ESCSI

FEATURED PROJECT

07-2002

Big River Industries

Bluff Stabilization, Natchez, Mississippi

LOCATION
Natchez, Mississippi

PROJECT OBJECTIVE
Stabilize 180-foot high riverfront bluff

PROJECT DIMENSION
Construct wall 32 feet high by 850 feet long to stabilize access road bed; construct stabilizing wall on bluff face 62 feet high by 450 feet long; backfill with lightweight aggregate

OWNER
City of Natchez, Mississippi

DESIGN/BUILD TEAM
Hayward Baker, Inc.
Ogden Environmental and Energy
Burns, Cooley, Dennis

LIGHTWEIGHT AGGREGATE PRODUCER
Big River Industries, Inc.
Gravelite Division
Baton Rouge, LA

QUANTITY OF EXPANDED CLAY LIGHTWEIGHT AGGREGATE USED
15,600 cubic yards

Saving a National Landmark

Lightweight Aggregate Plays An Important Role In Geotechnical Engineering Solution

Can a bluff be a national landmark? If it's along the Mississippi River in Natchez, Mississippi, the answer is yes. The bluffs are sliding into the river, and some ingenious geotechnical engineering is part of the rescue effort.

The lower wall is stabilized with soldier piles and anchors, and rises 32 feet and runs for 850 feet; the upper wall has a maximum height of 62 feet and is 450 feet long, and incorporates expanded clay lightweight aggregate.
(Photography by Kenneth Bergeron)

ERODING BLUFF THREATENS HOMES

An age-old conflict between man and nature was played out at the edge of a 180-foot bluff in Natchez, Mississippi, where a row of houses was hanging over a sheer drop to the river below. The rescue mission included some very resourceful people at city hall, several federal agencies and the design/build team comprised by the Atlanta office of Hayward Baker Inc. (HBI), Ogden Environmental and Energy, also of Atlanta, and Burns, Cooley, Dennis of Jackson Mississippi. But the real star of this show was the combination of geotechnical solutions applied to the dilemma.

INNOVATIVE GEOTECHNICAL SOLUTIONS INCLUDE LIGHTWEIGHT AGGREGATE AND SBMA's

The soil in the area, a wind-blown silt known as loess, can "turn to soup" when wet, according to John Wolosick, HBI's area manager. Soils of this type pose an engineering enigma. According to Roger

Engineers installed conventional ground anchors and single-bore multiple anchors to stabilize the Mississippi loess.
(Photography by Kenneth Bergeron)

Cockrell of the U.S. Army Corps of Engineers in Vicksburg, “Loess has been studied for years, and there are plenty of theories on its behavior, but no consensus.” Cockrell will oversee further bluff stabilization in the area when funds are available.

Using soil nails in the Mississippi loess was one of several innovations on the project. Single-borne multiple anchors (SBMA) made their U.S. debut at Natchez, and yet another first was the use of soil-mixing augers to install soldier piles. Additionally, some of the residents’ front yards were partially restored in a unique combination of systems that included lightweight aggregate in a section of the upper wall of the project.

BLUFF BACKGROUND

Their have been landslides along the bluffs for centuries, according to David Gardner, city engineer for Natchez. Geologists can match soil layers at the foot of the bluff with those at the top, suggesting rotational failure of ancient occurrence. Within the past 100 years, “sliver” slides have been recorded, along with resulting property loss, and in 1980 the loss of two lives.

Lightweight aggregate backfill placement behind Keystone Retaining Wall.
(Photography by Kenneth Bergeron)

One recent factor could be the Giles cuttoff, engineered by the Corps in 1933, one of many efforts to straighten the meandering Mississippi and deepen its navigational channel. Some believe this “correction” caused the river to run directly into Natchez. Since 1933, the city has lost 22 acres.

Natchez has a population of 19,500, and tourism is the major local industry with over 600,000 visitors each year. The bluffs and their surroundings were accorded National Register status in 1982. In the mid-1980’s, the Department of the Interior funded studies for preservation recommendations. In 1996, funding of $5.3 million was allocated by the National Resource Conservation Services, part of the Department of Agriculture, for emergency assistance. Additional funding under the Water Development Authorization Act of 1996 was also sought for the more extensive bluff stabilization program.

PHASE 1

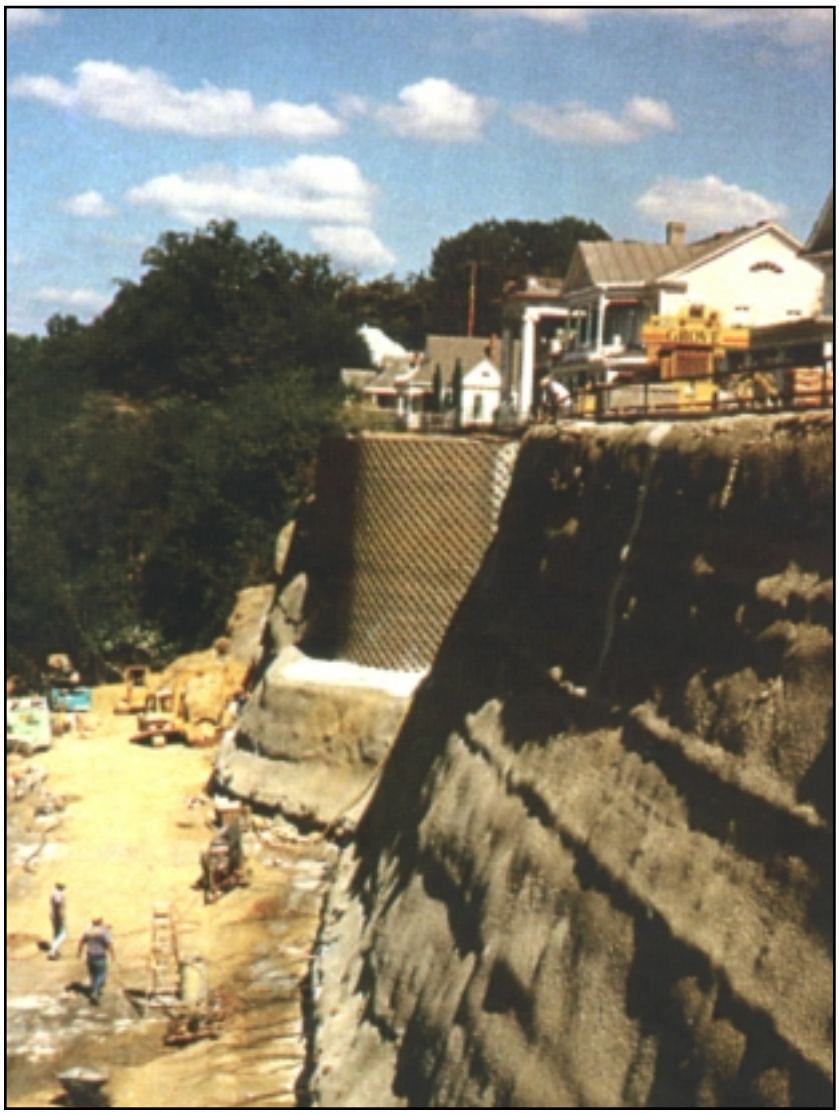
Phase 1 included a geotechnical investigation of the site and the design and construction of a temporary access road for the residents at the bottom of the bluff. It also included the design of the two lower retaining walls along Learned Mill Road which leads to the bluff summit.

PHASE 2

In Phase 2, the design/build team constructed the two lower retaining walls along Learned Mill Road, which had been undermined 4 to 6 feet in some places.

PHASE 3

Phase 3 of the contracted work included a surprise, says HBI’s Wolosick. The city decided that the design for the 62-foot high uppermost wall had to include a section to restore some frontage to the Clifton Avenue Property owners. This wall runs for 450 feet and is stabilized with 550 soil nails and 65 SBMAs. The initial 8-inch-think shotcrete is covered by a thinner cosmetic layer, colored to match the loess on the surrounding bluffs.



The Keystone Retaining Wall, backfilled with Lightweight Aggregate, provided an economical and aesthetically pleasing method to restore the eroded frontage property. (Photography by Kenneth Bergeron)

LIGHTWEIGHT AGGREGATE TO THE RESCUE

To restore the eroded area for the Clifton Avenue property owners, a Keystone Retaining Wall was utilized. This type of wall can be constructed with very little batter (slope). Since the eroded area had to be filled for the restoration, the Keystone Retaining Wall was a logical choice. This mechanically stabilized earth (MSE) wall system used Tensar Geogrid reinforcement and 15,600 cubic yards of Expanded Clay Lightweight Aggregate backfill in the reinforced zone of the

Aerial view of completed bluff stabilization project.

wall. Construction of the Keystone Wall on top of the soil-nailed wall presented design challenges since the soil-nailed wall was not designed for the additional weight created by the restored property above. In order to minimize the stress on the lower soil-nailed section, the near vertical Keystone Retaining wall was backfilled with Lightweight Aggregate. Even though the cost for Lightweight Aggregate was greater than conventional fill, Lightweight Aggregate has a much lower unit weight and a higher degree of internal stability. This combination of physical properties made Lightweight Aggregate the perfect fill for this challenging site.

WHAT'S NEXT

It is possible that another $26 million will be spent to stabilize the Natchez bluffs. Paul Montalbano, geotechnical engineer with the Army Corps of Engineers says soil nails and mechanically stabilized wall techniques will continue, and the segmental retaining wall system with reinforced lightweight aggregate backfill will be extended.

Some text exerpted from "Saving the Bluffs: Engineering on the Edge," by Virginia Fairweather; ***Civil Engineering***; December 1997; pp. 37-40. Selected photographs by Kenneth Bergeron.

For Additional Information About Geotechnical Applications for Lightweight Aggregate

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