Timber Tech Tips

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PORTABLE CROSSINGS OVER LOW-BEARING CAPACITY SOILS USING WOOD PRODUCTS AND TERRA MATS

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INTRODUCTION

Environmental sensitivity and soils with low bearing capacity can limit the access window into timber sale areas by heavy equipment. SDTDC has conducted field tests of several products with potential as portable crossings for vehicles over streams, soft soils, and moist areas. The products are readily available and provide effective, temporary, portable, and inexpensive crossings that can be placed by typical logging equipment and used by forest traffic. Site damage is minimized during use, and removal helps prevent future impacts by facilitating closure of the road or skid trail. This *Tech Tips* discusses portable crossings composed of wood products and recycled rubber tire parts.

PORTABLE CROSSINGS USING WOOD PRODUCTS

Wood Pallets

Supreme International produces a very sturdy wood pallet. Hardwood planks 3-inch by 8-inch (75 mm x 200 mm) are nailed together to make 3-ply interconnecting pallets useful for surfacing roads and platforms typically used for oil rigs (figure 1). The individual pallets are 8-foot (2.4 m) wide and come in 12 foot (3.6 m), 14 foot (4.3 m) and 16 foot (5m) lengths. The prefabricated pallets are constructed of approximately 250 nails and 1200 board feet of lumber, weigh 2200 pounds (1000 kg); and, at the time of this printing, cost $370. The design allows no nail points to surface, which reduces the possibility of tire punctures. The pallets last 2 years or longer, depending on site conditions; they are reversible and broken planks are easily replaced to further prolong system life. Each end overlaps for easy connection; if two sets of pallets are being placed side by side, the joints should be staggered. At road intersections, and on curves, the pallets are placed with the 16-foot (5 m) dimension width-wise to provide plenty of maneuvering room for log trucks.

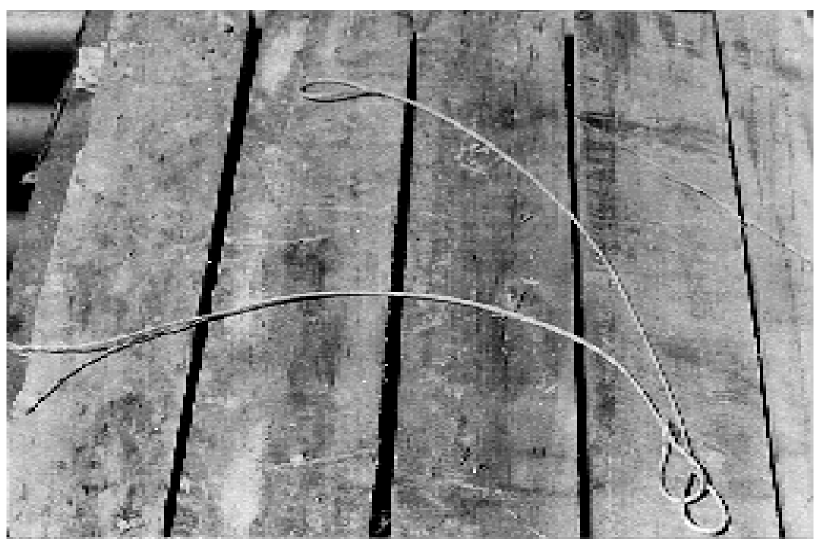

Figure 1. Cable loops for attaching chains on wooden pallets.

The Osceola National Forest in Region 8 hosted field tests of wood pallets in an area near a culvert in silty sand soil with a moisture content of over 30 percent. Ruts 4 inches to 6-inches (100 mm -150 mm) deep were present at the time of placement (figure 2). A non-woven, needle-punched geotextile was placed prior to pallet installation to provide support and separation, and also to reduce stresses on the pallet during removal. The pallets were cut in half, making 4-foot (1.2 m) by 14-foot (4.3 m) sections (figure 3). This helped reduce the weight and made them less cumbersome during placement. Each pallet was placed in a wheel track to ensure proper road width. Soil was then ramped at both ends to reduce abrupt edges and associated roughness.

Figure 2. Ruts in road prior to placement of portable crossing.

Figure 3. Placement of pallet sections.

The geotextile was unrolled by two people and the pallets placed by a backhoe. Transport was time consuming; the backhoe had to travel from dumptruck to the culvert, a distance of approximately 3/4 mile (1.2 km). Some difficulty occurred picking up the pallets because the chain could not be inserted between the closely spaced planks. One solution to this problem involves installation of cable loops for attaching chains (figure 1). The pallets held up well after approximately 150 round-trips over one week's time. Some pallet deflection occurred due to the pre-existing ruts but no further deterioration of the site occurred. One plank edge broke off forcing vehicles to slow down at the crossing due to roughness, and 2 to 3-inch (50 mm to 75 mm) bumps developed in the approach at each end.

Although untested, this product may accommodate skidders with some modifications. However, skidding logs along the surface could damage and possibly tear off individual planks. It may be possible to connect a metal sheet to the center of the pallet—leaving wheel tracks uncovered for traction.

The pallets worked very well as proved in the oil fields. Concerns include cost, size, weight, and sole source availability.

Wood Mats

Wood mats—an alternative to pallets—were also constructed and tested. Since the area was large enough to accommodate both pallet and mat installations they were both tested in the same area at the same time. The wood used was 4-inch by 4-inch (100 mm by 100 mm) and 6-inch by 6-inch (150 mm by 150 mm) posts between 12 feet (3.6 m) and 14-feet (4.3 m) in length. Holes were drilled through each post—5 foot (1.5 m) and 1 foot (0.3 m) from each end and connected with 3/8-inch (0.9 mm) galvanized wire rope (cable). Loops made at the end of each cable were clamped with 3/8-inch (0.9 mm) cable clamps. The cable between posts was left loose; putting tension in the cable might increase friction between posts, enabling them to act more as a unit. This was deemed unnecessary in these particular field tests.

The existing rutting was smoothed by a small bulldozer. Most of the rutting was re-established during placement by the backhoe and by log truck traffic allowed during installation. The geotextile and mats were dropped by a dumptruck onto the ground (figure 4). The backhoe picked up each mat by the loops and laid it in place on the geotextile (figure 5). The mats were positioned to optimize coverage over the weak soil area. The 6-inch (150 mm) mats were placed in the center with the 4-inch (100 mm) mats on either end as ramps. The length of each mat was between 4 and 6 feet (1.2 m and 1.8 m) to minimize weight and ease placement. The posts can be connected to each other on site but for this test were prefabricated. Grating may be installed to provide traction should the wood surfaces become slick.

Figure 4. Geotextile and mats ready for installation.

Figure 5. Wood mat and geotextile installation in progress.

During the first pass of a loaded log truck, a loop caught on the disconnect valve of the fuel line. It pulled the mat up and out of position and disconnected the valve. This highlighted the need to ensure that all loops are tucked under the mats. In the subsequent

150 round trips, no other vehicle damage occurred, and impacts to the site were minimal. The mats settled about 1/2-inch (13 mm) and made for a smooth road surface. The wood did not become wet or muddy to the point of becoming slick. At the beginning, the moisture content of the soil was so high that pumping of water through the geotextile onto the mat surface was visible. The 4-inch (100 mm) post mats were considered the most critical in terms of strength, and proved to work well, with lower cost and less weight than the 6-inch (150 mm) post mats.

Results

Moisture content, cone penetrometer, and shear vane data was gathered as well as surface deformation measurements at the crossing site and at an area without crossings. The site without a crossing had a moisture content typically 5-10% less than the crossing site. The rutting that occurred at the site without crossings was 4 to 8 inches (100 mm-200 mm). At the crossing, settlement was between 1/2 (13 mm) and 1-inch (26 mm) over the entire area. Advantages stemming from crossing use include minimal rutting or settling to hold or channel water, no specific areas of substantially increased compaction, and no need for maintenance.

Recommendations

Flag or stake mat locations on the ground based on the length of mats and area to be covered to make extra moves unnecessary.

PORTABLE CROSSINGS USING THE TERRA MAT PRODUCT

Background

Terra Mat is manufactured from parts of used tires and is available in a variety of types for various purposes. It is relatively inexpensive, temporary, reusable, and portable by typical logging equipment. One type of mat is manufactured by tying together tire side walls (figure 6). Mat size may be tailored to vehicle configuration, width of road, length of area to be covered, and weight that can be handled by equipment on site. Variations in type include doubled side wall layers or one layer of treads topped by another of side walls (figure 7). The standard 9-foot by 20-foot (2.7 m by 6 m) mat weighs 1500 lb (680 kg) and at the time of this printing costs $200. Another mat configuration is narrower for placement in wheel tracks (figure 8); these are typically 3 to 4 feet (0.9 m to 1.2 m) wide and 10 feet (3 m) in length. The most successful type for crossing purposes is two layers of tire treads topped with tire side walls. This mat weighs 1800 lb (816 kg) and costs $125 for two 20 foot (6 m) sections.

Figure 6. Terra Mat constructed of tied together tire sidewalls.

The Terra Mat product allows short term access with reduced impact by redistributing wheel loads over a larger area. It's use as a portable crossing was originally described in *Portable Wetland Area and Stream Crossing* (Mason, 1990) and subsequently has been field tested in a variety of locations and conditions.

Field Tests

Several field tests were performed using various mat types. On the Daniel Boone National Forest in Region 8, a standard 9-foot by 20-foot mat (2.7 m by 6 m) was placed on a timber bridge deck being used by skidders. Rain and mud caused the surface to become slick and the mat provided the necessary traction for skidders to operate on the bridge. The mat was transported to the site by light truck and dragged into place by a skidder. The logs caught and pulled apart the center of the mat during the first pass. Degradation continued throughout the operation and by the end of the test the only parts of the mat remaining were along the deck edge in the wheel track areas (figure 9).

A field test on the Osceola NF used the wheel track-type mats for log truck use where no road previously existed. Clearing and grubbing of stumps was performed by a feller-buncher. Then a non-woven, needle-punched geotextile was placed over the existing vegetation prior to mat installation. A loader stacked the Terra Mats for the skidder to drag to the site; each mat was chained-to and pulled into place by the feller-buncher (figure 10).

The mats are heavy—too heavy for people to help with placement and very flexible, with a tendency to curl under at the ends. Location of the chain is critical for proper placement; it should be attached to the very end of the mat. The mats took about 15 minutes each to place once they were

Figure 7. Layer of treads topped with layer of side wall.

Figure 8. "Narrow" mat configuration.

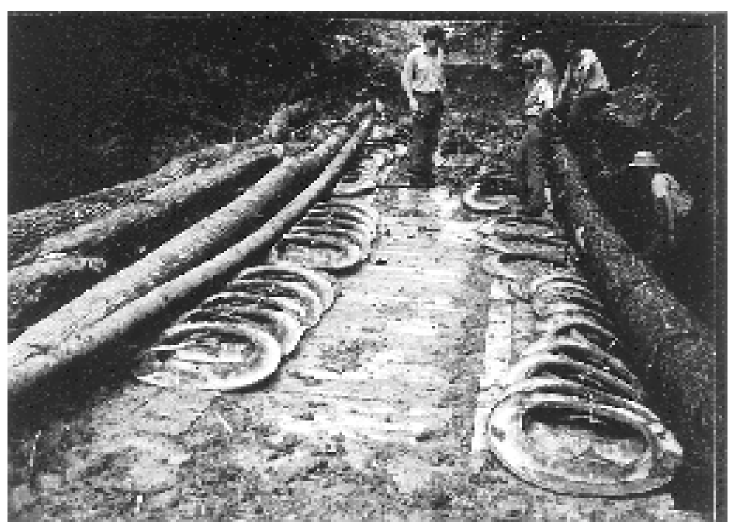

Figure 9. Deterioration of Terra Mat from skidding logs.

on site. Maneuvering room directly affected placement time. Transport and chaining took the greatest amount of time. The mats performed successfully for 35 round trips. Finally, due to increased moisture conditions, the mats began moving out of place and the test ended. At drier sites without a portable crossing installed, the log trucks required assistance. Impacts to the crossing area were minimal when compared to the areas without crossings.

Figure 10. Feller-buncher placing Terra Mat.

Another field test was performed on the Apalachicola Ranger District at a dry, sandy site with a grade of about 15 percent. A standard 9 foot by 20 foot (2.7 m by 6 m) mat was placed directly on the sand. No means of holding the mat in place was used. As a loaded log truck attempted to climb the grade, the mat was pushed out of place and the test abandoned. The test may have been successful had the mat been properly anchored.

Considerations

Placement of Terra Mats is difficult without the proper equipment. They are large, heavy, and very flexible. Although the flexibility allows them to conform to the shape of the ground, and their weight helps keep them in place, they are too narrow for typical forest road applications. Log trucks need at least 10 feet (3 m) and preferably 12 feet (3.6 m) of width on straight stretches; up to 18 feet (5.5 m) may be required on curves for curve-widening due to off-tracking. Although limitations due to maximum grade have not yet been determined, anchoring should be considered on road grades over 5%. The Terra Mats present a rough surface which dictates a reduction in speed due to operator comfort and vehicle wear and tear. Operators must understand the need for this reduction; good visibility and sufficient distance to slow the vehicle are also required.

The Timber Sales Technology & Development (T&D) Program is soliciting ideas from field personnel. If you have an idea which you would like to see investigated or tested; have seen something utilized in another industry and wondered if it could be modified to help you do your job; or just think that there must be a system, method, tool, or new technology which could improve the way you do business—this is the time to let us know. With reduced budgets and staff, it is even more important to have the most efficient tools and methods. Please submit your ideas for new projects on the enclosed form.

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