Soils
FACTSHEET

BRITISH COLUMBIA
Ministry of Agriculture and Lands

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BUILDING WITH REINFORCED SOIL

This Factsheet describes the use of geosynthetics, welded wire mesh and compacted soil layers to construct walls, box culverts and bridge abutments. Case examples are shown.

THIS IS NOT A MANUAL ON HOW TO BUILD THESE STRUCTURES.

ALSO, WHILE THIS FACTSHEET ILLUSTRATES ONE SUPPLIERS CONSTRUCTION SYSTEM, IT IS FOR INFORMATIONAL PURPOSES ONLY AND IS NOT PRODUCT ENDORSEMENT BY THE MINISTRY.

Introduction

Building in layers of compacted soil and reinforcing material is an old construction method – portions of the Great Wall of China were built that way and some sections still remain today! What is new is the reinforcing materials that are layered with the soil. Today a combination of geosynthetics and a welded steel wire mesh form is finding success. This Factsheet outlines general principles and materials as well as specific construction examples such as walls, box culverts, and bridge abutments.

Why Consider Reinforced Soil Structures?

The advantages of this type of structure are:

- in many cases, soil materials available at the construction site can be used
- the base preparation is not critical – doesn't have to be flat for a level structure
- wire mesh / geotextile fabric construction materials are light, easy to transport, and quick to construct
- the only machinery required is a backhoe / excavator (to place the soil fill) and a compactor (to compact the soil fill layers)
- it is easy to build on curves (horizontal or vertical)
- it is a low cost compared to other options, such as modular concrete block walls

What Are Geosynthetics?

Geosynthetics are man-made materials used to improve soil conditions. The word is derived from: ***Geo*** = earth or soil + ***Synthetics*** = man-made. Refer to Factsheet #644.000-1, ***Geosynthetics Materials*** for details of various types of these materials.

Geosynthetics are typically made from petrochemical-based polymers ("plastics") that are biologically inert and will not decompose from bacterial or fungal action. While most are essentially chemical inert, some may be damaged by petrochemicals and most have some degree of susceptibility to ultraviolet light (sunlight).

The geosynthetic material used in these reinforced soil structures is a **woven geotextile**.

Factsheet #644.000-2, ***Using Geosynthetics in Building Roads, Alleyways, Stream Accesses***, discusses some other agricultural uses of geosynthetics such as to improve soft soil conditions for livestock and vehicle traffic.

Geotextiles

Geotextiles are defined as "*any permeable textile used with foundation soil, rock, earth, or any other geotechnical engineering-related material as an integral part of a human-made project, structure, or system*". They are typically the most used geosynthetic material for agriculture purposes.

These are fabric or cloth-like materials that are classified based on the method used to place the threads or yarns in the fabric: either woven or non-woven. Geotextiles typically come in rolls up to approximately 5.6m (18 ft) wide and 50 to 150m (160 to 500 ft) long. Woven geotextiles are used in the following reinforced soil structures.

Woven Geotextiles. These cloth-like fabrics are formed by the regular interweaving of threads or yarns in two directions as shown in Figure 1, below. These products have a regular visible construction pattern, and where present, have distinct and measurable openings. Woven geotextiles are typically used for soil separation, reinforcement, filtration, and drainage. They can have high tensile strength and relative low strain or limited elongation under load (typically up to 15%).

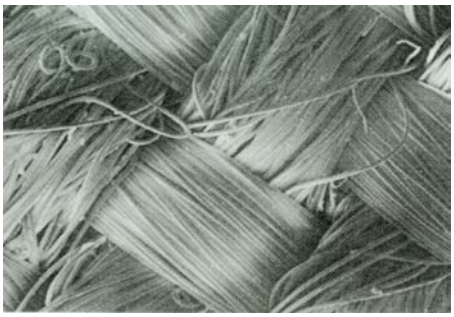

Figure 1 Enlarged Detail of Woven Geotextile

Support Form

The other material used in conjunction with the geotextile is welded steel wire mesh and steel struts that together become a triangulated form for the soil. Soil is added in compacted layers onto the geotextile. Figures 2 and 3 illustrate the arrangement.

The wire mesh / geotextile / compacted soil combination is repeated in layers of approximately 0.6 m (2 ft) height until the desired height is reached. Compaction of the soil is typically done in layers 225 to 275 mm (9 to 11 inches) thick. Caution is required when constructing with non-granular soils (silt and clay) or soils with a high percentage of silt and clay.

Figure 2 Wire Mesh, Struts and Woven Geotextile Materials

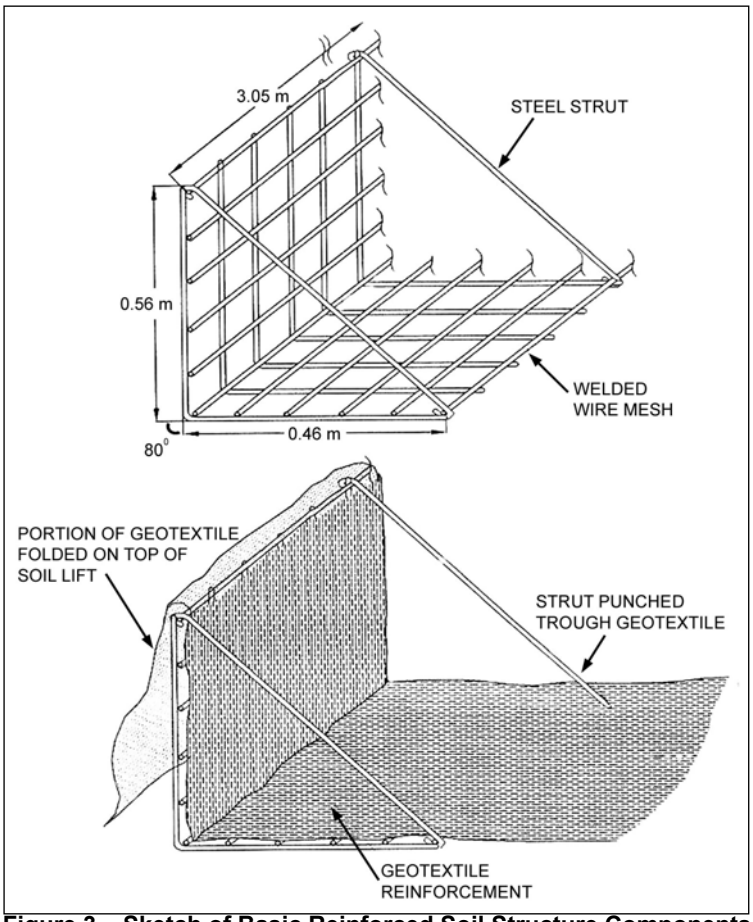

Figure 3 Sketch of Basic Reinforced Soil Structure Components

The wire mesh form and geotextile materials for a retaining wall, bridge abutment or crossing can be transported easily on a trailer as shown in Figure 4, below.

Figure 4
Wire Mesh and Woven Geotextile Easily Transported to the Site

Soil Requirements

The soil type suitable for this type of construction is not a limiting factor, but must be a type that can be compacted well:

- not too much silt and clay content
- not too much large rock content (no rock greater than 200 mm or 8 inches)
- preferably a soil having a mixture of sand and gravel with a minor amount (5 to 12%) of silt and/or clay that compacts well
- the soil must have a moisture content suitable for compaction
  - dry soil may have to be wetted
  - wet soil may have to left or spread to be dried prior to use

Retaining Wall Construction

Where a bank is eroding and sliding onto a road, near a building, etc, or if a road is being built through a draw or gulley, a reinforced soil structure can be a cost effective solution. Figure 5, below, shows a completed 5-tier retaining wall.

Figure 5 A Reinforced Soil Retaining Wall

Bridge Abutment Construction

Bridge abutments can be effectively constructed as a reinforced soil structure as shown in Figure 6, below.

Figure 6 A Reinforced Soil Bridge Abutment

Box Culvert or Small Bridge Construction

Small spans of up to 3.5 m (10 feet) can be effectively constructed as a reinforced soil structure as shown in the basic steps, Figure 7, below, and the completed construction in Figure 8, next page. This is a patent pending structure termed *Terraspan Soil Bridge* by the inventor. Where the crossing is to be temporary, it can be installed to be easily and environmentally safely removed.

THE FORMED SHEET STEEL STRINGER IS ASSEMBLED

THE REINFORCED SOIL ABUTMENTS ARE READY FOR THE STRINGER INSTALLATION

WIRE FORM, GEOTEXTILE AND COMPACTED FILL ARE IN PLACE ON TOP OF THE STRINGER

Figure 7 Basic Construction Steps for a Reinforced Soil Stream Crossing

Figure 8 A Reinforced Soil Box Culvert or Small Bridge Structure

Acknowledgement

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The projects shown in this Factsheet were designed and reviewed during construction by Terratech Consulting Ltd, Salmon Arm, B.C., phone 250.832.1117

More Information

Refer to other Factsheets in this series for examples used in agricultural situations:

- Factsheet #644.000-1 *Geosynthetic Materials*
- Factsheet #644.000-2 *Using Geosynthetics in Building Roads, Alleyways, Stream Accesses*

There are two main distributors of geosynthetic products in B.C.:

- Armtec Construction Products, Richmond, phone 604.278.3881
- Nilex Inc., Burnaby, phone 604.420.6433

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