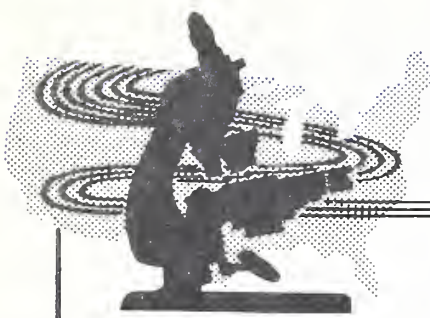


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ANCHORING AUTOMOBILE BODIES FOR STREAMBANK PROTECTION¹

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SUMMARY

Automobile bodies were used by the Agricultural Research Service, Southern Plains Watershed Research Center, Chickasha, Okla., to stabilize the banks of Winter Creek immediately upstream from a flow-measuring installation. The bodies were tied together with steel cable anchored to piling driven into the streambed and on the bank. Flexibility of the tying arrangement permits the bodies to move downward if the stream deepens. Similar installations have failed because of careless placement of the automobile bodies and inadequate anchorage. Willows, planted after silting and filling of the bodies began, helped obscure the ugliness of the car bodies. Automobile riprap cost only one-fifth as much as rock riprap for the same stream.

INTRODUCTION

The stream approaching a flow-measuring station operated on Winter Creek by the Agricultural Research Service, Southern Plains Watershed Research Center, Chickasha, Okla., threatened to cut around the weir because of bank erosion. Automobile bodies placed on the banks satisfactorily checked this erosion. This and similar installations will be described for those who might wish to consider the use of automobile bodies for streambank protection.

The measuring station endangered was located in an alluvial stream channel similar to many in southwestern streams. The alluvium

consisted of fine sands and silt. Streams in this material tend to meander and continually destroy adjacent agricultural lands and any buildings or structures on the lands. Most owners of property endangered by meandering streams cannot afford the more sophisticated bank protection used for industrial areas. Automobile bodies can be used to provide the low-cost control of meandering streams needed by farmers.

When construction is completed, woody plants, such as willows or other riparian vegetation, should be planted to make the banks more attractive. Most areas in need of protection are out of sight from the general public; therefore, automobile bodies for bank protection offer a practical and useful way to mitigate the eyesore of junk yards along our highways.

The success of installations of automobile bodies for bank protection depends primarily on the placement and anchorage of the bodies. Design and procedure for a successful installation are presented, along with an economic comparison with rock riprap. A survey of similar works on nearby rivers is presented.

THE SURVEY

When the possibility of using automobile bodies to check erosion at the Winter Creek station was proposed, little information could be found to indicate how the installation should be constructed. A survey was begun to determine where to place the protection, how to

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arrange the bodies, and how to anchor them if anchorage was necessary.

Many installations had been made along the Washita and South Canadian Rivers in Oklahoma by farmers and major oil companies. Since these rivers flow through alluvial areas similar to Winter Creek, the success or failure of these installations indicated some of the pertinent considerations for designing a successful installation. Eighteen observations were made by locating the automobile bodies by aerial photography, then investigating the location, taking photographs, and interrogating the landowners.

The most striking observation made over the entire survey area was the failures due to lack of some means of locking the bodies together. Figure 1 shows individual bodies anchored by cables to trees at the top of the bank. Shifting of individual bodies exposed the bank in spots and erosion undermined the trees used as anchors, thus destroying the effectiveness of the entire installation. Only one installation was found that had apparently been successful without anchorage.



Figure 1.--Bank protection failure due to inadequate anchorage.

Some installations made by oil companies were held in place by wood or steel jetties with the bodies used to protect the intervening areas. Costs are obviously higher for this type of construction, but no failures were observed. The intervening areas between jetties were not completely protected in some cases where velocities were low. One such installation is shown in figure 2. Willows were planted along this bank when the jetties were constructed.



Figure 2.--Partial protection between jetties proves successful when the area is not under direct attack.



Figure 3.--Complete protection between jetties by automobile bodies.

Another installation showing complete cover of the banks is illustrated in figure 3. This installation had been in place for 17 years and had not required extensive repair or alteration. At half-bankfull stages, the highest velocities approach this bank at approximately 45°.

The effective arrangement shown in figure 4 consists of bodies placed side by side with a slack steel cable run through the windows. Additional tiers of bodies are set back in the bank under the fill and also tied together with cable. The bodies appearing in this photo are protecting the most vulnerable part of the banks in sand and silt alluvium. On the South Canadian River the lower reaches of the channel are extremely wide and have low banks. Here, jetties such as those shown in figure 5 appear to control the location of the main channel very



Figure 4.--Automobile bodies used to prevent undercutting of an embankment on the Washita River.



(A)



(B)

Figure 6.--(A) An example of poorly arranged bank protection, (B) Displaced automobile bodies diverting flow in the channel.



Figure 5.--Low-flow jetties constructed of well-anchored automobile bodies on the South Canadian River.

well where flow depth does not exceed 7 or 8 feet. These jetties are anchored to one piling located at each end of the arrangement of bodies by threading a cable lengthwise through the bodies.

Unanchored bodies not only failed to provide the intended protection, but posed a severe hazard to control of the channel. Figure 6, A and B, was taken at the same location to illustrate how damaging random dumping of automobile bodies can be. The currents in figure 6, B, may cause radical change of direction of the channel at slightly higher flows than that shown in the photograph. Removal of these displaced bodies is both difficult and expensive after they have filled with sediment.

Adequate protection to accommodate possible change in the point of attack appeared to be important in this type of installation. All successful installations extended both downstream and upstream from the area under attack, thus allowing for any shift in the point of attack. Many failures were found where meanders had progressed downstream. Some failed at the upstream end because obstructions on the opposite bank caused the point of attack to move upstream.

THE DESIGN

The survey indicated that an adequate anchorage system was essential for the successful use of automobile bodies at Winter Creek.

The design illustrated in figure 7 was developed to accommodate any conceivable

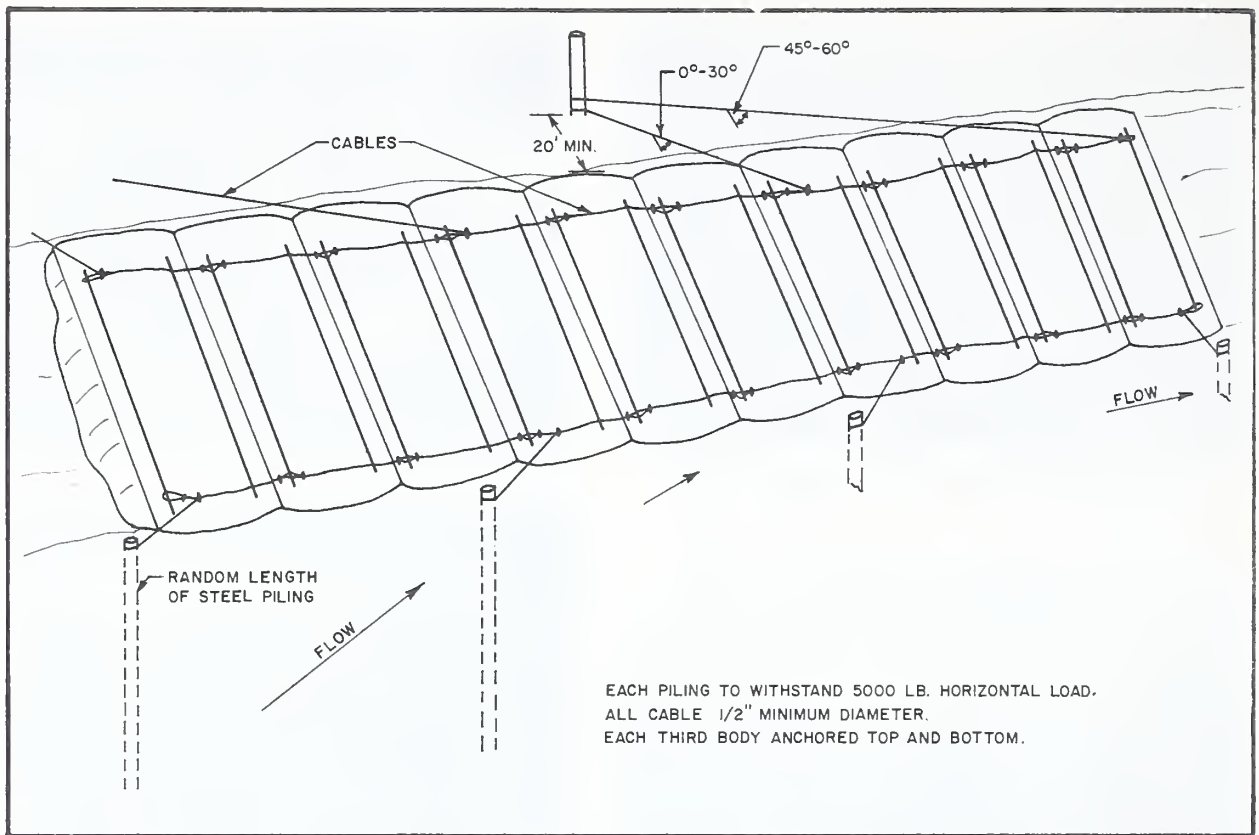


Figure 7.--Cable anchorage for automobile bodies.

change in direction of attack. Only bodies with frames should be purchased. Bodies are held in place on the lateral cables by clamping a splice to the frame as shown in figure 8. Anchor cables resist both movement downstream and movement away from the bank, yet are flexible enough to allow the entire assembly to settle when the stream bed is degrading. Additional flexibility for vertical movement of the bodies may be provided by loosening the cable clamps on excess cable attached to the anchor piling. Bodies should be placed top down to facilitate anchoring, and reduce turbulence in the streamflow.



Figure 8.--A simple cable arrangement for locking automobile bodies together.

INSTALLATION

The damaged area on Winter Creek had raw vertical banks 16 feet high. Damage was most severe on the left bank, requiring 280 lineal feet of protection. The right bank required only 120 feet.

Wood piling was placed in drilled holes on the top of the bank 20 to 30 feet from the raw

edge and driven to a depth 10 feet below the channel. Shorter steel piling was driven in the streambed approximately 15 feet from the bank. A crane was then used to place the bodies in position to be cabled and clamped. A bulldozer was used to apply tension to the cables attached to the top piling while anchor cables attached to the lower piling were left

slack. A portion of the completed installation is shown in figure 9.

Willow cuttings were planted between the cars and along the toe of the protection to develop a screen to cover the ugliness of the car bodies.

This installation was completed in July 1964 and has since been subjected to two high flows and to numerous flows up to 4 feet in depth. Depth of the highest flow averaged about 8 feet, with velocities ranging up to 10 feet/second. Sedimentation inside and behind the bodies was heavy on the first large flow, with as much as 4 feet of sediment being left inside. Subsequent flows have added to this deposit in some areas. The willow plantings have grown well where they were not subjected to heavy attack in the



Figure 9.--Upstream end of bank protection placed on Winter Creek north of Alex, Okla.

first flow. At the end of 3 years, the bodies are well screened from view (fig. 10). No maintenance cost has been necessary other than a periodic check of the cables.

COST COMPARISONS

Automobile bodies cost \$2.00 each in the junk yard. Hauling costs averaged \$11.20 each. The costs were:

56 bodies	\$740.00
Cable, clamps, and piling.....	170.00
Machinery rental and labor ¹	790.00
Total.....	<u>\$1,700.00</u>

¹ Crane, bulldozer, and five-man crew for 2 days.

An estimate was made for conventional rock riprap costs at this site as follows:

1,080 yards of backfill in place	\$1.00	\$1,070.00
180 yards of bedding in place	6.00	1,080.00
180 yards of spalls in place	6.00	1,080.00
900 yards of rock in place	6.30	<u>5,670.00</u>

Total cost of 400 lineal feet.....\$8,900.00

These estimates were based on cost of rock protection installed downstream from the automobile bodies (some of which can be seen in fig. 11) and rock protection used on four other weir installations in the immediate area. The cost of the automobile-body installation was about one-fifth that of the rock riprap.



Figure 10.--Downstream end of bank protection placed on Winter Creek north of Alex, Okla.



Figure 11.--Winter Creek installation after three years' growth of willows.

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