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Use of Concrete Median (Jersey) Barriers as Ford Walls in Low Water Crossings

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The use of precast concrete median (Jersey) barriers as ford walls on low-volume roads is described. Ford walls are used on U.S. Forest Service roads to stabilize low water stream crossings. This is an acceptable practice on roads that have been temporarily closed for 1 or 2 hours as a result of flooding from sudden and intense storm runoff. The barriers are readily available, precast units that can be transported to the site and installed with conventional equipment that is used to maintain low-volume roads. Modified barriers with steel caps have also been used successfully to prevent erosion of the top of the concrete wall as a result of abrasive bedload movement during high water flows. Ford walls that were constructed with concrete median barriers have been used on hundreds of low water crossings in the desert and mountainous regions of the southwestern United States. These barriers have proved to be an efficient, low-cost alternative to conventional, cast-in-place concrete walls.

The U.S. Department of Agriculture, Forest Service, manages a network of approximately 300,000 mi of road on almost 200,000 million acres of land. These roads are needed to manage a variety of resources and activities, such as timber harvest, recreation, mining, forage, fire protection, and other forest-related activities.

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The Southwestern Region of the Forest Service manages approximately 46,500 mi of road in the states of Texas, Oklahoma, New Mexico, and Arizona. About 70 percent of these roads are of a low standard; most are single-lane roads with dirt or pit-run surfacing and an average daily traffic count of less than 50.

The terrain in the Southwest varies from low Sonoran desert to mountains that are more than 10,000 ft high. Annual rainfall varies from 5 in in the desert to 50 in in the upper pine and alpine forests. Sudden, intense rainstorms are common during the rainy season in July and August. Stream beds that are normally dry become raging torrents within a matter of minutes. These storms often cause injuries and occasionally cause deaths.

A wide range of soil types exists in the Southwest. Much of the soil is composed of highly erodable sandy clays, decomposed granite, and plastic clays. Many roads are impassable for short times during storm runoff because the crossings are flooded and road surfaces are soft and slippery. Good drainage is the key to reducing repair and maintenance expenditures.

THE PROBLEM

The Southwestern Region of the Forest Service has experienced seven major storms since 1972 that have caused over $25 million in damage to roads. Much of the damage occurred at low water crossings. Because of budget restrictions and low traffic counts, drainage structures such as large culverts and bridges are the exception instead of the rule.

The ford structures at low water crossings typically consist of cast-in-place ford walls that are placed in the downstream shoulder of the road to stabilize the road grade at the crossing. These walls are approximately 3 ft high and 6 in thick and may have a footing. Most of the structures were constructed by miners, ranchers, loggers, and road maintenance crews, often with substandard materials. Most of the structures were not designed in accordance with good engineering practices. The walls were subsequently damaged by the movement of rocks in the stream bed. The ends of the walls were also undermined and scoured as a result of undersizing.

Past repair methods involved extending or replacing the wall with a reinforced cast-in-place concrete wall. A 3/8-in-thick steel plate was attached to the tops of some walls to prevent bed load movement from eroding the concrete during floods. Quality concrete is available in this region, but haul distances of 50 mi or more are common. The excavation, forming, mixing, and curing of concrete and dewatering in live streams posed difficult construction problems.

AN ACCEPTABLE ALTERNATIVE

Forest Service engineers faced with tight time schedules for storm damage repairs studied alternate ways to reduce the costly repair and maintenance of ford crossings. The use of a system of precast median (Jersey) barriers as ford walls was a solution to this problem. These precast sections are widely used as temporary traffic separators during construction on state highways and are readily available in new and used condition (see Figure 1).

Jersey barriers are available in lengths of up to 20 ft. A standard section 12 ft, 6 in in length and about 5,000 lbs in weight was selected. This length can be easily transported and handled with equipment that is typically used in the construction and maintenance of low-volume roads.

Design

The structure of the ford wall consists of a series of precast concrete barriers that are embedded at a right angle to the stream and pinned and tied together with a length of 9/16-in cable and clamps (see Figure 2). The end sections are typically sloped upwardly to form a weir shape that forces the water to flow over the center of the structure. The center section is designed to be level.

A 1-ft-wide strip of 70 to 100 equivalent opening size (EOS) geotextile fabric is placed over each joint. The fabric will therefore retain fine-grained material on the upstream side of the wall and prevent holes from developing in the road grade.

The drainage structure should be sized to pass the anticipated storm runoff. Forest Service engineers perform a hydrological analysis for 50- and 100-yr stream flows for major structures. Structures of this type are sized for a 25-yr flow by using an appropriate weir formula or Manning's equation.

The structure is protected with riprap or gabions downstream, as required (see Figure 1). This process is described in many other publications. A 3/8-in-thick steel cap is placed on the structure to prevent bed load movement (boulders) from eroding the top of the concrete. This is easily done at the casting yard because the structures are cast upside down and a C6 × 10.5 steel channel is laid in the bottom of the form and anchored to the concrete.

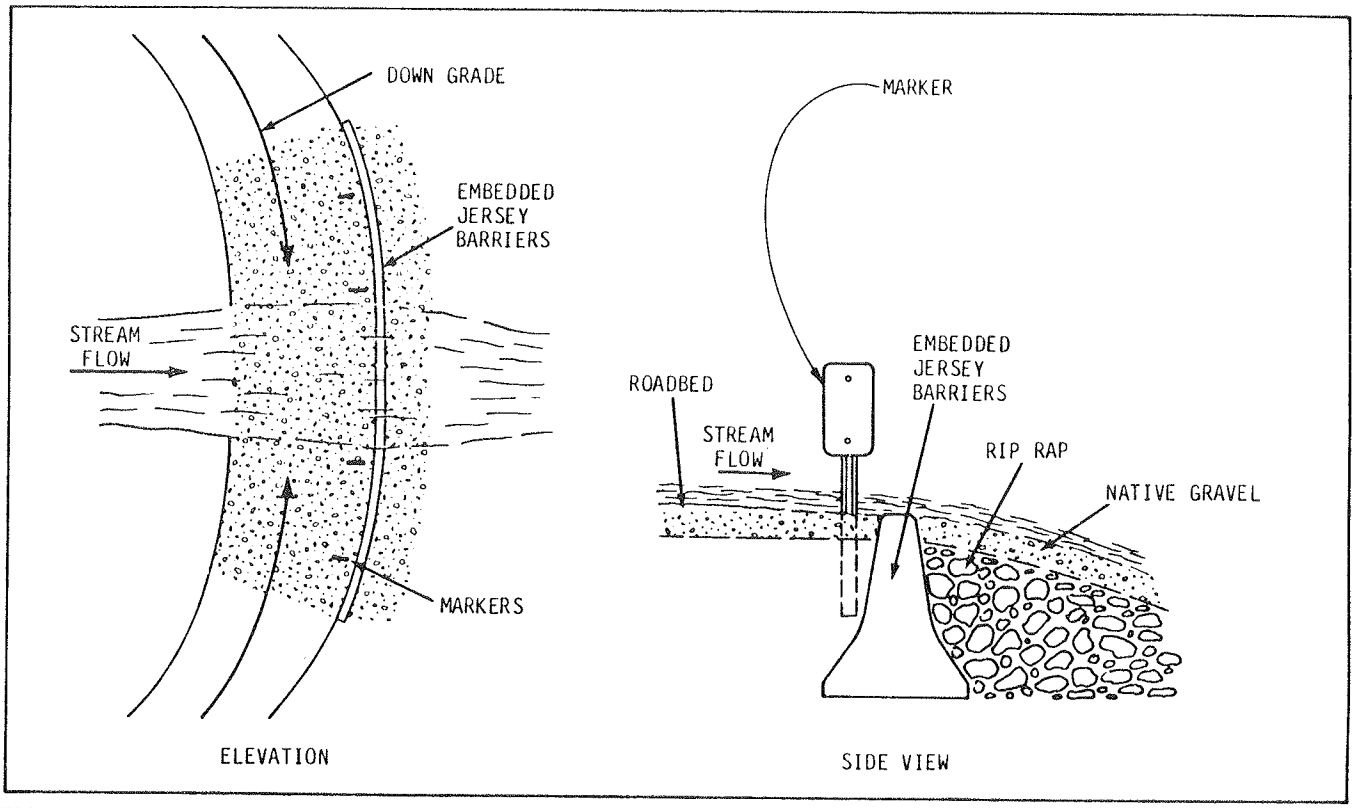

FIGURE 1 Typical installation of barriers.

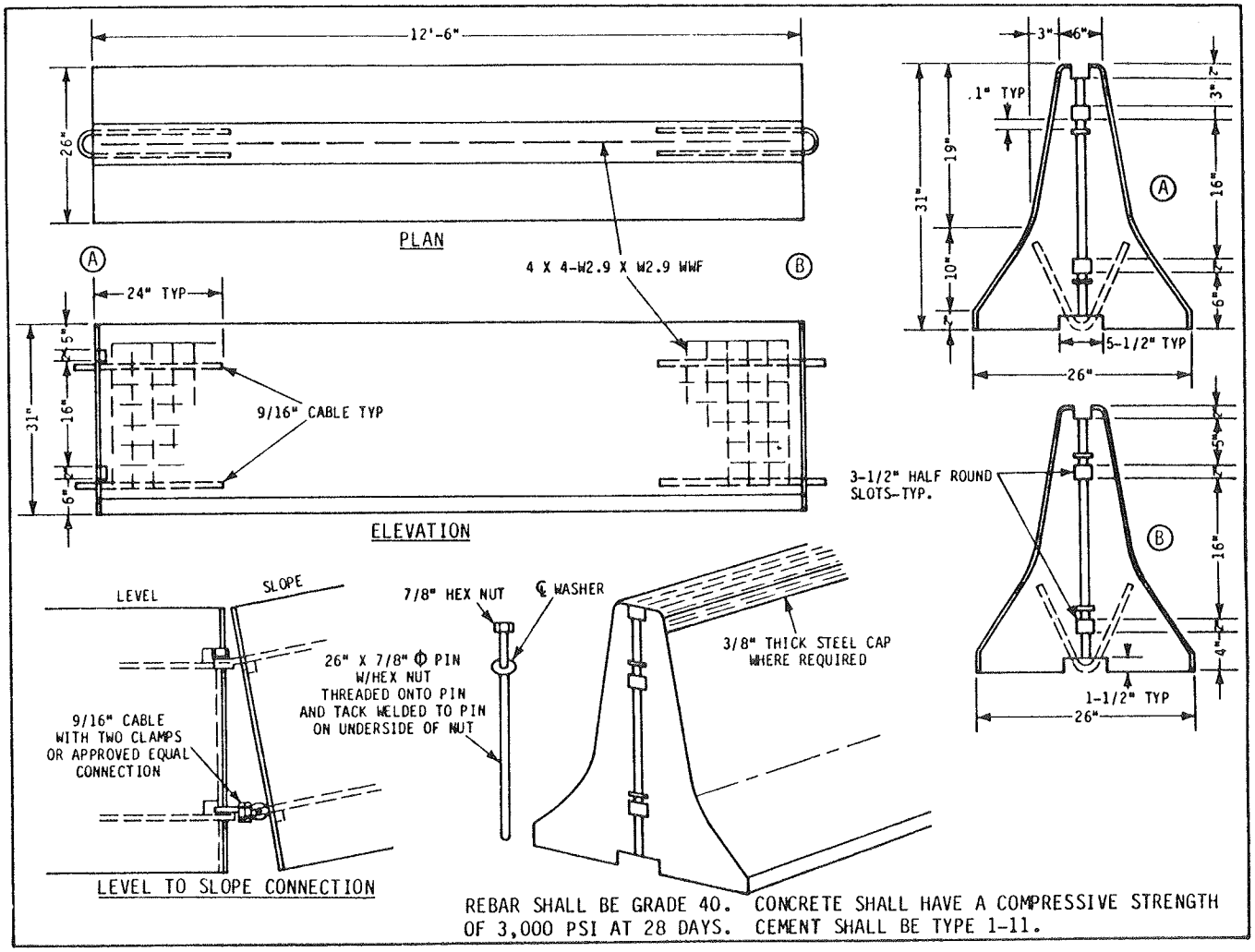

FIGURE 2 Typical fabrication details.

Installation

The equipment needed to install the structures consists of a rubber-tired backhoe and a boom truck or front-end loader large enough to handle the 5,000-lb load.

A trench is dug to the designed shape of the weir. The 12-ft, 6-in sections are then set directly into the trench and pinned or tied together with cable (see Figure 2).

CONCLUSIONS

The following benefits were realized by using precast concrete barriers as ford walls:

- They can be installed in intermittent or live streams without the complicated dewatering or diversion of water required for cast-in-place walls;
- The problem of transporting, forming, mixing, placing, and curing concrete at remote sites is eliminated;
- The foundation requirement is reduced because the base of the barrier is wide;
- Precast walls can usually be salvaged and reinstalled if they are washed out in extreme floods; and
- The purchase and installation costs are reduced from a range of $100 to $200 to $40 to $50/linear ft.

The use of precast concrete median barriers is recognized by the Forest Service as an economical, timely, and effective method of stabilizing ford crossings on low-volume roads.