TEXAS TRANSPORTATION INSTITUTE
THE TEXAS A&M UNIVERSITY SYSTEM

Project Summary Report 1836-S
Project 0-1836: Regional Applications for Biotechnical Methods of Streambank Stabilization in Texas

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PROJECT SUMMARY REPORT

Biotechnical Streambank Stabilization: A Viable Technology in Texas

The Texas Department of Transportation (TxDOT) has commonly utilized concrete and other non-biodegradable measures to stabilize stream channels throughout Texas. While these practices have temporarily solved problems incurred by streambank erosion, evidence indicates a secondary effect occurs downstream and/or upstream of the structure. This secondary effect eventually causes failure of the structure, which not only leads to continual maintenance of the site but could also lead to the retrofitting or eventual replacement of structures.

Biotechnical engineering combines live plant materials with inert materials such as geosynthetics and rocks to provide protection of streambanks or slopes. Live plant cuttings are harvested and planted during the dormant period. This technique has been successfully applied in the United States; however, its use in Texas is still very rare.

This project investigated the applicability of biotechnical streambank stabilization techniques in Texas. The objectives of the research included:

- identifying applicable biotechnical streambank stabilization techniques for use in Texas,
- designing and building a streambank stabilization project coordinated by TxDOT local offices for demonstration purposes,
- developing and drafting reference/guideline materials, and
- developing detail drawings and specifications.

What We Did...

Researchers identified the biotechnical streambank stabilization techniques described in the literature as:

1. live stakes,
2. live fascines,
3. brushlayering,
4. branchpacking,
5. vegetated geogrids,
6. live cribwall,

Figure 1. Guardrail posts exposed after erosion of the streambank/embankment. Abandoned pipe crossing the creek caught a lot of debris. (Photo taken in May 1999)

7. joint planting,
8. brushmattress,
9. dormant post plantings,
10. tree revetment,
11. log and rootwad revetment, and
12. coconut fiber rolls.

Of these twelve techniques, the first nine require the use of live cuttings or live posts. These nine techniques may have a great potential for use in Texas because of the availability of suitable plants such as black willow (Salix nigra). In addition, researchers reviewed the literature for technical guidance on the application of these biotechnical techniques.

Demonstration Project

Researchers designed and built a streambank stabilization project located on Goode Road in Hutchins, Texas. This project represents the first attempt to provide a comprehensive biotechnical streambank stabilization plan on a TxDOT project using multiple biotechnical techniques. The demonstration project, an old bridge replacement and streambank stabilization project, allowed Texas Transportation Institute (TTI) and TxDOT the opportunity to test the applicability of biotechnical techniques for streambank stabilization in Texas. In addition, the project provided TxDOT design engineers examples of streambank stabilization alternatives. Furthermore, post-project monitoring efforts enabled researchers to collect plant growth and hydraulic data necessary for future streambank stabilization projects.

Goode Road's west-facing embankment is also the streambank of Cottonwood Creek. The creek's flow had severely eroded the roadway embankment. Particularly, a sewer and a water line crossing the creek caught large amounts of debris, which indirectly led to erosive currents downstream (Figure 1). To determine the new bridge elevation and the soil type and profile, researchers conducted a drainage study and collected soil data. Researchers also conducted a monitoring program to collect data for future application.

Researchers used vegetated geogrids to stabilize this streambank/embankment area. Geotextiles protect fine soil materials from erosion, geogrids provide soil reinforcement, and plant cuttings dissipate the energy of the stream flow.

The abutment of the bridge was eroded by the flow from the drainage swale and the scouring flow on the bend area. Because little or no sunlight can reach the abutment area, a structural technique without using vegetation was used (gabion mattress).

Dormancy Extension Study

The demonstration project fueled a further investigation into extending plant dormancy in order to offset significant challenges encountered when applying streambank stabilization to Texas' warm regions. The demonstration project identified five challenges—three strongly correlated to plant dormancy and planting period, because short dormant periods in warm regions make construction scheduling very difficult. The dormancy extension test procedure of each treatment type followed the sequence of:

- harvesting live cuttings during dormant periods,
- storing live cuttings using different storage treatments,
- removing portions of live cuttings from treatments and installing them every month for up to three months, and
- monitoring planted live cuttings.

What We Found ...

The literature review provided an inventory of biotechnical methods but offered no solid technical guidance for application in Texas. Biotechnical techniques tend to be region-specific and may be difficult to transfer to regions with different climates and soils. Since plant dormancy is critical for harvest and installation, the inability to transfer region-specific plant installation guidelines hinders application efforts in Texas. Most literature and documentation focuses on cold, dry climates where long winters allow more flexibility in scheduling biotechnical works and takes emphasis off the plant dormant period.

The demonstration project monitoring results offered cuttings' survival data, flow velocities sustained, and creek cross-section survey data. This built biotechnical streambank stabilization project in Hutchins, Texas, demonstrates the potential applicability of biotechnical methods in Texas. The project construction, completed in March

Figure 2. Gabion mattress abutment and streambank stabilized by vegetated geogrids. (Photo taken in May 2002)

2001, showed good vegetation growth conditions in May 2002 (Figure 2). However, the project encountered the following challenges:

- construction schedule conflicts;
- climatic constraints, such as short, rainy winters in Texas;
- plant physiological limitations, such as short plant dormancy period;
- insufficient technical guidance; and
- shortage of qualified contractors.

These challenges are discussed further in Research Report 1836-1.

Researchers identified the short, wet, dormant period in warm climates as the major challenge to applying biotechnical methods in Texas. Researchers then searched for a practical means of extending plant dormancy when construction and letting schedules do not correspond to actual dormant periods. Researchers investigated three storage methods:

1. cold storage,
2. onsite storage in compost, and
3. onsite storage in water.

For the single season of the comparison, the cold storage treatment showed the highest cutting survival rate among the three treatments and proved to be cost-effective. Onsite storage methods are probably not applicable because they do not maintain the cuttings in a completely dormant state. The dormancy extension experiment is described in greater detail and with additional data in research Report 1836-1.

The Researchers Recommend...

Biotechnical streambank stabilization is a viable technology that has application in almost all areas of Texas. However, the site-specific characteristics of streambank stabilization projects make the development of a stepwise procedure for selection of biotechnical techniques impractical. In addition, Texas' short, rainy winters and correspondingly short dormancy periods combined with the timing difficulties of the letting process make biotechnical construction scheduling very difficult.

For future development and implementation of streambank stabilization projects, researchers recommend the following:

- Project letting must be scheduled so that live cuttings can be installed and harvested within the normal dormancy period of a particular region of the state.
- Live material installations must be started after the onset of dormancy, usually December, and completed no later than three months after harvest when stored using the cold storage method.
- TxDOT should develop an educational program to inform designers about the application of biotechnical stabilization techniques, especially where environmental conditions require special attention.
- TxDOT should develop a vehicle that will allow designers to access technical support for selection and design of biotechnical techniques.

For More Details . . .

The research is documented in Report 1836-1, *Investigating the Applicability of Biotechnical Streambank Stabilization in Texas.*

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TxDOT Implementation Status
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This project evaluated the viability of biotechnical streambank stabilization in Texas. Biotechnical engineering combines live plants with inert materials such as geosynthetics and rocks to provide protection of streambanks or slopes. The project conducted a pilot demonstration of biotechnical streambank stabilization and developed draft guidance and specifications for biotechnical streambank stabilization. The results of the research will form the foundation of future Texas practice in this technique.

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