Timber Tech Tips

United States Department of Agriculture
Forest Service
Technology & Development Program
February 1995
2400 9524 1301—SDTDC

Pipe Bundle and Pipe Mat Stream Crossings

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Many forest activities require stream crossings by vehicles and equipment. When these activities are short term in nature, and the required access is temporary and environmentally sensitive, crossings with quick easy installation and removal are desired. The pipe bundle stream crossing is one potential means under trial by the San Dimas Technology and Development Center (SDTDC). This type of crossing is effective, portable, reusable, lightweight, inexpensive, and constructed of readily available materials. These crossings provide temporary short-term access to forest lands and resources, and are *not* considered alternatives to permanent access. Testing was conducted at SDTDC to first verify adequate strength of polyvinyl chloride (PVC) schedule 40 pipe under direct loading. A second set of loading tests was performed on pipe chilled to freezing temperatures. The pipe proved strong enough to support the vehicle loads shown in table 1.

Table 1.—*Direct loads applied to individual pipe.*

Vehicle	Front Axle Weight, lb	Rear Axle Weight, lb	Front Tire Pressure, psi	Rear Tire Pressure, psi
Loader	8840	10,240	28	28
Fire Engine	7000	15,000	70	90
1/2 Ton Truck	2990	2270	37	37

Specifications for the materials used in the pipe crossing installations discussed in this *Tech Tip* are given in Table 2 below:

Table 2.— Materials specifications.

PVC Pipe	Schedule 40
Cable	Stranded wire rope
Hardware	Grade 5
Grating	3 by 10-foot, 1-5/16-inch steel, 10 gauge galvanized
Geotextile	Polypropylene, nonwoven needle punched, 150 gram/sq. meter

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PIPE BUNDLES

Field trials confirmed that connecting all of the pipe which come in contact with vehicle tires is mandatory. Wire rope, hereafter referred to as cable, can be used to accomplish this. Pipe are drilled 1-foot and 4-feet from each end to allow cable to be threaded through. Four 3/8-inch cable sections are used to connect individual pipe. The cable ends are pulled tight, looped, and clamped with 3/8-inch cable clamps, forming a pipe bundle. This prevents the individual pipe from rolling, shooting out the sides, or moving in other directions (figure 1).

Figure 1.—Cabling pipe into bundles.

U-SHAPED CHANNEL

Cable was used to assemble bundles made of 2-inch, 4-inch, 6-inch, and 8-inch schedule 40 PVC pipe as shown in the chart below (table 3).

The bundles proved very successful in crossing U-shaped channels (figure 2).

Figure 2.—Equipment crossing a pipe bundle.

GENTLE SIDE SLOPE CHANNEL

On a long, shallow channel with gentle side slopes, a smooth travel surface could not be obtained using bundles. In this case, the pipe were loosely placed to fill the channel. Then, a single layer of pipe was connected along the surface, first using clamps (figure 3), then with cable (figure 4), forming a pipe mat. Sheets of deck safety grating were placed on top to protect the pipe and provide traction. Expanded sheet metal was also considered as a surfacing although a trial proved it to be unsuccessful. The grating was placed with the 10-foot edge perpendicular to the wheel lines and adjacent edges were tied

Table 3.—*Designs of pipe bundles.*

Bundle No.	No. of 2"	No. of 4"	No. of 6"	No. of 8"	No. of Hrs.	Cost $	Size of Cable	No. & Size Cabled	Weight lb
1			6		4.0	230	3/8	6-6"	220
2	2	2	11		4.5	405	3/8	9-6"	460
3				9	5	470	1/2	9-8"	500

together with 3/8-inch cable. Finally, 3/8 x 3-inch bolts were installed vertically, securing the grating to the pipe. This configuration proved adequate in stability and durability, with little pipe movement under 10 loaded log truck passes (figure 5).

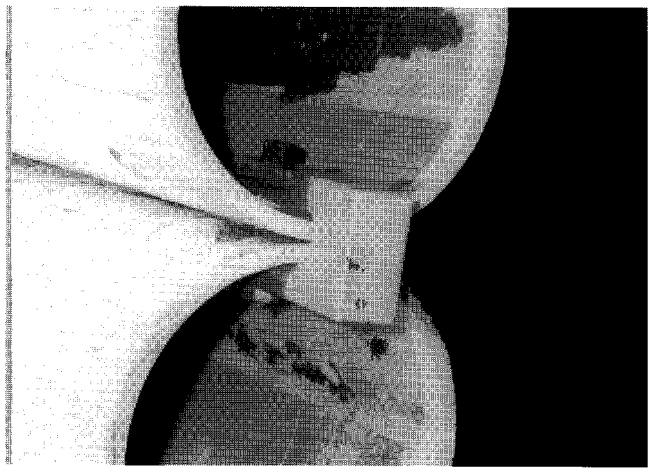

Figure 3.—Pipe mat clamps.

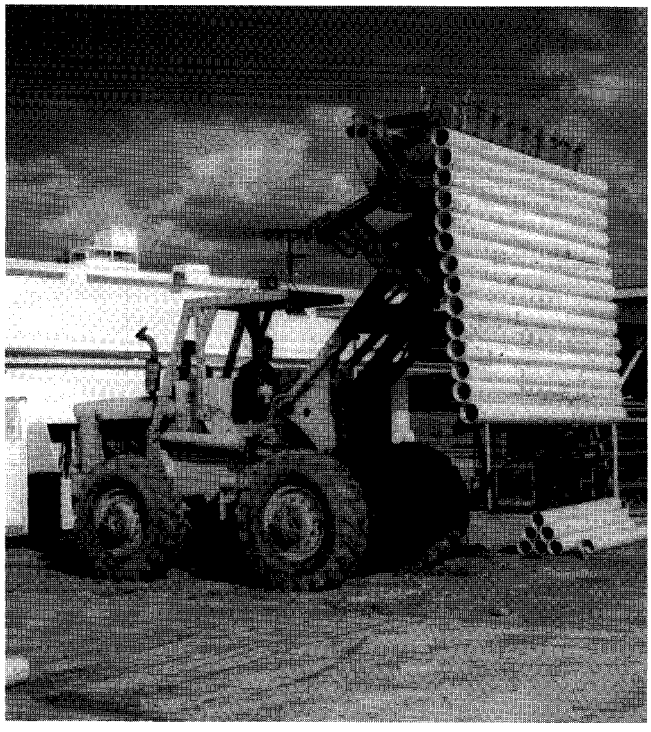

Figure 4.—Loader transporting cabled pipe mat.

VIRTUALLY NO DEFINED CHANNEL

A field test in Florida was conducted at a site where a small, shallow stream required crossing by a skidder. Only a single layer of pipe connected to form a mat was needed. The PVC mat consisted of 3-, 4-, and 6-inch pipe, with the 3-inch on the outside

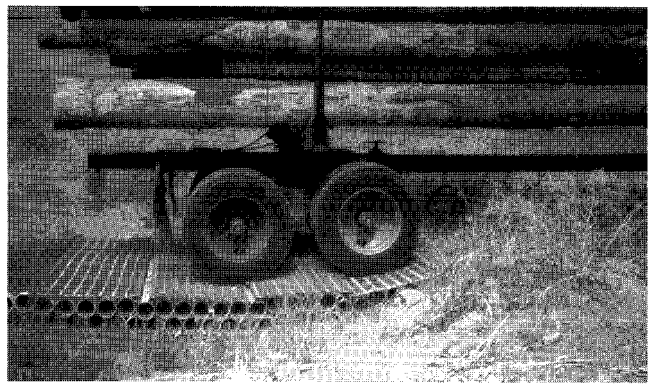

Figure 5.—Trailer duals on grating covered pipe mat.

ramping to the 4-inch, then to the 6-inch in the center. The mat was 9-feet long by 20-feet wide and provided the skidder with plenty of maneuvering room. Geotextile was placed along the stream bottom, with the PVC mat placed on top. Due to the short length, no additional surfacing material was needed, either for traction or protection of the mat. The crossing cost was approximately $602. with an as-yet unknown life expectancy. The skidder successfully completed 40 round trips—one direction with logs in tow—with no movement or damage to the pipe crossing (figure 6).

Figure 6.—Skidding logs over a pipe mat geotextile installation.

The soils in this area are a silty sand and, except for the slight indentation from the pipe, the stream showed no detrimental effects from the crossing (figure 7). The only damage to the mat occurred after removal and was due to the skidder arm swinging back and hitting one pipe (figure 8). The mat remains usable after this incident.

Figure 7.—Streambed after crossing removal.

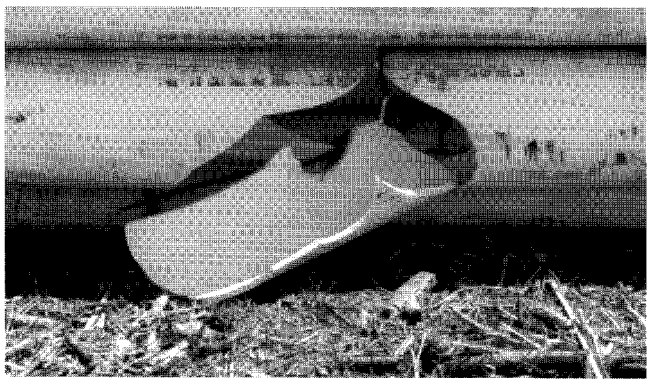

Figure 8.—Pipe damaged by equipment.

DESIGN AND INSTALLATION

The pipe configurations have proven to be a very successful means of crossing a stream, provided the stream bottom has little, if any, grade. For all designs, it is important to place geotextile prior to pipe installation to ensure separation of pipe and soil and prevent sinking. Sinking may cause impacts to the stream and makes pipe removal difficult. A pipe mat should be placed along the stream bottom. If necessary, loose or connected pipe should then be placed to the desired height; then, a final pipe mat is placed. Both bottom and top mats should be long enough to extend beyond the stream edge for protection of stream banks. Typically, a tractive surface, such as grating, Terra Mat, or timber mats, should be connected to the top mat.

An important consideration is width. A 10-foot width is too narrow for many vehicles, and 20-feet (typical PVC length) may be excessive. It is possible to use shorter sections, end to end, between full length pipe, making 13- to 14-foot wide mats. This concept is illustrated in figure 9.

Figure 9.—Use of shorter PVC pipe sections.

Transport depends on the length and amount of pipe. In some cases drilled, individual pipe are transported by pickup truck and constructed on site. Preconstructed bundles and mats may be heavy enough to require a lowboy or dump truck. Equipment on site, typically front end loaders or skidders, are used for placement due to weight. Time to place depends on length and depth of stream, amount of water, available equipment, and amount of room for equipment to maneuver. The greatest consumption of time is fabrication of the bundle or mat. To cut, drill, and cable together a 20-foot long, 14-foot wide mat typically requires 3 people working 3 hours.

OTHER CONSIDERATIONS

The two main causes of pipe deterioration are impact—from dropped loads or from hitting with the skidder arm—and ultraviolet (UV) light. Pipe with UV inhibitor is available or the pipe may be kept covered as much as possible. One other consideration is keeping mud and debris that may fall off vehicle undercarriages or logs out of the stream. An extra layer of geotextile placed under the top mat may provide this function.

There are two main potential hazards that could cause vehicle damage; the first involves loops at the cable ends hooking onto vehicle undercarriage components; the second, insufficiently attached grates springing up under passing tires and colliding with the underside of the vehicle.