Advantage
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Contents

Plastic arches for temporary off-road stream crossings

Abstract

This report discusses the use of high-density-polyethylene (HDPE) plastic arches as temporary off-road stream crossings for harvesting equipment. FERIC developed and tested these plastic arches in two operations and found that the arches can offer effective alternatives to other options for spans of up to 3 m.

Keywords:

Stream crossings, Plastic arches, KWH plastic arch, Harvesting equipment.

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Introduction

As government regulations grow stricter and companies become more environmentally conscious, temporary stream crossings can let harvesting equipment reach harvest sites and let work crews access areas where permanent road crossings were deactivated. As well, temporary crossings can give harvesting equipment access to certain problematic parts of a site without having to build an access road, and this can produce significant cost savings. FERIC has previously reported on two temporary stream-crossing products: steel planks (Plamondon and Maranda 1996) and plastic pipe bundles (Légère 1997). However, there remain instances where alternatives are desirable. To provide one alternative, FERIC worked with KWH Pipe (Canada) Ltd. to develop a stream crossing based on a plastic arch cut from existing round pipe (Partington 1999). This report documents trials of these plastic arches for off-road applications. Appendix 1 summarizes three alternatives for temporary stream crossings.

Product specifications

KWH Pipe Ltd. manufactures non-corrugated, high-density-polyethylene (HDPE) pipe. This pipe differs from other types of plastic pipe in that it has smooth inner and outer walls. KWH arches are created by cutting this pipe in half; the pipes are available in diameters of from 0.25 to 3.0 m. As a result of the company's manufacturing process, the pipe tends to spring open once it has been cut in half and can increase in span by up to 24% over the original pipe diameter. This expansion must be considered when sizing an arch to fit a proposed stream crossing.

A 4-m overall length is usually sufficient to allow typical forestry equipment to cross a stream, but to facilitate transportation and installation, the arches in FERIC's operational study were tested as two 2-m-long, 1.5-m-span sections. Shorter sections conform better to the stream's shape than a single long section. They are also easier for workers to position without assistance from heavy equipment. Each section of arch weighed 120 kg

(@ 60 kg/m), and chain handles were passed through holes cut in both ends of each section to help workers move the arch into place or to provide a grip during transportation by equipment such as skidders (Figure 1).

FERIC testing suggests that the smallest functional arch span is around 1.5 m; this would cost approximately $1000 for a 4-m length. Footings would typically be necessary only for the central part of the arch, thus 3-m long footings made of 0.38-m diameter pipe were used. These cost approximately $300, for a total cost of approximately $1300. A similar arch with a 2-m span would cost approximately $2000.

Installations

Testing of the plastic arch began in 1999 on the operations of Domtar Inc. (Trenton, Ont.) and Mactara Limited (Upper Musquodoboit, N.S.) for use as skidder and forwarder bridges. In these operations, an arch was placed directly on the extraction trail, and the machines traveled over the arch, with and without a load, so that the arch's performance could be studied. The arch deflected considerably while it supported the machines, but returned to its original shape once the load was removed. The testing also indicated that the arch should be modified to prevent its edges from digging into the soil and that placing corduroy over the arch would help distribute the load and thereby reduce deflection.

Figure 1. The rugged KWH plastic arch can be easily transported to the installation site.

Based on the results of these preliminary tests, FERIC conducted an operational trial with Tembec Industries Inc. (Huntsville, Ont.) in a tree-length hardwood operation. The product was delivered to the landing as a 2-m-long, 1.5-m-diameter round pipe, which was then cut in half with a chain saw. The span of the resulting arch sections increased to 1.65 m. Handles were then attached through holes in both ends of each section. A John Deere 640G cable skidder moved the sections from the roadside landing to the stream. To prevent the arch from sinking into the soil, 0.38-m-diameter pipes were split down the middle with a chainsaw and slid onto the edges of each arch to serve as footings. The arch sections were light enough to be moved into place by two workers. Once the arch was installed, the workers placed corduroy on both sides and over the top of the arch (Figure 2).

Because the stream being crossed was rocky and had high streambanks, the arch fit between the two banks, and care was taken to avoid sedimentation. The support provided by the stream's banks helped to minimize deflection of the arch. The arch was undamaged after 1 month of use, and will be reused in subsequent stream crossings. The stream was fully protected throughout the study period, with no obvious sedimentation and very little debris entering the stream.

Implementation

The KWH plastic arches provide an effective temporary stream crossing on

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appropriate sites. They work best in stream channels with firm, deep banks because the banks support the edges of the arch and thereby minimize deflection.

- Because KWH's HDPE pipe expands up to 24% in diameter after cutting it into arches, pick a pipe diameter only slightly larger than the width of the stream that you will span with the arch.
- The KWH plastic arch is light, durable, and easy to transport. The arch sections can be dragged behind a skidder or placed in the bunk of a forwarder. Once the arch reaches the stream, two workers can move the sections into place; with a forwarder, a single worker can lower the arch over the stream using the grapple.
- Where the stream has soft banks, take care to avoid sinkage of the arch into the soil. We recommend using split pipes as footings or placing the arch on a bed of corduroy or brush.
- Where sedimentation of the stream is possible, place a sheet of geotextile and a layer of brush on the ground on either side of the approach to the arch. This will minimize rutting and the creation of sediment that could enter the stream.
- Where the stream banks themselves provide inadequate support, use stakes to stabilize the edges of the arch and reduce deflection.
- To complete the installation, place corduroy over the arch; this distributes the loads imposed by passing machines (and thus further reduces deflection) and protects the arch from the tire chains or tracks of the machines.
- Since arches can grow fairly tall once the corduroy is in place, placing the arch between deep streambanks minimizes the height that vehicles must pass over. In a stream channel with lower banks, the installed arch can be difficult for machines to climb over, particularly in wet weather. Extending the corduroy on either side of the arch will minimize the height of the hump.

Figure 2. Corduroy helps to protect the arch and to distribute the load imposed by passing equipment.

As machines pass over the arch, the arch deflects slightly. If the arch has been properly installed (Figure 3), this deflection amounts to only 1 or 2 cm; in contrast, an improperly installed arch can deflect by more than 10 cm. Since the arch is fabricated from plastic, it is important to minimize the amount of deflection of the arch; repeated deflection can cause permanent deformation over time.

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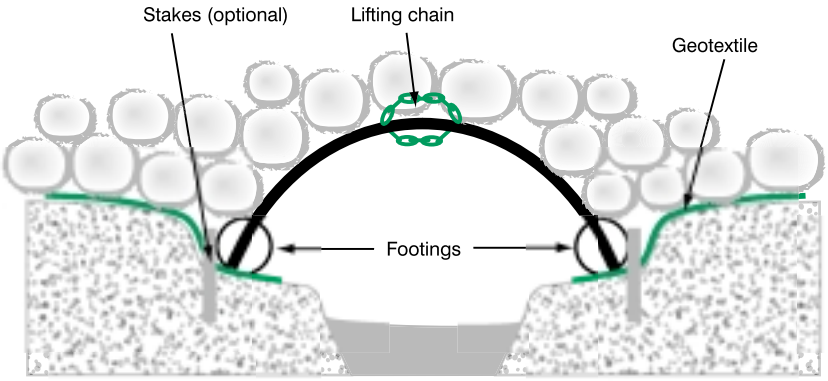

Figure 3. Correct installation of the KWH plastic arch requires the use of corduroy on top of the arch, and the use of stakes if the banks of the stream can't support the edges of the arch.

References

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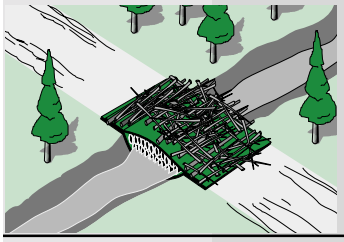
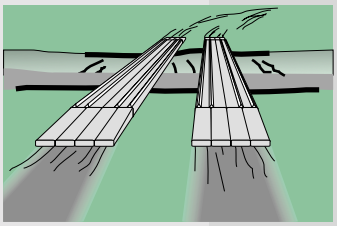
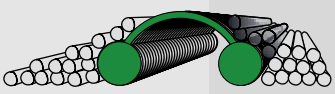
Plamondon, J.A.; Maranda, R. 1996. Temporary stream crossings using steel planks. For. Eng. Res. Inst. Can. (FERIC), Pointe-Claire, Que. Field Note Roads and Bridges-42. 2 p.

Appendix 1. Alternatives for temporary stream crossings

	Description	Price	Dimensions	Weight	Limitations on use	Equipment required for transport	Level of stream protection
Pipe bundles 	Bundles of joined HDPE pipe.	Each pipe costs $9 to $10 per m. A typical 0.5-m crossing uses 3 bundles of 8 pipes (ca. $1000).	Each pipe is 4 m long x 0.1 m in diameter.	A typical bundle of 8 pipes weighs 110 kg.	Can only be used in streams with solid bottoms.	Skidder or forwarder.	Low. May not meet provincial regulations on Crown land.
Steel planks 	Each plank is fabricated from 4 hollow structural sections.	Total cost for 2 planks is $5000.	Each plank is 7.3 m long x 1.2 m wide.	Each plank weighs 2 tonnes.	Not suited to streams with gradual approaches on soft ground. Limited to streams less than 7 m wide.	Excavator, or hooked to front of skidder.	Medium. A central log deck must be added to permit skidding of wood.
KWH plastic arch 	Portable bridge made from HDPE pipe.	The arch in FERIC's study cost about $1300.	Various sizes are available. The test arch used 2 sections, each 2 m long x 1.5 m wide.	Each section of the test arch weighed 120 kg.	Works best for streams with solid banks.	Skidder or forwarder.	High.