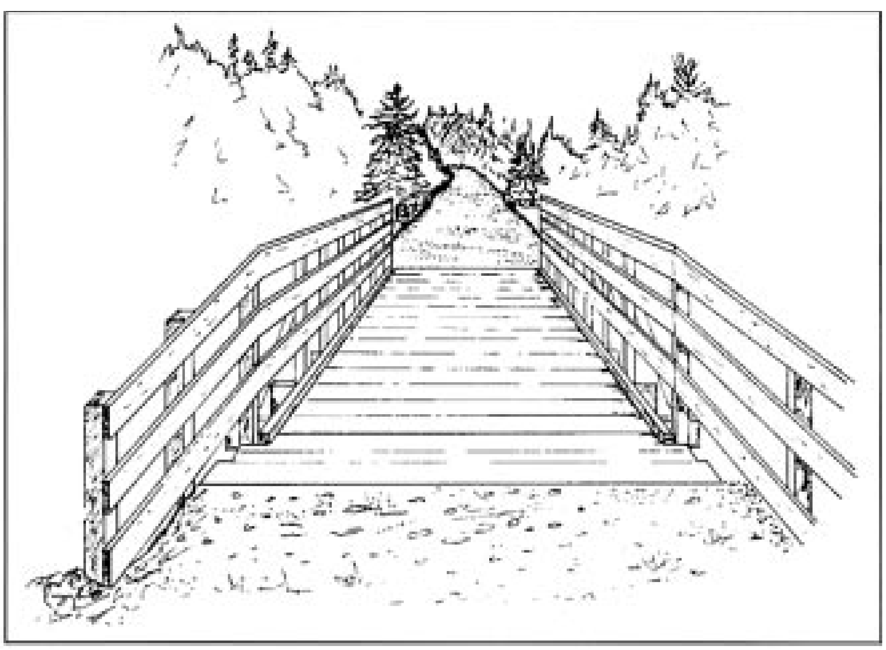
The purpose of this chapter is to provide more in depth information on the use of abandoned railway bridges as multi use trail bridges.

In the 1980's and 1990s Nova Scotia government took ownership of over 1100 km of abandoned rail lines. This land was designated as Parks reserve and is managed by DNR.

Some of these rail lines, such as in Shelburne and Yarmouth Counties, had been abandoned for an extended period of time while others, such as in the St Margaret's Bay area were used by the railways up to the mid 1990's.

This time difference has created varying conditions for the bridges and culverts. Some structures are in fairly good condition, others have sustained considerable deterioration brought on by corrosion, erosion, and rot, while still other bridges were completely removed when the rails were lifted.

Many of the abandoned bridges are fairly long-span structures and can be spectacular attractions to users. However, their size also implies that all work pertaining to re-commissioning these bridges be of high quality and conform to acceptable standards. The following sections will hopefully provide basic information to trail groups so they may be aware what steps will be required to ensure a safe, well designed bridge, useable to the public on a long term basis.

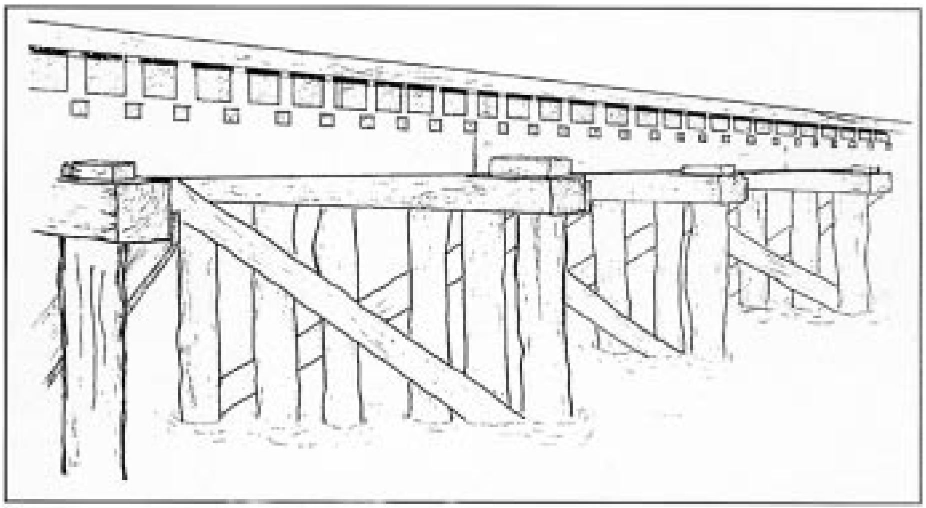


Sissiboo River, Weymouth, NS.

6.1 Bridge Types

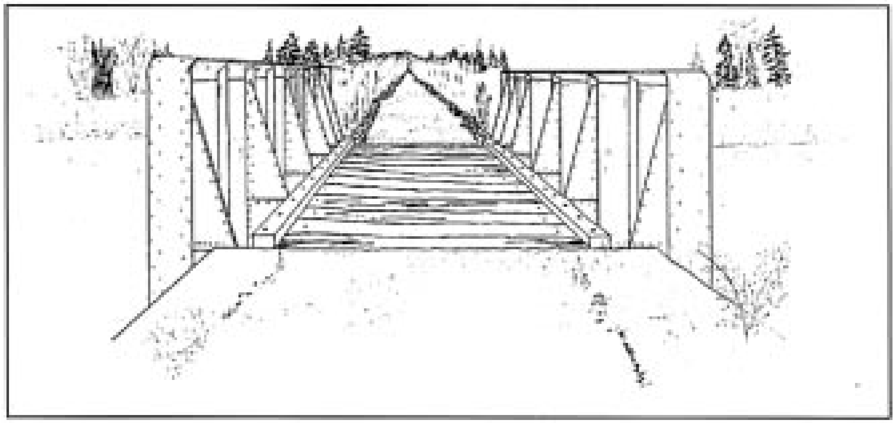
The original rail bridges were constructed using a variety of materials and designs, depending on site conditions, length, and date of construction. Wood, steel, concrete, and masonry were used in varying combination, and sometimes a mixture of all four can be found in the same structure.

Where crossings could be completed using one or many short, low spans, such as through tidal estuaries, and over small streams, timber trestles were usually the preferred method. These types of bridges were usually made entirely of creosote timbers with abutments and piers completed by driving a line of 5 to 7 piles and adding braces and a cap across the top. There are many of these structures throughout the province.

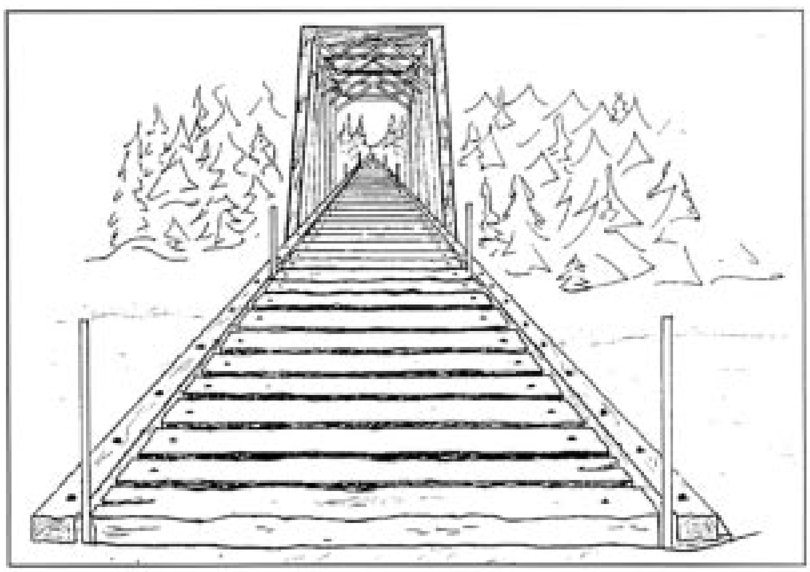


Drawing of Timber Trestle
Pictou Gut, N.S.

When longer spans were required, the rail companies used structural steel. Steel bridges were designed using two main systems, either with large plate girders (beams) or with steel truss. Each of these in turn could be used as a deck or through truss or deck or through girder. A deck girder or truss is totally under the deck ties, whereas a through girder or truss has most of the structure above the deck, so the traffic has to pass “through” the bridge. (See pictures) These larger structures are usually supported on masonry and/or concrete piers and abutments, some of which may be in turn supported on piles. Old time workmanship is evident on many of the masonry abutments found throughout the province.



Through Girder
Pubnico Head, N.S.



Through Truss
Wallace River, N.S.

Some of the rail bridges that were used to cross over highways were built with a combination of two steel girders with concrete slabs as floors, and filled with gravel and ballast.

Although there were only a few different types of material used to build the bridges, these were used in many different combinations, shapes and site conditions, and at many different times, resulting in very few identical bridges.

6.2 Planning

Sections 1 & 2 of the manual have already dealt with the planning issues regarding trails in general. Many of these same issues apply to re-commissioning abandoned railway bridges.

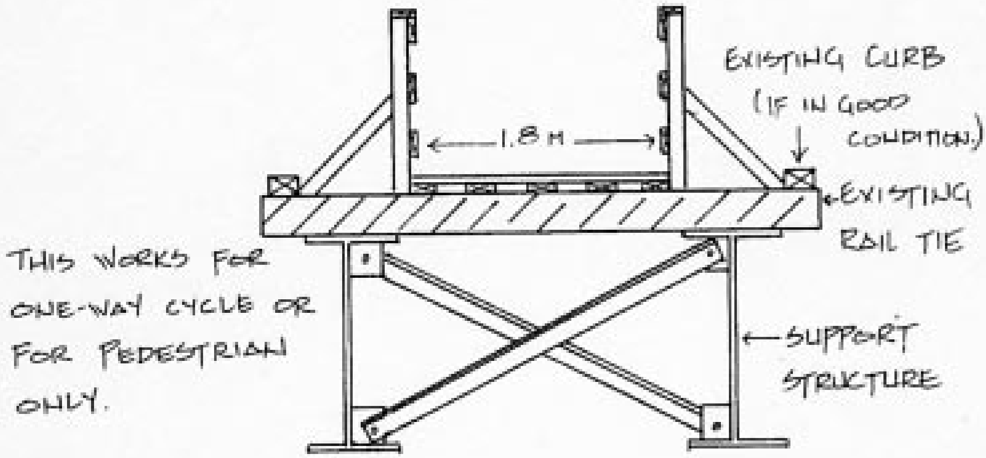
It is important that trail proponents consider all aspects of using these bridges for multi use trails and that proper planning be carried out before any work is undertaken. Funding from NS Sport and Recreation Commission for planning and design costs may be available for 50% of costs up to $ 3000.

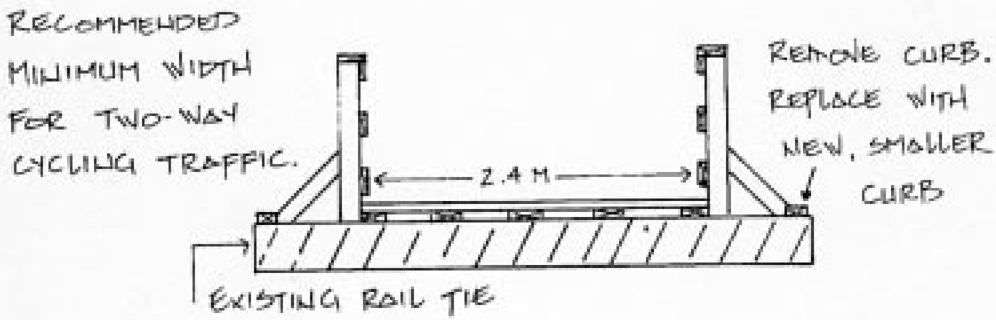
Determining the end-users, trail type and classification, trail purpose, objectives, vision, invariably answers some of the questions that crop up when considering using abandoned rail bridges.

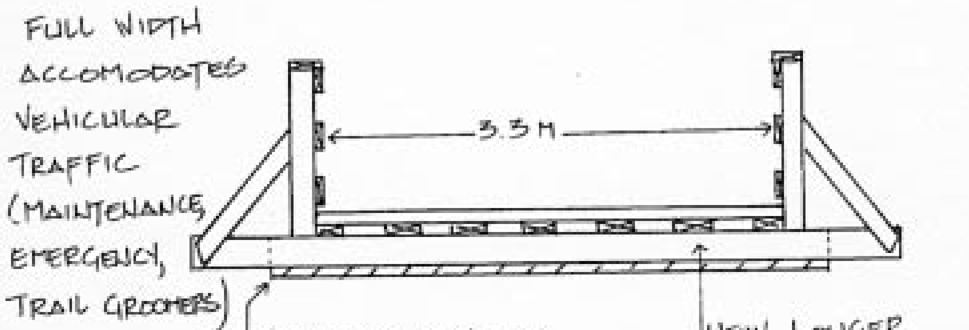
The type of traffic anticipated would determine what modifications will have to be done to the structure. For instance, it may be important that the bridge be capable of carrying medium weight (or heavy weight) traffic for immediate or possible future maintenance work to the rail bed, such as trucking in gravel for the trail tread or to fix a washed out culvert. A particular bridge may be the only way to reach a section of the railway. Culvert blockages and washouts are occurring on a regular basis on the abandoned lines and it is anticipated that, due to their age, the frequency of culvert, rail bed, and bridge problems will increase with time. Trail proponents must plan ahead for these and access to the rail bed with heavy equipment is important. Not only may the bridge need to carry considerable weight; the deck will have to be wide enough to permit this type of traffic to pass between the guardrails.

The bridge may only be required to carry multi-use trail traffic, especially if it is readily accessible from both sides by other means. This may also mean that the open width between the guardrails may be considerably narrower. However, if at all possible, the width should be at least 2.4 metres (8 feet) to permit two-way bicycle traffic.

MINIMUM WIDTHS:







Due to their natural appeal, bridges can be focal points of any trail. They can also be an expensive part of that trail. It is important that trail groups look at the whole picture to determine all options available. Questions to ask:

* *Is the bridge desirable?*
* *What is its life expectancy?*
* *Can it be re-commissioned at a justifiable cost?*
* *Are there alternate routes that would be cheaper, especially in the long run?*
* *What will the design traffic be?*

Once the broad questions have been answered, more detailed information on the size, number, and condition of the abandoned bridges must be collected. Some of this information is already available through the Railway Audit and provides a good first step in assessing the existing conditions and dimensions. More detailed inspections will be required before any work can begin.

Originally, these bridges were designed for very heavy loading, and under normal circumstances would be capable of carrying highway type traffic, as long as they have not deteriorated too much. Unfortunately, many are already at the point where their strength has been greatly reduced.

> **Trail developers shall have all abandoned railway bridges assessed by a qualified engineer to determine if the bridges are structurally sound and capable of carrying anticipated loading.**
>
> **The extent of the assessments will depend on the proposed use for the trail and the size and condition of the structure.**

For instance, a small timber bridge, designated to be used for light traffic, may only require a preliminary assessment where an engineer would evaluate the general condition of the structure, and provide a written report saying the bridge is deemed acceptable for trail use providing certain modifications and repairs are carried out. On the other hand, a larger steel structure, meant to be used for vehicular traffic in addition to trail traffic, may require a full bridge assessment according to Clause 12 of CSA S6 Design of Highway Bridges. This is an in-depth study of a bridge that must be carried out by qualified consultants.

The Nova Scotia Sport and Recreation Commission offers planning assistance for these types of studies on a 50 - 50 basis for costs up to $ 6000.

It is also important to know the bridges' existing conditions so that present and future maintenance costs can be estimated. A good assessment will help in addressing liability issues and will certainly be welcomed by insurance companies.

Permits 6.3

There are several government departments and agencies, both federal and provincial that regulate various aspects of the abandoned railways. It is important that trail groups understand these agencies' involvement early on in the planning stages so that required permits and approvals are not delayed.

As mentioned, the abandoned lines are owned by NSDNR. A letter of agreement or a management agreement between the trail group and DNR is required before any work can begin. See "Procedures for Trail Planning and Development on Abandoned Railway Corridors and Crown Lands - Ten Steps to a Great Trail" by Parks & Recreation, 1999.

After the letter of authority has been issued, DNR will request that drawings of the proposed work on the bridges be provided to DNR for approval. In some instances, technical assistance for completing drawings may be available through DNR staff. At other times, groups may be required to hire consultants to produce plans, especially if the bridge in question requires specialized skills to assess the structure and determine the extent of the work needed. Trail developers must have an approved drawing before they can begin the work.

If any work is to be done in or over a watercourse, approval from the Nova Scotia Department of Environment and Labor may be required. Although adding decking and rails to an existing railway bridge may not require approval from NSDEL, the building of a new bridge if the original bridge has been removed will, in all probabilities, necessitate an approval. The local office of DOE should be contacted.

For work taking place in a watercourse, NSDEL may involve Fisheries and Oceans Canada who in turn may assess the site for fish habitat and may place certain restrictions on the work, depending on the situation.

If the existing or new bridge crosses over navigable waters (watercourse that can be navigated by boat or any other type of watercraft, including canoes and kayaks) the work must be approved by Coast Guard Canada, which is a branch of Fisheries and Oceans. This is a separate approval process and may include public notification of the group's intent by placing an ad in the local paper.

Community groups receiving funding through federal funding agencies such as ACOA or HRDC will have to undertake and environmental assessment (EA)

Depending on the municipality where the work will take place, a building permit may also be required. Usually, the building inspector will request a detailed construction drawing.

Some of the above permits and approvals can take a considerable amount of time to process. Groups should make initial contact with the appropriate agencies as soon as possible. (See "A Guide to Regs, Permits, and Approvals for Community Groups" by Graham Fisher, 1999)

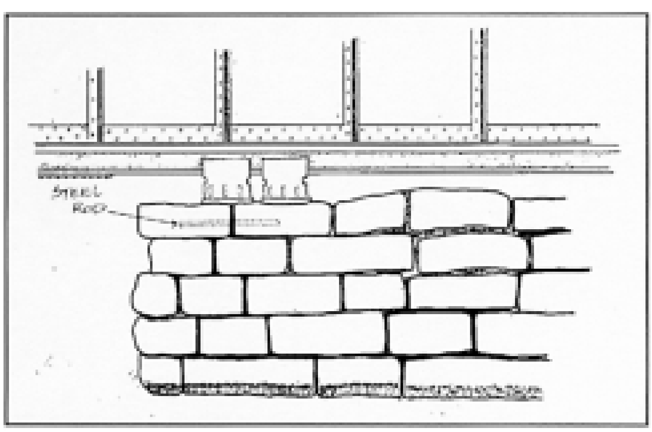
Bridge Inspections 6.4

Bridge inspections may be divided in two categories, the first being preliminary inspections where the condition of the structure is not known but some information on its condition is required to help in the planning exercise and to determine if an in-depth study is warranted. The second category is a more in-depth study of the structure carried out by a structural engineer. The second is needed if the bridge has to be certified, i.e., rated to a certain load capacity to handle, for instance, highway truck loadings, or, if the bridge has deteriorated to the point where its structural integrity is in question. Badly deteriorated piers and abutments, broken, bent, or missing pieces, and severe corrosion to the point where steel sections are substantially reduced are but a few of the indications that a bridge may be in severe distress and an expert should evaluate its condition.

In all cases, an in-depth report on the bridge's condition will help the group in long term planning, and should provide them, funding agencies, and the group's insurance companies reassurance that the project is a good investment.

Of course, these inspections are at the planning or pre-construction stages of the project. Once the construction has been completed and the trail is open to the public it is essential that regular inspections be carried out at least on a yearly basis so that structural problems are detected as soon as possible. Members of the group may be able to carry out this type of regular inspection providing they have some background in construction and maintenance.

The key to regular maintenance is early detection of changes to the bridge, such as bent beams, settled abutments, and missing braces.



Picture of Settlement in Piers
Annis River, N.S.

To ensure consistency in the inspection program, more than one person should be involved, and at least one person should have been present at the last inspection. Inspectors should consider taking a camera along and take several pictures of key components at each time. A photo file showing yearly changes, especially repairs will provide a recent history of the bridge and help in determining at what rate changes are occurring.

A helpful form has been prepared and may be used for a regular inspection program. It is strongly recommended that a qualified engineer undertake an initial inspection of all abandoned bridges that are to be re-commissioned for trail use.

The Inspection 6.5

Although some aspects of bridge inspections can be specialized and fairly complicated, most are fairly straightforward and easy to complete.

Using the aforementioned inspection form, and following a methodical procedure, a person with some knowledge of structures can get a decent indication of the bridge's general condition.

Inspections should follow a top to bottom or bottom to top sequence, with all structural aspects covered in a logical order. Inspectors should make themselves familiar with what to look for and where.

Some general points to consider are:

- Gather whatever inspection data is already available.
- Special equipment, such as fall arrest gear, life jackets, boats, climbing apparatus, may be required to access parts of large bridges.
- Is the bridge near salt water? Corrosion of steel or concrete deterioration will be a problem.
- Evidence of some deterioration should warn you that there probably is more that you can't see. Do a closer investigation.
- If the bridge is in tidal waters, try to arrange to be there at low tide, if it's in a fairly large stream, at times of low water.

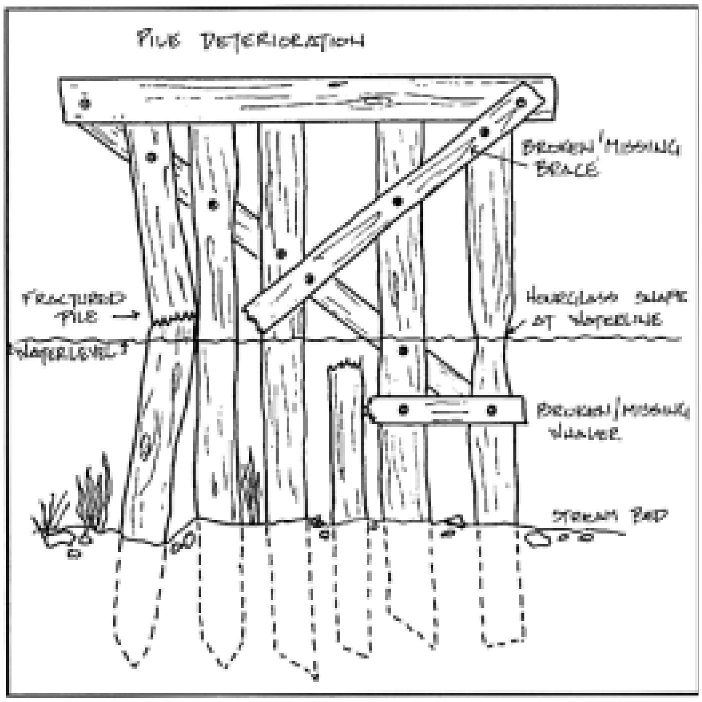
A thorough bridge inspection should begin with the substructure, that is, its abutments, piers, and whatever else makes up its foundation. Things to look for are erosion problems along the base of the foundations, evidence of scour by flowing waters, and settlement in of any part of the supporting pieces.

A masonry pier (cut stone stacked and held together with mortar) showing open joints where the mortar has fallen out, missing or broken stones, or evidence of sagging at a corner should be an alert to the inspector that something is amiss and a thorough investigation is required.

Undermining of parts of the piers and abutments may bring the bridge's integrity in question. Left alone, scour can eventually cause the abutments to collapse into the watercourse.

If the original railway bridges were removed, and subsequently replaced with smaller, lower bridges, these may be inadequate in size and prone to flooding and washout. Evidence of this can be ice or debris scars on the underside of the bridge.

Bridge openings, especially smaller bridges, should be checked for blockages caused by debris, gravel bars, or beaver dams, which can significantly reduce flows and endanger the bridge.



Many rail bridges are supported on timber pile foundations and these should be checked for rot by taking core samples where possible. Some piles may be worn by the endless flow of water, ice and debris. Look for hourglass shape piles at the waterline. Cross bracing make piles act together as a group and is very important. Many of the bridges have loose, broken, or missing braces, and these should be noted, and included in future repairs.

Other piers and abutments are built of structural steel resting on concrete footings. Steel substructures should be assessed in the same manner as superstructure steel, discussed later

Concrete footings and abutments should be inspected for scour, ice damage, spalling (flaking or crumbling), for Alkaline Aggregate Reaction (a network of cracks with a whitish substance oozing out) and for exposed reinforcing steel or iron stains from the steel.

Substructure Inspection 6.6

When a river flows very fast, it picks up material from the riverbed or banks and washes it away. This destructive action is called **scour**. Sometimes scour causes large holes in river beds or washes entire sections of the bank away. Scour is the most common cause for structural failure of river bridges. The term **scour** is defined as a lowering of the riverbed below an appropriate datum. Usually bridges are damaged by scour when the river is too big to go through the waterway under the bridge or when the river changes its path.

The are three reasons why a river may not be able to go through the waterway of a bridge:

- a river can grow and become too big for the waterway;
- the waterway under the bridge can be blocked by part of old bridges, trees, fences and other debris;
- the waterway under the bridge was not designed large enough in the first place

In flood conditions, when the river is too big for the waterway under the bridge, resulting damages may include:

- the washing away of the bridge itself;
- the washing away of the approach embankment - the river actually goes around the bridge;
- the washing away of fill in front of the abutments and the scour of holes in the riverbed.

Rivers can change their path slowly or very quickly. Changes in the river path can, after time, cause damage to a bridge. For example, a new island can form around a log jam. A new island upstream of a bridge can make a river change its path and scour around an abutment or under a pier.

A qualified civil engineer, experienced in this kind of specialised inspection work is necessary to ascertain the extent of these problems. These inspections may include the use of SCUBA equipment. Remedial action in response to damages identified through a sub structure inspections is very specialised and must be carried out by a qualified engineer, experienced in this kind of work.

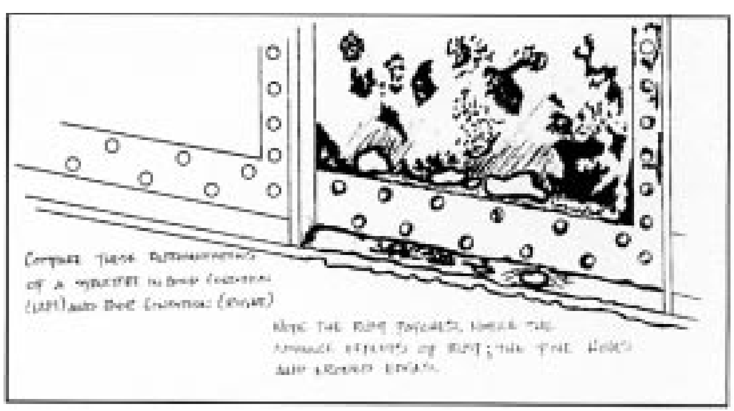
6.7 Superstructure Inspection

Superstructure includes everything above the foundations, and is comprised of timber stringers, steel girders, trusses, decking, and railings.

Timber bridge inspectors should look for decay (rot), especially where the stringers are supported, where bracing and other pieces are attached, and at the interface between the stringers and the decking. A skilled inspector may be able to detect the presence of decay simply by sounding the beams with a hammer. (Solid wood has a ring to it while rot has a dull thud.) A better way is to take core samples as mentioned for timber piles. Stringers should also be inspected for stress fractures caused by overloading (as opposed to cracks formed by weathering). Stringers that have failed in bending will generally have cracks at the bottom of the stringer at mid-span. All stringers (and steel girders) should make even contact with the supports. Uneven bearing may be a symptom of serious foundation problems.

Steel superstructures generally come in two main designs, steel girders and steel truss.

The steel girders make up the medium span bridges, are massive and generally two per span. Sometimes, the girders extend above and on each side of the deck (see bridge types). Girders can be made of welded and/ or riveted steel plate. Obvious problems to look for are corrosion, missing, bent, or broken braces, and bent flanges on the beams. Corrosion is very common on these old bridges and will eventually cause their collapse if they are not kept repaired and protected by painting or other means. Unfortunately, some of these bridges are already severely corroded to the point where painting will serve no purpose, and the only alternative for the long-term preservation of the bridges is replacing the deteriorated pieces, or the entire bridge, which will be very expensive.



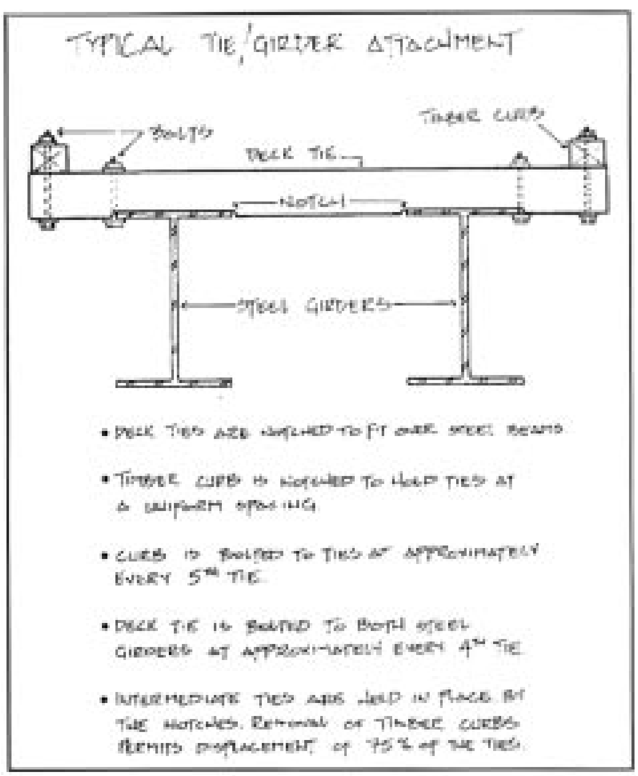
Areas Prone to Corrosion
Web of Steel Girder

Assessing the effects of substantial corrosion to the bridge’s strength is a complicated task that should only carried out by an expert.

Steel trusses are usually used in the larger rail bridges. These are more complicated structures than the steel girder bridges and present some unique inspection problems. As mentioned, it may be difficult to reach some sections of the trusses because they may be well above or below the deck. They have many connections, braces, and plates, many of which can be critical to the bridge. Failure of one may lead to the entire bridge collapsing. Any sign of corrosion, cracks, missing bolts, or bent pieces should sound off an alarm to have an expert have a look at it.

Decking is a fairly straightforward item to inspect. Most rail bridges have 8 x 10 creosote timbers, 13 feet in length for decking. These are usually spaced 4" apart and held together by curbs (guard pieces) or flat steel bars at each end. In turn, about one out of four or five is bolted to the carrying beams underneath. Decay is the major problem with decking, and depending on what type of traffic will use the re-commissioned bridge, may necessitate the replacement of all, or some of the deteriorated deck ties. The occasional poor deck tie may not have to be replaced, providing the adjacent ones are in better condition. The deck ties at the beginning and the end of the bridge is frequently in poor shape due to not only decay, but also because of damage done by traffic.

The curbs or guards are generally in poorer shape than the deck ties and should be evaluated. Many times, if they are to be used to attach railing braces, they have to be replaced.



6.8 Bearings and Expansion Joints

Bearings in bridges, generally located between the superstructure and the substructure, are necessary to accommodate movements due to traffic forces, temperature variations, wind and earthquakes. Failure to allow for these movements could lead to severe damage to the bridge and possibly catastrophic consequences.

Few parts of a bridge are as important as the bearings where the entire weight of the structure and the loads, which it carries, are concentrated. Unfortunately, in many cases, maintenance is infrequent or neglected and deterioration occurs. Without exception, the bearings inspected during preparation of this section of the manual show no evidence of recent attention.

Most rail bridges in Nova Scotia were constructed in the early years of the century and their designers could not take advantage of the many developments in bearing fabrication due to new materials that have been developed in recent years.

6.8.1 FIXED AND EXPANSION BEARINGS

Most bridges have fixed bearings that allow for some rotation of the superstructure member but no horizontal movement and expansion bearings, which permit both rotation and movement in a longitudinal direction. Vertical loads are shared proportionally between all the bearings and horizontal forces are transmitted to the substructure at the fixed bearings. Expansion bearings only transmit horizontal forces to the point where frictional resistance is overcome.

The most important cause of movement in steel bridges is due to variations in temperature. Since steel expands when heated, a 100 feet long bridge girder will increase in length almost an inch with a 100 degree F rise in temperature and the expansion bearing must be capable of accommodating this movement. Upon cooling, of course, the girder will contract.

6.8.2 TYPES OF BEARING

Steel rail bridge bearings generally have three basic components:

* a sole plate, bolted welded or riveted to the underside of the bridge girder which distributes the loads from the superstructure to the bearing.
* a masonry plate which distributes the load from the bearing to the substructure.

* anchor bolts designed to resist lateral forces and also to locate the masonry plate and sometimes the sole plate in position.

Depending on requirements, other elements may be located between the sole plate and the masonry plate. On older rail bridges, these might include pins, rockers, and nests of rollers or material with low coefficients of friction.

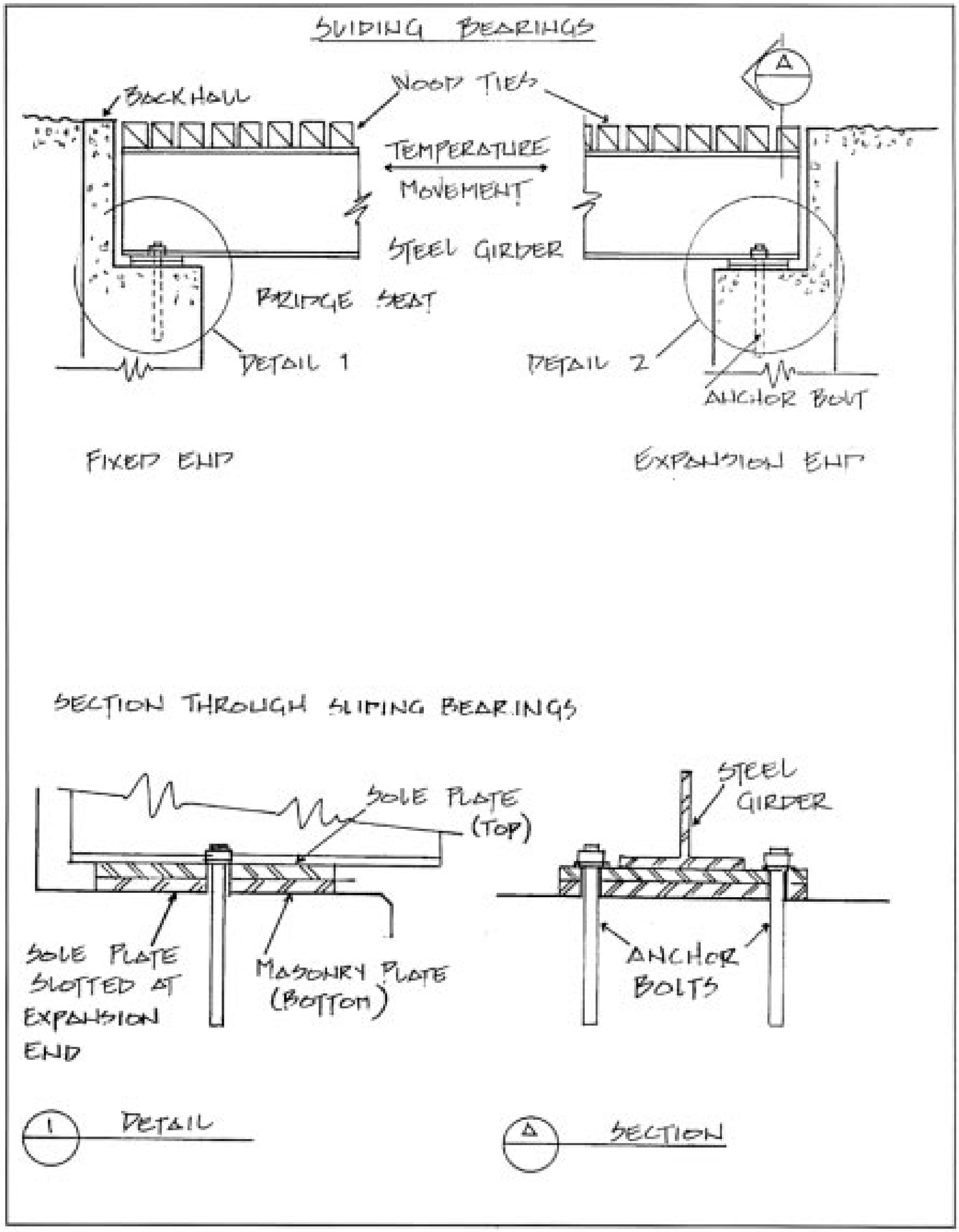
6.8.3 SLIDING PLATE BEARINGS

These are the simplest forms of bearing for steel bridges and are commonly used for spans up to 50 feet. In fixed bearings of this type, the anchor bolts pass through the edges of the sole plate and masonry plate, effectively attaching the bridge girder to the substructure. In expansion bearings, longitudinal movement is permitted by slotting anchor boltholes in the sole plate and allowing the sole plate to slide over the masonry plate.

For short spans, rotation of girder ends due to deflection under load is neglected although there will be increased pressure on the side of the bearing closest to the span.

Since bare steel surfaces of sliding bearings could corrode and impede movement, various methods were used to reduce the coefficient of friction. These included using grease, oil or graphite, or adding lead or bronze sheets between sole and masonry plates.

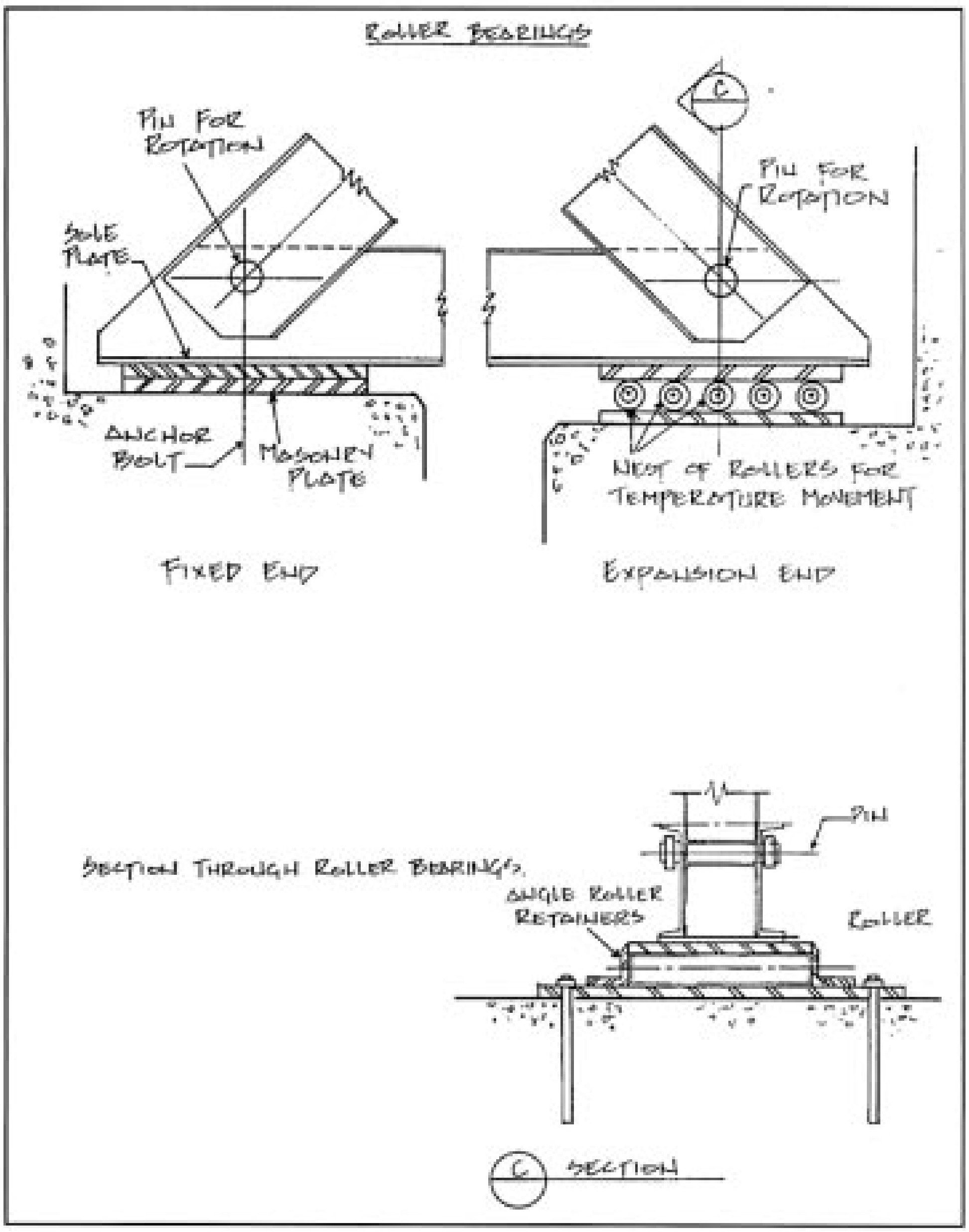
Expansion bearings will not move until friction forces are overcome. If movement cannot occur due to rusting and complete “freezing,” considerable forces will be applied to the substructure leading to possible damage.


SLIDING BEARINGS
BACKFILL
WOOD TIES
TEMPERATURE
MOVEMENT
STEEL GIRDER
BRIDGE SEAT
DETAIL 1
DETAIL 2
ANCHOR BOLT
FIXED END
EXPANSION END
SECTION THROUGH SLIDING BEARINGS
SOLE PLATE
(TOP)
SOLE PLATE
SLOTTED AT
EXPANSION
END
MASONRY PLATE
(BOTTOM)
STEEL
GIRDER
ANCHOR
BOLTS
1
DETAIL
A
SECTION

6.8.4 ROLLER BEARINGS

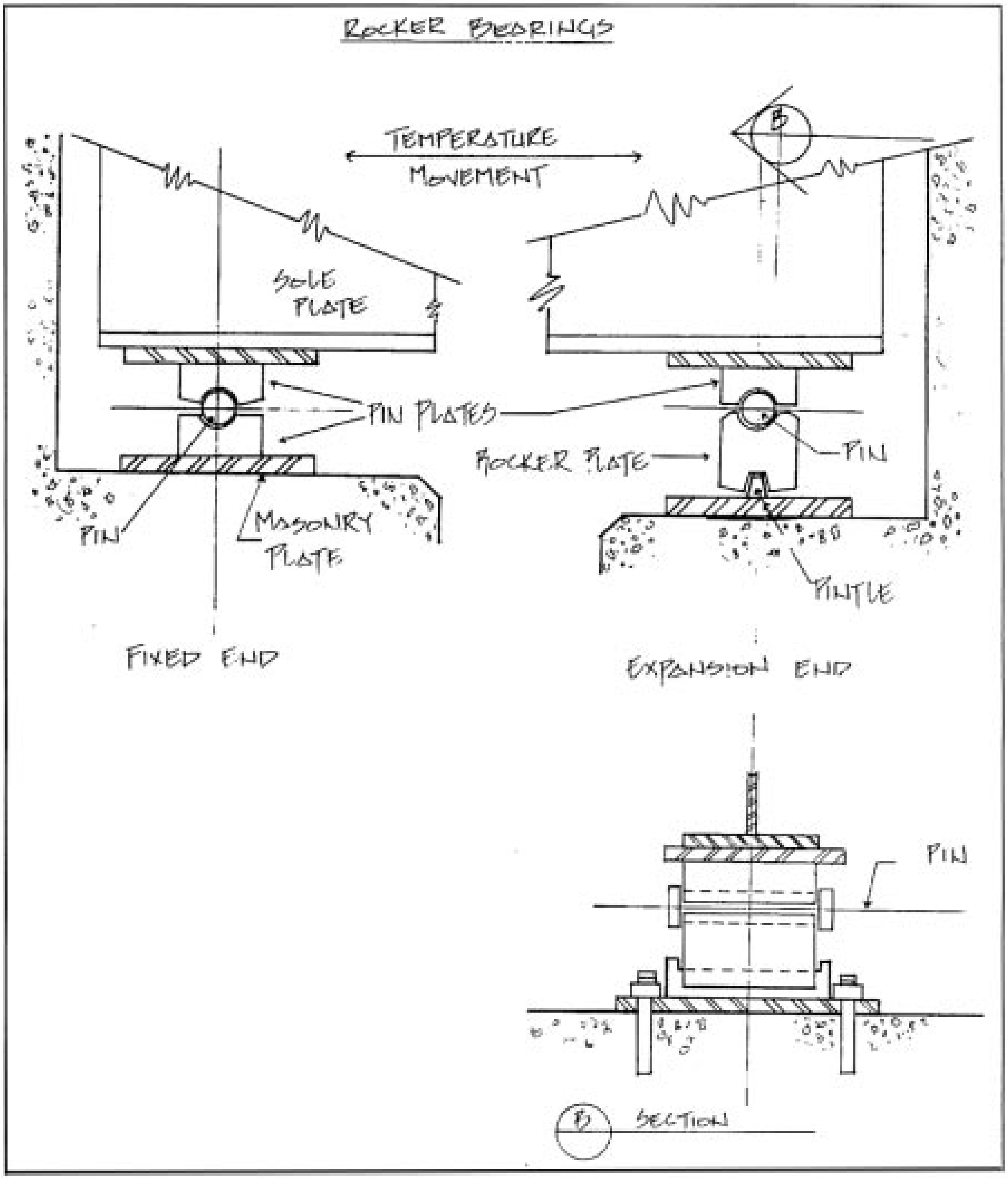
For spans greater than 50 feet, a more sophisticated expansion bearing was usually provided although the fixed bearing remained similar to that used for short spans. In the expansion bearing, a series of rollers was inserted between the sole and masonry plates. These were retained by plates or angles attached to the lower masonry plate.

End rotation of longer span bridge girders was frequently allowed for by use of large diameter horizontal pins.



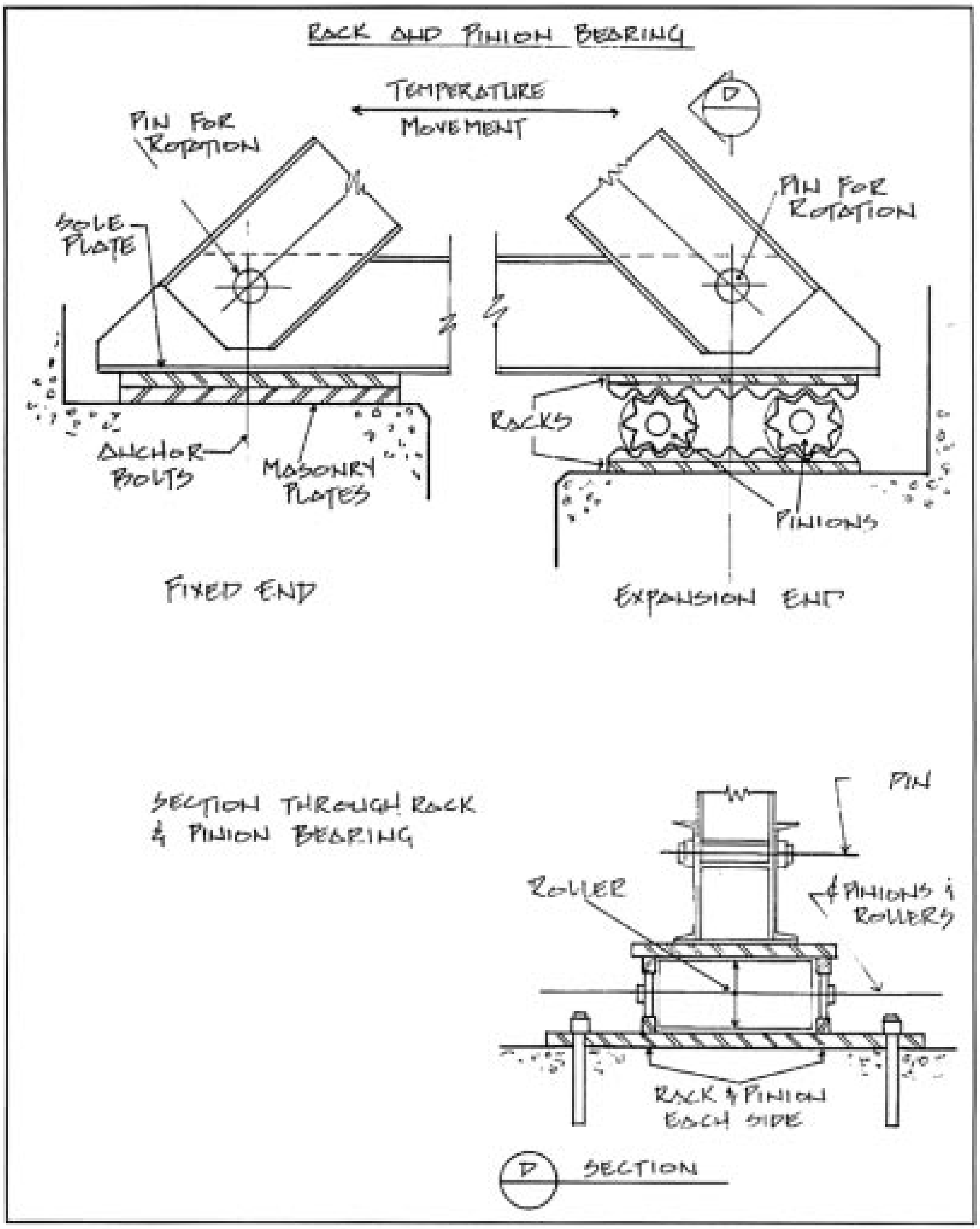
6.8.5 ROCKER BEARINGS

For large bridges, bearings incorporating pins at the fixed end, and pins and rockers at the expansion end were often used.



6.8.6 RACK AND PINION BEARINGS

For very large span bridges, rack and pinion expansion bearings were sometimes used. In these, a pair of large rollers was located between the sole and masonry plates. Each roller had a pinion or gear on each side, which meshed with racks mounted on the masonry plate.



6.8.7 OTHER BEARINGS

Over the past 25 years, new materials have been developed and used in the manufacture of bridge bearings. It is unlikely that any bridges associated with trails in Nova Scotia will be equipped with bearings other than those described in the foregoing text. New bearings include:

- **Elastomeric Pads:** alternating layers of rubber or neoprene and steel. Rotation is accommodated by the neoprene and longitudinal movement by shear deformation.
- **Elastomeric Bearings with PTFE:** a PTFE (polytetrafluoroethylene) surface sliding on a stainless steel plate permits longitudinal movement. Friction between PTFE and steel is extremely low
- **Pot Bearings:** an elastomeric bearing is confined within a steel cylinder and accommodates rotation in any direction. Longitudinal movement is accommodated by use of PTFE and a stainless steel plate.
- **Spherical bearings:** a large ball and socket arrangement, lubricated with PTFE permits multi-directional rotation while a PTFE/ stainless steel plate caters to longitudinal movements.

6.8.8 PROBLEMS ASSOCIATED WITH BEARINGS

Bearings are the only part of a bridge structure where differential movement must take place, and because they are located beneath the traveled way and at the juncture of the superstructure and bridge approaches, they are continually subjected to moisture and debris. Even in cases where bearings are easily accessible, due to their location, they are not readily visible.

If it is not removed on a regular basis, dirt accumulates on the bridge seats next to the bearings. Since it is often sheltered from direct sun, this dirt retains moisture for long periods and eventually starts to corrode parts of the bearings in contact with it. It is common to see piles of debris on bridge seats with vegetation growing from it.

Corroded surfaces in sliding plate bearings prevent the normal operation of expansion bearings and in consequence, large forces due to thermal expansion of bridge members are imposed upon superstructure. This can lead to cracking and spalling of concrete in the bridge seat and progressive deterioration due to frost action.

Similar problems may be experienced in the sophisticated bearings systems using nests of rollers, rocker assemblies and racks and pinions. Since more moving parts are involved, however, there is a greater likelihood of deterioration. Since these bearings are associated with longer span bridges and larger movements, the possibility of serious damage is increased.

6.8.9 REMEDIATION PROCEDURES

The first priority in upgrading the bearings of any bridge is to clean the abutment seats of all dirt, debris and vegetation, and to remove loose and flaking paint by wire brushing. A rigorous inspection should then follow to determine the extent of any deterioration of the bearings and to note signs of any damage that has been caused to the substructure.

Expansion bearings suspected of being “frozen” should be monitored for a full year to gather data over a full temperature spectrum. This might be done by measuring from a fixed point on the upper (sole) plate to the back wall of the abutment. If no movement detected, it is obvious that the bearing is “frozen” and that the tremendous forces caused by not allowing expansion will create problems at the bearing seat or elsewhere such as cracking or spalling of concrete or masonry.

Damage to bearing components due to rusting or blockage with dirt is difficult to assess without dismantling the assembly. This is obviously very difficult with large spans due to heavy loads involved and the general use of narrow bridge seats. Without expensive testing procedures or removal, detection of deterioration or pins is similarly difficult.

The severity of defects found during the inspection and monitoring procedure will determine whether bearings can be rehabilitated or need to be replaced. If the bearing can be made to function adequately and accommodate anticipated movements, then rehabilitation is warranted.

Some defects that occur can be remedied without disturbing the function of the bearing. Others, however, such as replacement of sliding plates, rollers or rockers, will require jacking of the superstructure in order to remove and replace the bearing. Since rail bridges used as trails can be closed to traffic on a temporary basis, jacking each end in turn to replace bearings is technically simple, although possibly expensive. For this reason, replacement of entire bearings, rather than parts, is advisable. Installation of modern bearings should also be considered.

6.8.10 LUBRICATION OF BEARINGS

As a general maintenance activity, the contact surfaces of steel bearings should be lubricated. Regular cleaning and lubrication prevents the buildup of dirt and rust, and ensures that mating surfaces are free to move relatively.

Bearings that are “frozen” can sometimes be freed by application of a product such as WD-40 if corrosion is not too severe. Other lubricants that could be used are grease, motor oil and graphite-based compounds.

6.8.11 PAINTING OF BEARINGS

Parts of all bearings, except contact or sliding surfaces, should be protected with an appropriate paint system. Advantage should be taken of products developed to deal with the severe climatic conditions experienced by oil platforms in marine environments. The section on Painting in (6.9) this manual should be consulted for suitable materials and procedures.

6.8.12 REPAIRING ABUTMENT SEATS

To repair concrete in bridge seats, removal of loads by jacking the superstructure is essential. After removal of existing bearings, anchor bolts and loose and deteriorated concrete, steel dowels would be inserted in sound material and high strength concrete placed, compacted and cured. When the concrete has reached its required strength, new bearings and anchor bolts would be installed and the jacks removed.

6.8.13 ENGINEERING SERVICES

Inspection, monitoring and design of jacking systems for bearing replacement should be carried out by a Structural Engineer with relevant experience. Work associated with large structures, where the decks frequently have high clearances, should only be carried out by experienced personnel. Similarly, work associated with jacking and replacement of bearings can only be undertaken by qualified contractors familiar with the strict provincial safety standards.

Painting 6.9

For most steel bridges, a coating system is used to protect the structure against corrosion. Aesthetic factors, such as colour, gloss and general appearance, while important to the public, are secondary considerations. Painting constitutes a major part of the cost of the bridge maintenance as may be seen on major structures where it is a continual activity. If it is neglected for even a few years, rust begins to appear and generally must be removed before a new system can be applied.

An exception to the foregoing is a steel type developed in the sixties, Atmospheric Corrosion Resistant Steel (Canadian trade name: Corten), which forms a hard dark brown oxide film upon exposure to the elements. This film prevents progressive rusting and thus, it is not necessary to provide a further coating system.

Under ideal conditions, application of a painting system involves three or four distinct stages. These are surface preparation, prime coating, and intermediate coating (often optional) and finish coating. These are addressed in the following sections:

6.9.1 SURFACE PREPARATION

Mechanical Cleaning. This degree of surface preparation is acceptable when the existing pain system is in good condition and scraping or wire brushi ng can remove loose paint.

Brush Off, Blast Clean. Mechanical cleaning combined with dry blast cleaning of small rusted areas.

Commercial Blast Cleaning. Blast cleaning to remove all previous coatings and loose rust.

Near White Blast Cleaning. Multi-pass blast cleaning to remove all previous coatings and rust, thus exposing bare metal.

Blast cleaning involves the use of compressed air together with dry or wet abrasive material or the use of very high-pressure water. Special enclosures are required for blast cleaning to prevent potentially contaminated residues from polluting the atmosphere or adjacent waterways.

Requirements for environmental protection are given in “Guidelines for the Application and Removal of Structural Steel Protective Coatings” (revised May 1997), prepared by the N.S. Department of Environment. In addition to providing requirements for environmental protection during removal of paint and rust and application of new coatings, the guidelines describe how residues are to be managed on site and disposed of afterwards.

Representative samples of spent blasting abrasive, paint, rust and dust must be submitted for laboratory testing to determine whether it is to be classified as solid waste or waste dangerous goods. The former may be disposed of in an approved waste disposal site, but for the latter; agreement and approval for treatment and/or disposal must be obtained from the N.S. Department of Environment. Waste dangerous goods must be transported in compliance with strict federal and provincial regulations.

The test procedures identify the presence and concentration of barium, cadmium, chromium and lead, and compares them against acceptance parameters established by the N.S. Department of Environment. A copy of the guidelines is appended to this report.

6.9.2 PRIME COATING

The prime coat is dependent on the degree of surface preparation and the existing paint system to be covered but is generally organic or inorganic zinc, epoxy mastic or coal tar epoxy.

Organic Zinc. Requires a commercial or near white blast clean surface. Adheres well but needs a finish coat.

Inorganic Zinc. Requires a commercial or near white blast clean surface, but bonds chemically to the steel, and if sufficiently thick, does not need a finish coat.

Epoxy Mast or Coal Tar Epoxy. Can be applied over sound, previously coated surfaces, the latter also over bare steel.

6.9.3 INTERMEDIATE COATING

These are sometimes used for additional paint film thickness or to provide a common base for the finish coating where the old paint has not been completely removed. An intermediate coat of contrasting colour also helps to ensure complete finish coating coverage.

6.9.4 FINISH COATS

Finish coats may be vinyl, epoxy, latex, acrylic, urethane or alkyd. A wide variety of colours and degrees of gloss are available. Obviously, finish, intermediate and prime coat paints must be compatible, and for that reason should be supplied by a single manufacturer.

6.9.5 NEW PRODUCTS

In recent years, with the increase in offshore oil activities, much research has been carried out to develop suitable coatings for steel structures to withstand severe atmospheric conditions. Desired characteristics include ease of application, high corrosion resistance and colour and gloss retention. Candidate products for consideration in the maintenance of old bridges should include the following:

Wasser Moisture Cure Urethanes. These are single component coatings that can be applied in high humidity, with no dew point restriction and at low temperatures. They can be applied to damp surfaces and immersed within 30 minutes. The products can also be applied over leadbased coatings; thus minimizing costs associated with blasting and disposal of spent blasting abrasive.

A typical specification might include surface preparation with hand tools, spot priming of bare, rusted steel, application of a full prime coat and finally, a top coat with the required colour and gloss characteristics. The coatings can be applied by spray, brush or roller.

Neutra Rust 661. This is a white organic copolymer latex coating which reacts chemically with rust to form a hard black non-tacky layer in 30 minutes. It is neutral and non-toxic, and can be coated with a variety of finishes. For many applications, its black finish, after two coats, can be left uncovered. This product is particularly suitable for use on bridges where the original paint system has completely disappeared.

Surface preparation would include wire brushing to remove loose rust and water washing to provide a clean surface. The Neutra Rust 661 can be applied by brush or spray over dry or damp rusted steel, but areas of existing paint would be left uncoated.

6.10 Attachments

If there are other attachments to the bridge, such as walkways or railings, these also have to be assessed to make sure they are capable of carrying anticipated loads. They will generally not pass today's standards and will probably need replacement.

Some of the existing bridges have small platforms that extend over one or both sides of the deck. These should be looked at very closely. It is recommended that they be removed due to the risk they present to users.

Maintenance of Existing Bridges 6.11

The abandoned rail bridges represent an important part of the railway land acquisition. These provide trail access over many rivers and streams in the province. As already mentioned, due to their age, many are in the autumn of their lives and are going to demand repairs and maintenance to remain useable.

Some repairs will be minor, such as fixing a piece of deck, or maybe replacing a rotten stringer, while other repairs will be relatively expensive and require specialized equipment and labour to be completed.

Part of the planning exercise should be to determine what will be done to protect the bridges in the long term.

Deciding not to keep a particular bridge painted will undoubtedly save dollars for the present and near future, but once the structure deteriorates to the point where paint alone will not save it, its remaining life span will be limited, necessitating large sums of money at the end of this term to do major repairs or to find another trail location.

All trail groups should endeavour to do whatever they are capable of doing to extend the bridges' lives.

For instance, keeping dirt, debris, and vegetation away from the bearing areas of the bridge will help in slowing down the corrosion and rot processes.

Other things that groups may be able to do are:

- removing vegetation growing on masonry and concrete piers and abutments
- placing rip rap rock at the base of eroding piers
- replacing rotten timber
- reattaching or replacing missing or loose braces
- protecting the approaches to the bridge from erosion
- replacing broken or rotten railings and posts
- controlling types of traffic that will use the bridge
- regular inspections

6.12 Re-Commissioning the Bridges

All abandoned railway bridges will require some work to adapt them to trail use. The work will vary depending on what uses the bridges will have.

Trail proponents should make sure that all work carried out be done in a safe manner. All people involved should be properly trained to do the tasks at hand and have all necessary safety equipment. When hiring contractors and consultants, make sure these are safety certified by appropriate agencies, are in good standing with the Workers Compensation Board, and carry adequate liability insurance. Companies contracted to do the work, or forepersons hired to oversee the work crews and the project should be asked to provide a written safety plan for the project. This plan should explain all steps that will be taken to minimize risks to the workers and the environment.

As mentioned, the present condition of the bridge must first be assessed to determine if the structure in general can withstand the anticipated loadings. This should come from an engineering report on the structure.

If structural repairs are required, these should certainly be done under the supervision of an engineer.

Before work can proceed on any parts of the bridges, the trail group must provide a plan or drawing to DNR and any other department or agency that has jurisdiction over certain aspects of the proposed work, so the project can be reviewed for approval.

If the structure is capable of handling the anticipated loads, then all that may be required is the addition of new decking and rails. The planning done in the preliminary work has already determined the type of use - hence the width of the deck required.

The sequence of completing the deck and rails depends on the condition of the existing ties and curbs, the width of the deck required for the trail uses, and the construction method used for attaching rail posts. This will be elaborated later on.

Materials 6.13

All work done to these bridges should be of a permanent nature, capable of lasting many years while exposed to fairly harsh conditions such as salt-water environments. For this reason, materials incorporated in the work must be resistant to corrosion and insect and fungal attack.

In the case of steel products used in the bridges, such as fasteners, beams, and railings, their surfaces should be treated by painting or galvanizing, unless they are made of resistant metals such as aluminum or stainless steel. Preferred treatment is by galvanization, which, when properly done, will provide many years of service.

All timbers should be pressure-treated to a level appropriate for their use. It is recommended that pressure treatment be done according to the CSA Standard O80, Wood Preservation. Timber in contact with the ground should have a higher concentration of chemicals than what would be used for decking. Although it is recommended that treatment be with CCA, creosote may be an acceptable alternative, providing it has air dried and is only used where it will not come in direct contact with users, such as in stringers.

The following concentrations of CCA are recommended:

Type of Use		Concentration (kg/m3)
Lumber in contact with the ground (cribs, posts, etc.)		6.4
Lumber above ground (rails, decking, stringers)		4.0
Piles	- Fresh Water	12.0
	- Salt Water	24.0

In some cases, it may be possible to use untreated wood for decking if the decking is not structural, i.e., just a running surface, and it is anticipated that the type of use, e.g., snowmobiles, will wear the decking down before decay will destroy it. In this case, a fairly dense and naturally resistant wood, such as tamarack, could be used. Quarter sawn decking is more resistant to wear than flat sawn, treated or untreated.

All structural timbers, such as railings, rail posts, and stringers should be graded according to National Lumber Grading Association rules and should carry the grading stamp of the mill where the lumber was produced. Additionally, all pieces that have visible defects, even if they are part of a shipment that was graded as specified, should not be used except where the defect will not affect their intended use.

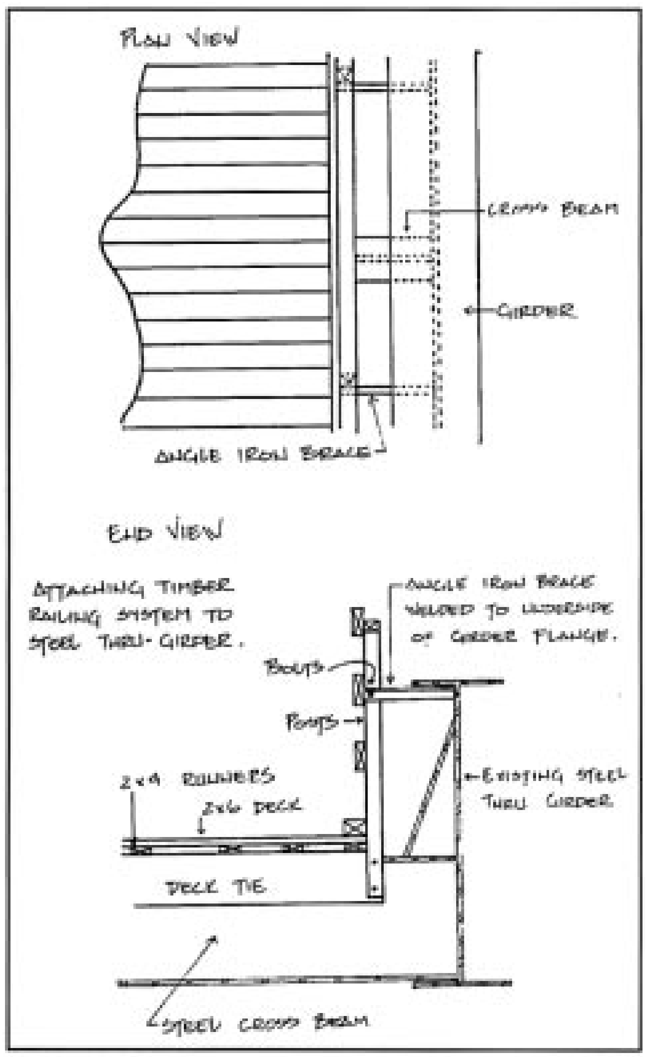
Proper carpentry practices such as using string lines, squares, and levels will insure a neat, professional looking job.

6.14 The Decking

For all but the heaviest uses, such as dump trucks, the decking installed on top of the existing ties can be 2" thick stock such as 2x6 or 2x8. The decking must run perpendicular to, or at an angle to the traffic, and should never run longitudinally, especially if biking is one of the permitted uses.

To provide an even nailing surface for the deck, a series of 2" thick runners is first applied longitudinally, about 18" apart on the existing ties.

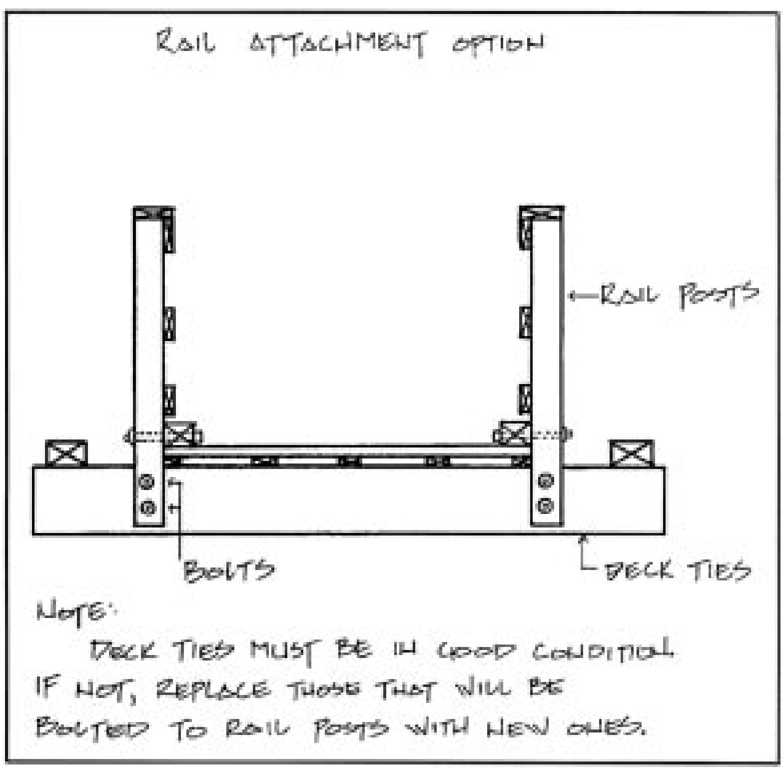
If the construction method requires that the deck ties be temporarily moved to facilitate the attachment of the rail posts (see option # ?????), the placing of the runners should be delayed until this work has been done.



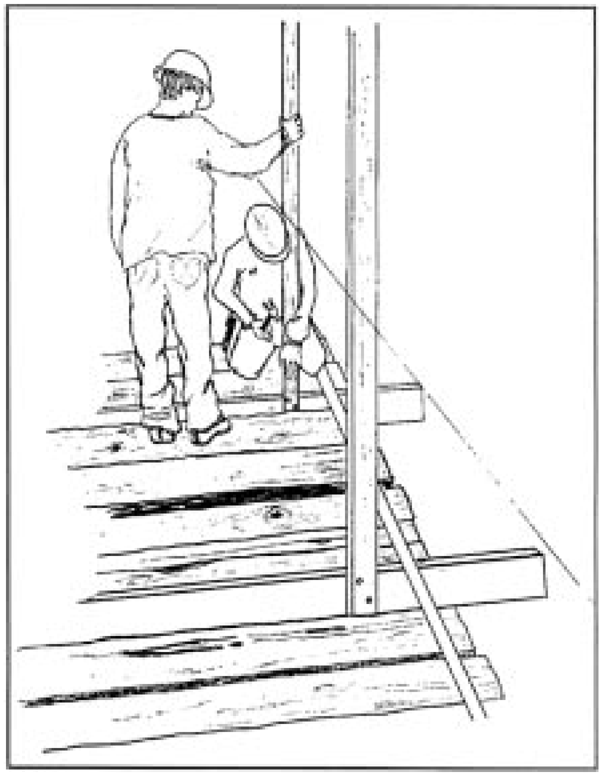
In general, the existing rail ties have been notched and lay on two or more steel or timber beams. Only about 1 in 4 or 5 of the ties are attached to these beams, the others are prevented from moving laterally by the notches. The ties are restrained at their ends, being held together by long steel straps and lag screws, or by timber curbs that are themselves notched so the ties are held at an even spacing. Here again, only about 20% of the ties are actually attached to the curb. This system holds everything in place, but makes dismantling fairly easy.

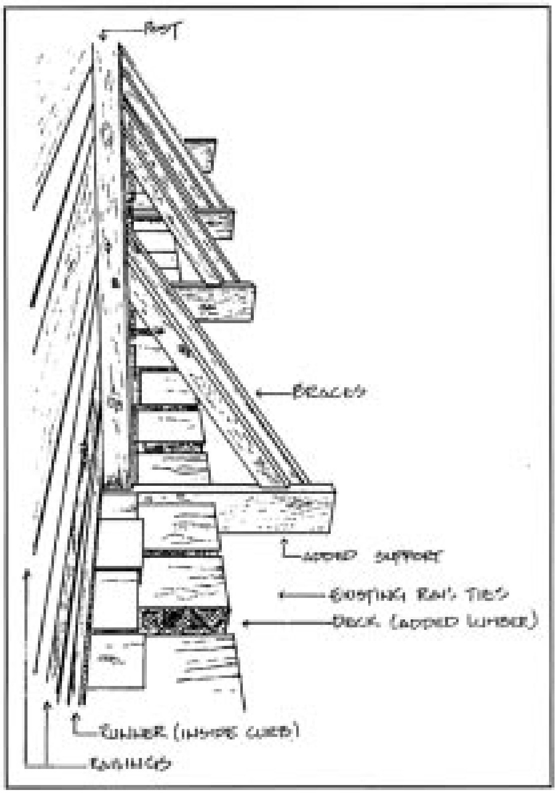
Once the timber curbs or steel bars mentioned above are removed, 75% to 80% of the ties are simply laying on top of the beams and can easily be removed or slid to the side providing space between the ties to work. Most timber curbs on the abandoned bridges are in advanced stages of decay and often need to be replaced if they are to be integrated in to the final rail/deck system. If they are not incorporated in the railing, it may be possible to leave them out completely because the runners and the new decking system will tie everything together, as long as the bolts holding the ties to the main beams are still in place, and the intended use is light traffic only.

Diagrams below show recommended options for attaching rail posts to the bridges. Some of these may not be appropriate depending on the condition of the bridge, especially if the deck ties are in poor condition. Again, it is important to have knowledgeable people evaluate the bridge and recommend a suitable method of doing the work.



Some rail bridges have been built on curves and were super-elevated (banked). These may create problems in slippery conditions if motorized vehicles are permitted on the trail. Decks on super-elevated bridges longer than 20 metres should be leveled with shims or other appropriate methods to make the trail surface as flat possible.

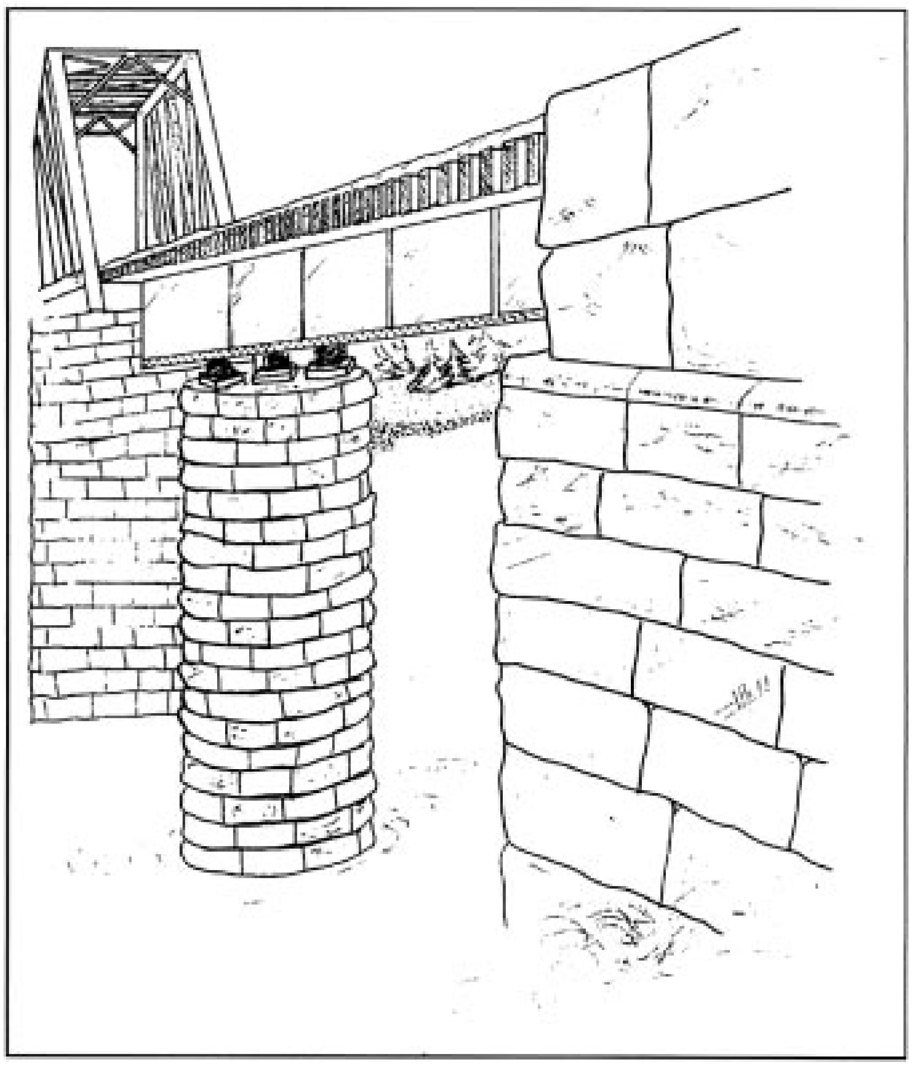




Approaches 6.15

Many of the higher railway bridges have high approaches that may be tens of feet above surrounding grades providing a hazardous vertical drop on both sides leading to the bridge. It is important that the railing system extends past the bridge to protect users from biking or riding off the abutments and possible injury.

Although each situation should be dealt with on a case by case basis in the design and planning stages, normally, the railings are extended to a distance sufficient to protect users from the hazardous drop. The extra amount required can be as much as 70 feet on both sides of each approach, increasing the total length of railing by almost 300 feet on a large bridge.



To remove the risk of users being impaled by the ends of the railings, the final section should be angled outward and downward. Reflective signs or tape should be placed on the ends of the rails so they effectively warn users of the bridge at nighttime. Of course, signs placed well in advance of the bridge are also a must. It is recommended that all signage conform to "Guidelines for Snowmobile Trail Signage and Placement," 1988, published by the North East Chapter of the International Association of Snowmobile Administrators.

Attaching railing posts to concrete or masonry abutments may present some problems, depending on the situation. It may be possible to anchor posts with masonry type anchors that are drilled into the rock. Details showing how the attachments will be made should be included on all drawings submitted for approval.

If it is necessary to prevent vehicular traffic from using the bridge, it will be necessary to install some type of control either at the bridge (maybe both ends) or at a strategic point where the bridge cannot be accessed past this point.

A number of different controls have been used. Most are removable and lockable so that maintenance and emergency vehicles can get by if necessary. These controls have to be designed and built in a way not to be a hazard to users and they should always be highly visible, especially at night.