Soil Bioengineering Repair of a Highly Steepened Waterway Bank

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A BANK REPAIR ON A FLOOD PRONE WATERWAY IN HOUSTON, TEXAS

Buffalo Bayou in Houston, Texas.

This soil bioengineering vegetated reinforced soil slope (VRSS) structure installed 25 years ago is a synergistic design combining geogrid, drainage and live cut branches installed in between reinforced soil wraps. The design was developed to repair a 36-foot high bank failure caused by subsurface seepage, frequent flash flood events, highly erodible soils, long dam release periods and rapid drawdown. See Figure 1. The work describes the pre-and post-construction conditions, environmental and aesthetic benefits, vegetation selection, design considerations and the excellent long-term endurance of this soil bioengineering design.

Soil bioengineering is an integrated technology using sound engineering practices and ecological principles to assess, design, construct and maintain dynamic watershed lands for the protection and enhancement of healthy functioning systems. Combining specific soil bioengineering vegetative techniques with geosynthetic reinforcement and drainage formed a strong fully functioning composite system. The project developed a synergistic system with enhanced opportunities for exceptionally aesthetic and environmental functions within a sound engineering structure. See Figure 2.

Figure 1. Initial failure conditions 1993

Figure 2. Installing live cut branches

This case study includes basic principles of soil bioengineering that are intended to provide an initially strong foundation where nature can thrive and become self-sustaining mechanically, hydrologic/hydraulically and ecologically. The main benefits of woody vegetation on the mass stability of slopes and streambanks include root reinforcement, soil moisture modification, buttressing and arching. (Sotir et. al., 2003). See Figure 3. These combined with a geogrid reinforced slope produce a system that is stronger and has broader mechanical and environmental functions than either system used alone. The reinforcement provides for an immediate and long-term foundation. Mechanically, the soil bioengineering provides a

significantly more durable facing treatment, protection to the outer surface while improving the internal stability and soil reinforcement of the system. Biologically, this system offers modifications in soil and water temperatures, sets in place enhanced wildlife habitat, aquatic life, ecological diversity including riparian wildlife corridors and connectivity to the uplands.

This project contributes to the preservation of a healthy biologically functioning Buffalo Bayou "Ribbon of Green" system flowing through Houston, Texas. See Figures 4 & 5. Furthermore, it is an important component in meeting specific stream, river and bank requirements for both structural and environmental goals such as flood control, stormwater management, stabilization and aquatic, riparian and upland restoration and aesthetic enhancement. It also provides an opportunity to meet agency permitting requirements where alternative hard structures such as riprap or sheet pile options would not be acceptable.

Figure 3. Bank conditions 1994

Figure 4. Bank conditions 1998

Figure 5. VRSS Bank conditions 2018

CONCLUSION

Since construction, this project designed for the 100-year flood event has survived several 500 years hurricane/tropical storm events including Hurricane Harvey in August 2017, a testament to the strength and endurance of these soil bioengineering composite structures.