SCHWANTES, E. D., JR.
Consulting Geotechnical Engineer, Huntington Beach, California, USA

Recent Experience with Fabric-Faced Retaining Walls
Expérience récente avec de soutènemente à façade en géotextile

SUMMARY

Three experimental retaining walls were constructed using a composite, fabric facing supported by a Reinforced Earth mass. Because the basic components are strong, light weight and relatively inexpensive, it is expected that such walls could have many different uses on both military and civilian projects in remote areas. This paper briefly describes the intended purpose of the test walls, the composition of the fabric facing, the general construction sequence, and a discussion of potential uses for this type of construction. The use of the composite fabric for erosion protection is also presented.

SOMMAIRE

Trois murs de soutènemente experimentaux ont été construit avec un géotextile composé et soutenu par un massif de Terre Armée. Puisque les constituants élémentaires sont solides, légèrs et assez économiques, il est prévu que ce genre de mur peut avoir plusieurs usages pour projects militaires et civils dans des endroits lointains. Cette note technique décrit brièvement l'objet des murs d'essai, la composition de la peau en géotextile, la méthode de construction ainsi qu'une discussion en ce qui concerne les usages possible de ce genre de construction. L'usage du géotextile composé pour la protection contre l'érosion est aussi présenté.

INTRODUCTION

During the summer of 1980, three experimental retaining walls varying from 2 to 6 meters (6 to 18 feet) high were constructed in Woodbridge, Virginia, U.S.A., by the author with the support of the Reinforced Earth Company. These walls, which averaged 30 meters (100 feet) in length, were unique in that the vertical wall facing was a composite fabric supported by a Reinforced Earth mass. The following describes some of the more significant aspects of design and construction of these walls.

PURPOSE

The concept for fabric faced walls evolved from an earlier concept to stabilize steep slopes (1:1 or steeper) using an open weave fabric and Reinforced Earth strips. It was hoped that this might result in a relatively inexpensive method for improving land utilization in densely populated areas. Since the design modifications to develop a vertical wall were minor, this was the next logical step.

The various components of the fabric facing are significantly less expensive than concrete. However, because they have a shorter design life (estimated to be 10 to 15 years), these walls are considered to be temporary structures. Thus the ultimate market for such walls would be in remote areas, where the need for strong, flexible, inexpensive structures is greater than the need for polished appearance and long design life.

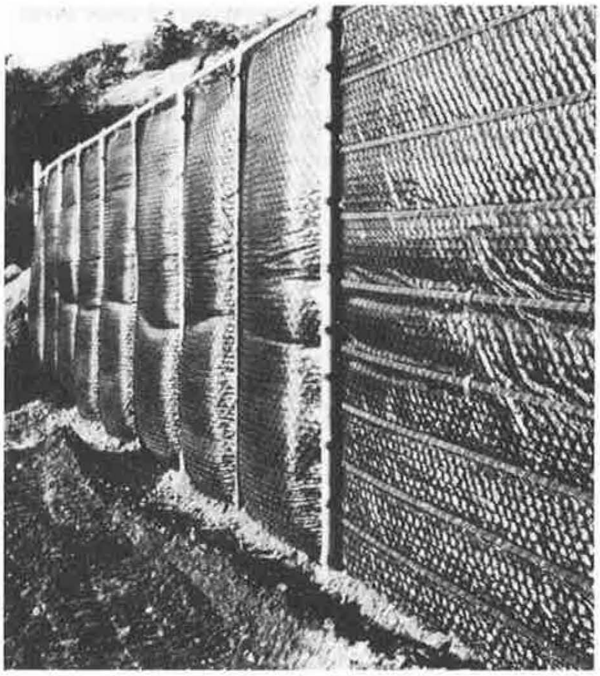

PHOTO 1 FABRIC FACING, TEST WALL NO. 3

PHOTO 2 TEST WALL NO. 3, BEFORE BACKFILLING

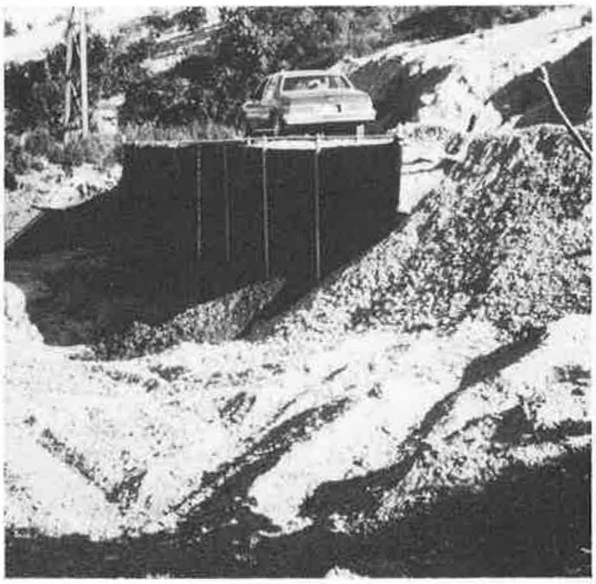

PHOTO 3 TEST WALL NO. 3, BACKFILLED

FACING MATERIALS

The wall facing consisted of woven polyproplene fabric (Poly-Filter X) bonded to polyvinyl chloride coated and galvanized, steel wire mesh. The steel mesh used in all three walls was a conventional 9 gauge chain link fencing fabric (Photo 1).

This composite material has several significant advantages; it is strong, light weight, flexible, free draining and relatively inexpensive. It is also possible, by special arrangement with materials suppliers, to use various colors to better blend into the surrounding environment.

During construction a variety of connectors and stiffness were tested to determine the most satisfactory method of attaching the facing fabric to the Reinforced Earth strips embedded in the backfill. Attempts to build pre-fabricated facing panels, which could be lifted and bolted into place, proved unsuccessful. In the end, the best facing erection technique was to hang and stretch the facing fabric on conventional, steel fence posts spaced on 2-meter (6-foot) centers. The Reinforced Earth strips were then attached to the posts. Figure 1 shows a typical cross section through Test Wall No. 3.

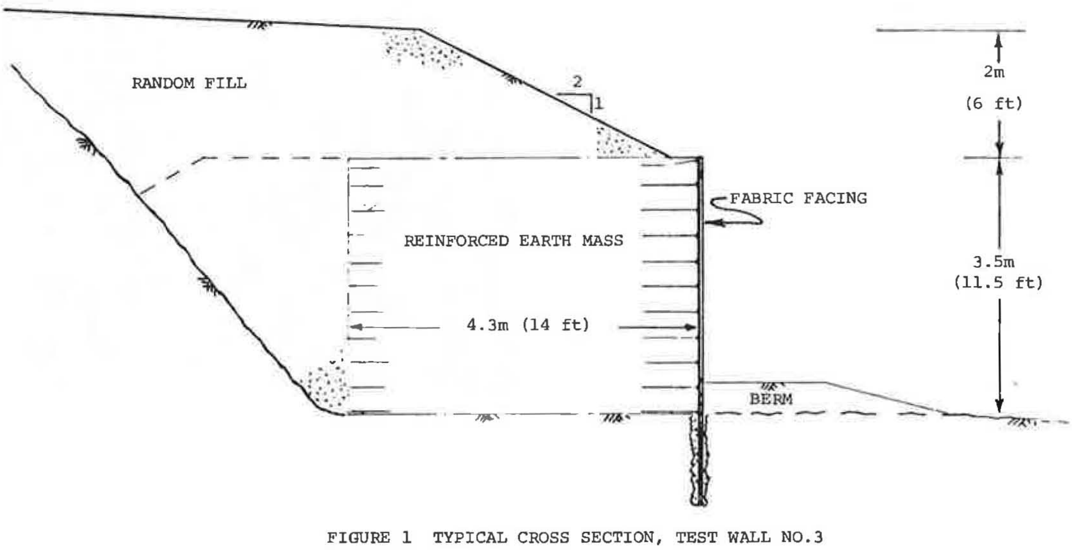

FIGURE 1 TYPICAL CROSS SECTION, TEST WALL NO.3

REINFORCED EARTH MASS

Reinforced Earth has been used world wide to construct hundreds of retaining walls. Generally these walls are faced with either precast concrete panels or galvanized steel panels.

As in other Reinforced Earth structures, the three experimental walls used galvanized reinforcing strips built into the granular backfill to provide tensile resistence to the earth mass, much as reinforcing bars do in reinforced concrete (Photo 4). Thus the fabric facing served largely to contain the granular backfill and provide a finished exterior surface.

PHOTO 4 REINFORCED EARTH STRIPS, TEST WALL NO. 1

CONSTRUCTION PROCEDURE

After several attempts, the most satisfactory sequence of construction was as follows: rough grade site, set fence posts, attach and stretch facing fabric onto posts (Photo 6), attach connectors, bolt on lower level of Reinforced Earth strips (Photo 7), place and compact initial lifts of backfill. Additional strips are attached as the backfilling progresses (Photo 8). This is repeated until the backfill is brought up to the top of wall (Photos 9 and 10). Following this procedure, a 4-meter-high wall, approximately 35 meters long, could be completed in 2 to 3 working days using a relatively small labor crew (4 to 5 men and light weight equipment. Because of design and construction constraints, it is estimated that 8 meters (25 feet) is a realistic limit on the height for this type of wall.

Following construction, wall performance was observed by applying traffic loads from trucks, construction equipment and a dead load from stacked concrete panels (Photo 5). Though the walls were not loaded to failure, it was determined that they performed as designed; no significant distress under heavy load.

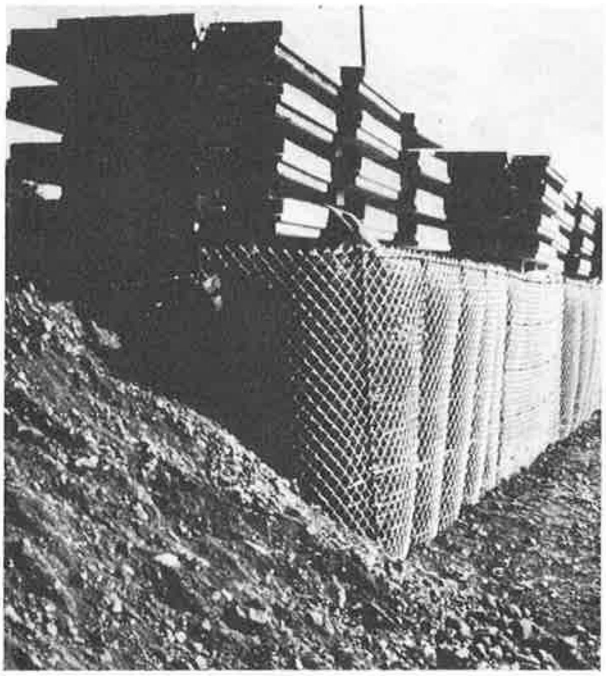

PHOTO 5 LOAD TESTING TEST WALL NO. 1

POTENTIAL USES

Because the structural elements (facing, connectors and reinforcing strips) are relatively light weight, this type of wall construction is well suited for remote locations. The construction of logging roads in mountainous terrain is one potential use.

The materials are also well suited for a variety of military applications, such as roads, helicopter landing pads, railroad embankments and airfields. With a little advanced planning, entire retaining wall systems (except the backfill) could be packaged and air dropped into the construction site.

The facing material also makes an excellent slope cover or channel lining to reduce erosion of sandy or fine grained soils. For this use the facing fabric is "nailed" to the underlying ground using "nails" fabricated from No. 4 reinforcing bars. The "nail" spacing and length varies considerably depending on the soil conditions and the severity of the flow through the area to be protected.

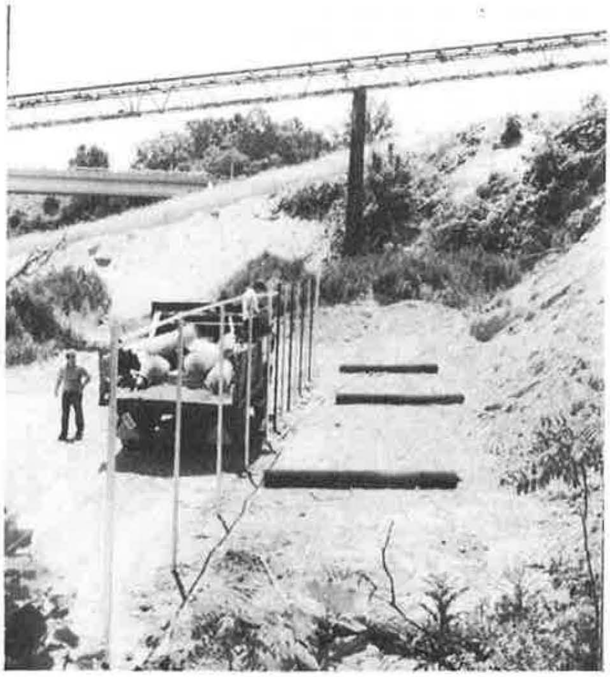

PHOTO 6 HANGING FABRIC FACING, TEST WALL NO. 3

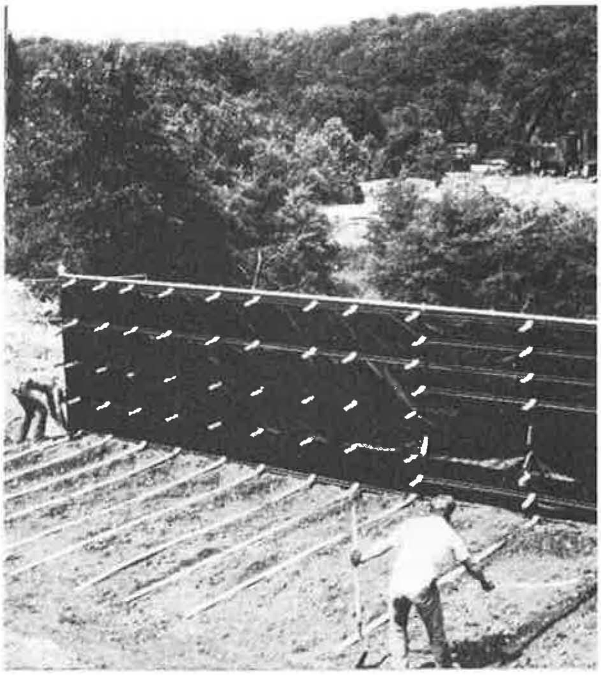

PHOTO 8 ATTACHING REINFORCING STRIPS, TEST WALL NO. 3

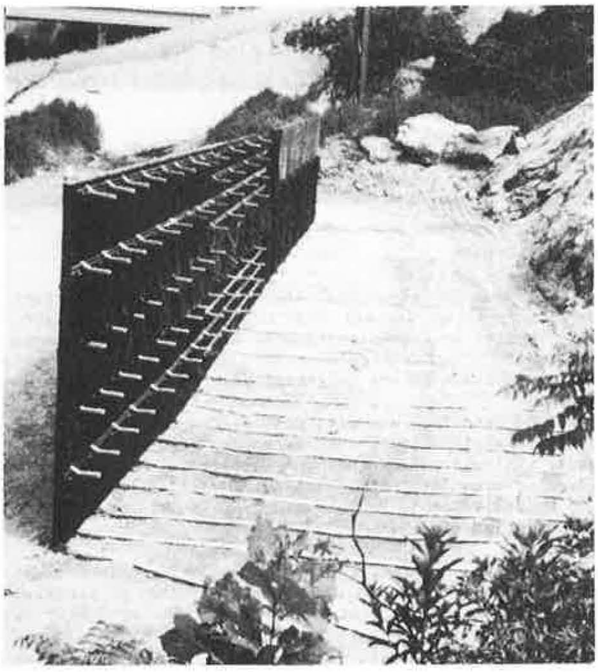

PHOTO 7 READY TO START BACKFILLING, TEST WALL NO. 3

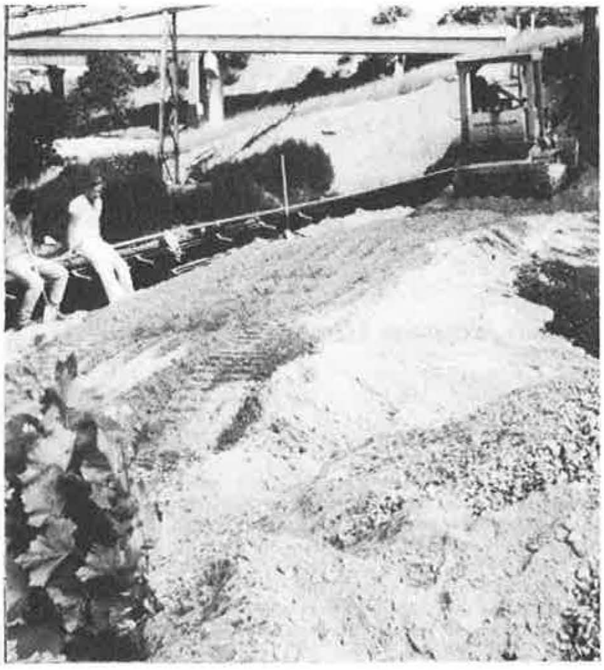

PHOTO 9 SPREADING BACKFILL, TEST WALL NO. 3

PHOTO 10 COMPACTING BACKFILL, TEST WALL NO. 2

PHOTO 12 TEST WALL NO. 3

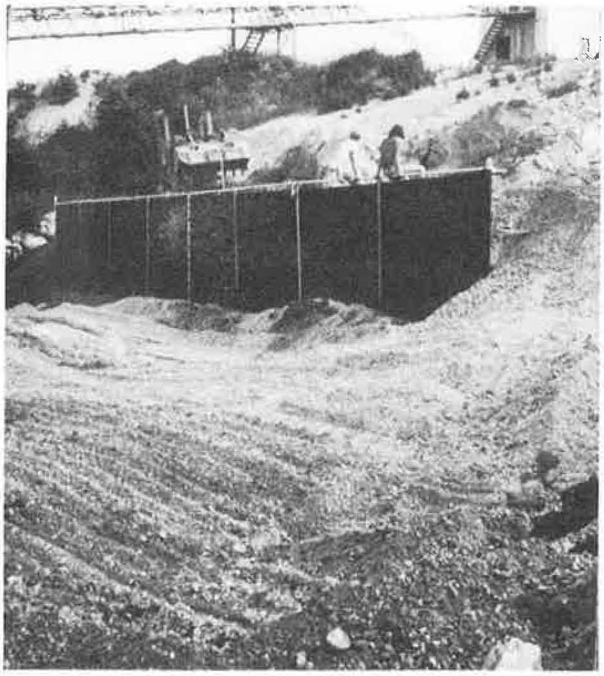

PHOTO 11 BACKFILLING TEST WALL NO. 3

CONCLUSIONS

The three test walls demonstrate that fabric-faced Reinforced Earth walls are strong, flexible, relatively inexpensive and portable. Though test construction has shown the concept to be a practical engineering application, marketing of the system has been deferred. However, some ongoing study is in progress to mitigate long term problems related to ultraviolet deterioration, to determine the effects of fire and lightning, and improve the visual appearance by using colored components to blend with the environment. Improved procedures for bonding the cloth to the wire mesh are also being evaluated.

ACKNOWLEDGEMENTS

Research and construction funding provided by The Reinforced Earth Company, Washington, D.C., USA.

Poly-Filter X fabric for Test Wall No. 3 donated by Carthage Mills, Cincinnati, OH, USA.