New Products and Current Trends in Natural Shoreline Engineering

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OVERVIEW

• What are natural shorelines and bioengineering
• Design considerations
• Bioengineering techniques, new and old
WHAT IS A LIVING SHORELINE?

“A shoreline management practice that provides erosion control benefits; protects, restores or enhances natural shoreline habitat; and maintains coastal processes through the strategic placement of plants, stone, sand fill, and other structural organic materials (e.g., biologs, oyster reefs, etc.).”

- NOAA Shoreline Glossary
THE BIG PICTURE.....

- Natural shoreline engineering efforts are becoming commonplace nationwide
- State, Federal, and Local agencies are requiring bioengineering in many cases
- Technology has gained acceptance by the traditional engineering world
- The level of sophistication has grown across the board
WHERE HAVE WE BEEN?

BEFORE:
Mid 1900’s method of stabilizing shorelines using various forms of construction debris…

AFTER:
Replacing rubble with clean backfill, controlling toe erosion and restoring ecological function & value
WHERE HAVE WE BEEN?
WHERE HAVE WE BEEN?
How DYNAMITE streamlines streams

Crooked streams are a menace to life and crops in the area bordering on their banks. The twisting and turning of the channel retards the flow and reduces the capacity of the stream to handle large volumes of water. Floods result. Cross arms rupture. Lives are lost. Banks are undermined, causing caves and gullies that scar valuable property.

In many instances straightening out a stream has doubled its capacity for discharging run-off water.

DYNAMITE may be used most efficiently and economically in taking the kinks out of a crooked stream. The dynamite is loaded along the length of "cut-off" channel. When fired, the dirt and other debris is hurled high so the area is in shambles over the adjoining territory—leaving practically no spill banks. In addition to the material actually thrown out, much dirt is loosened and is later scoured out by the water which rushes swiftly through the straightened channel.

Du Pont Dynamite has straightened many thousands of miles of crooked streams. Du Pont engineers have worked for years to develop the best blasting methods for the cleaning out and straightening of streams. All their data is in a 48-page book, "Ditching with Dynamite." It is for your use. Write for it.

Dynamite can help you do other jobs, too. It can help you build highways, dams; fight willows; remove waste quarries. Du Pont has an explosive for every purpose.
1937

Feb. 23, 1937.

M. S. WILLING

MEANS FOR PREVENTING SOIL EROSION

Original Filed July 10, 1935

2,071,779

UNITED STATES PATENT OFFICE

2,071,779

MEANS FOR PREVENTING SOIL EROSION

Mark S. Willing, Mount Holly, Va.

Application July 10, 1935, Serial No. 29,712

Reissued November 6, 1958

(31—11-13)

2 Claims.

This invention relates to improvements in means for the prevention of soil erosion by flowing water.

One object of the invention is to provide a device of simple and inexpensive construction which will be highly efficient in preventing soil erosion by flowing water.

A further object is to provide a device of this nature which lends itself readily to being assembled in any desired numbers, the several individual devices being interconnected, one with the other, to form an extended mass of desired size to stem the flow of water over any given area, thus preventing or curtailing the scouring or eroding action of the water.

A still further object is to provide a framework container of flexible material which will readily adapt itself to the contour of the surface upon which it is placed.

More specifically, the invention contemplates means for preventing soil erosion by flowing water, said means consisting of a flexible container of wire mesh material, preferably filled with means for augmenting the accumulation of earthy matter therein and a plurality of hooks secured to said container and more or less permanently positioned around the same, whereby two or more of said containers placed in contact with one another will become entangled and form a substantially unitary mass.

With these and other objects in view, the invention consists in certain details of construction and combinations and arrangements of parts, all as will hereinafter be more fully described, and the novel features thereof particularly pointed out in the appended claims.

In the accompanying drawings:

Figure 1 illustrates a mass of the present containers located in a depression in the earth's surface, under which circumstances further erosion by water flowing along the depression will be prevented.

Fig. 2 is a side elevation of one of the individual containers.

Fig. 3 is a transverse sectional view on the line 1—1 of Fig. 2, and

Fig. 4 is an end elevation of the container.

In order that there may be some separation or flow of water through an obstruction formed by a multiplicity of the containers of the present invention, said containers are made of a mesh-like material, a wire mesh material being illustrated in the present instance. Enclosed within each container is a material which will facilitate motion so as to form a substantially closed obstruction to the flow of water in the channel in which the mass of containers is assembled. One material that can be used, as illustrated in the present instance, is brush or heavy weeds or, like, preferably secured more or less in bundles by means of bands.

As illustrated in Fig. 1, a large number of the containers 10 are massed in a depression or channel in the earth's surface 12. In other words, this depression may be assumed to have been formed by an erosive force of water over this area, and by damming up the depression with the containers, further erosion or scouring of the earth's surface at this point will be prevented.

If desired, additional weight may be given the individual containers by some means, such as employing rather large stones or rocks (not shown) within the brush material, but such anchoring masses are not essential as the present container is provided with a number of hooks 16 distributed pervasively around the container. Each hook is formed with an eye at one end, loosely encircling one or more of the wire strands constituting the mesh material, so that the hooks may be said to be pivotally secured to the container. In depositing or throwing the containers in or on the area to be protected, a number of them may be secured together by hooking one into the other, prior to placing them on the earth, or they can be thrown in individually and, due to the irregular disposition of the hooks and the swiveling action of which they are capable, the bundles, as they are successively placed in contact with one another, will immediately become entangled and thus build up a mass such as illustrated in Fig. 1. Furthermore, the hooks, in addition to facilitating entangling the containers one with the other, also serve as anchoring means, because they will readily attach themselves to irregularities on the surface on which the containers are placed.

It will also be observed that no frame is used in the present container. Therefore, due to the flexibility of the mesh, the container is formed, the containers will readily adapt themselves to major irregularities in the surface of the ground on which they are placed.

The construction of the individual containers is such that they may be produced at very little expense and, by the provision of the several hooks on each container, they may be readily and securely entangled to build up a mass of the desired...
WHAT IS NATURAL SHORELINE ENGINEERING (BIOENGINEERING)?

• “An applied science that combines the use of engineering design principles with biological and ecological concepts to construct and assure the survival of living plant communities that will naturally control erosion and flooding.” – Bioengineering Manual

• Techniques originated by Forest Service to stabilize eroded areas using natural, on-site materials

• Focuses on balancing functionality with the surrounding ecosystem

• Incorporates natural and man-made materials to prevent or minimize erosion
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STABILIZATION TECHNIQUES: A CONTINUUM OF CHOICES

Bioengineering
Native plants and natural materials

Biotechnical Engineering
Native plants, rock, and erosion control materials

Structural Engineering
Rock, gabions, sheetpile, and concrete
CHOOSING A STABILIZATION TECHNIQUE

- Erosive Forces
- Cultural Issues
- Regulatory Concerns
- Goals
- Resources (Time, Money, etc...)

Ecology

(Data and image from GEI Consultants)
CHOOSING A STABILIZATION TECHNIQUE

Erosive Forces

Cultural Issues

Ecology

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GEI Consultants
UNDERSTANDING NATURAL SHORELINE ENGINEERING GOALS

Goals

• Why do you want to use bioengineering?
• What is causing the erosion?
• How severe is the problem?
• What limits the potential solutions?
DESIGN CONSIDERATIONS

- Form MUST follow function
- Cost vs. risk
- Aesthetics
- Sunlight
- Habitat considerations (ie, threatened, endangered or rare species)
- Access to site
- Soils/moisture
- Waves/shear stress/erosive forces

Erosive Forces

Cultural Issues

Ecology

Regulatory Concerns

Goals

Resources (Time, Money, etc...)

Resources

Goals

Erosive Forces

Cultural Issues

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GEI Consultants
SO HERE’S THE THING ABOUT “NEW” PRODUCTS….

- All variations on the same themes that have been used for decades
- What’s old to one person is new to another
- Some people might consider all bioengineering “new”, compared to traditional shoreline stabilization techniques
- Note—the techniques about to be shown are not automatically endorsed!
SO HERE’S THE THING ABOUT “NEW” PRODUCTS....

• Techniques aren’t changing much, but the sophistication behind their application is

• We’re gaining a better understanding of when and where to use these techniques

• Being accepted into engineering mainstream
• Traditional is a relative term, since most of these techniques are considered unconventional
• Typically share common elements of native plants, bioengineered materials, and natural materials configured in different ways
• Designs normally combine multiple techniques
PLANTING

Before

Installation

2 Years Later...
ROLLED Erosion control products (RECP)

- Typically constructed of straw and/or coconut
- Rolled over a seeded surface and secured in place
- Curlex, Rolanka, North American Green, etc.
COIR LOGS
COIR LOGS

Photos: WI DNR
LIVE STAKES AND FASCINES
BRUSH MATTRESS
LIVE CRIB WALL
LIVE CRIB WALL
SOIL ENCAPSULATED LIFTS

MSU Extension Bulletin E3198, 12/2013
VEGETATED RIPRAP (JOINT PLANTING)

Source: Michigan State University
**GEO VERDE/GEO BAGS**

**GEO VERDE™**

**Fascia**

Stunning landscapes, visual softness, and structurally sound fascia are no longer mutually exclusive design goals for reinforced soil walls and steep slopes. Geo Verde™ units combine custom growth mediums, conventional engineering tie-back principals, and simple installation steps to enable development and long-term vitality of diverse, vegetated fascia. If going “green” has been a challenge in having “green,” overcome the obstacles with Geo Verde units.

Geo Verde units use a geosynthetic bag to permanently contain select growth mediums, giving the medium shape and support during installation, allowing rain or irrigation waters to penetrate into the medium, and enabling excessive water to escape through the fascia without corresponding erosion. The geosynthetic bag locks the bag and medium to the adjacent soil, ensuring fascia stability and long-term wall “shape” maintenance. These extensions allow taller structures or greater overburden without subsequent primary reinforcement—resulting in cost savings on many projects. Finally, the composite bag and geogrid allow the Geo Verde units to achieve any slope or wall steepness, including vertical inclinations.

Vegetation selection is literally a function of the designer's imagination given the geometrical, climatic, and maintenance project requirements. Plant placement within the fascia system is not limited to species selection either, as seed can be mixed within the medium or hydraulically applied to the completed fascia, plugs and live staking may be applied through the bags, or brush layering between bags is possible. Similarly, soil mediums used within the Geo Verde units may be customized to meet specific plant species needs, resulting in excellent plant growth and long-term vitality. In essence, Geo Verde units offer versatility to the plant selection process.

*Geo Verde is a trademark of Hanes Geo Components, a Leggett & Platt company.*

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**GEO VERDE Fascia**

Geo Verde Units

- Reinforced soils
- Retained soils
- Primary reinforcement (when needed)
- Foundation soils

Hanes Geo Components offers delivered Geo Verde units either with or without growth medium pre-filling. Both pre- and on-site filling, in addition to growth medium selection, result in sight variations in unit weight and in-place dimensions. Nominal unit characteristics are:

1. Accommodates one concrete footer (1 ft) of wall face,
2. Weighs 80 lbs, and
3. Offers 12” of growth medium behind the fascia.

Designers of Geo Verde fascia systems can continue to use conventional engineering standards for soil-reinforced structures, e.g., AASHTO, NDMA, ACE, Bishop Modified, etc., while accommodating the desirable performance characteristics associated with the Geo Verde units.

Contact your Hanes Geo Components Regional Representative for additional information regarding Geo Verde slope and wall fascia units. Visit our website for more details pertaining to any of our erosion control, site civil improvement, and surface water quality products, related technologies, and design methodologies.

Source: Hanes Geo
CURLEX BLOC

Curlex Bloc
Secure against waves and ice

2 x 2” hard wood stakes
3/8” manilla rope (biodegradable)
COMPOST FILTER SOXX
COCONUT PILLOWS
Designed gaps for wildlife passage across the land/water interface
BIO D BLOCK
IN SUMMARY

- Remember project goals, and beware of shiny new toys
- Natural shoreline engineering technology has become more sophisticated and has gained general acceptance
- Active research is being completed to Regulations are encouraging and/or requiring soft shorelines wherever possible
- These things aren’t going anywhere. In fact—we’re going to see a lot more of them in the future!
THANK YOU!

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