



GEOQUEST

Reinforced Earth[®] walls

Technical presentation

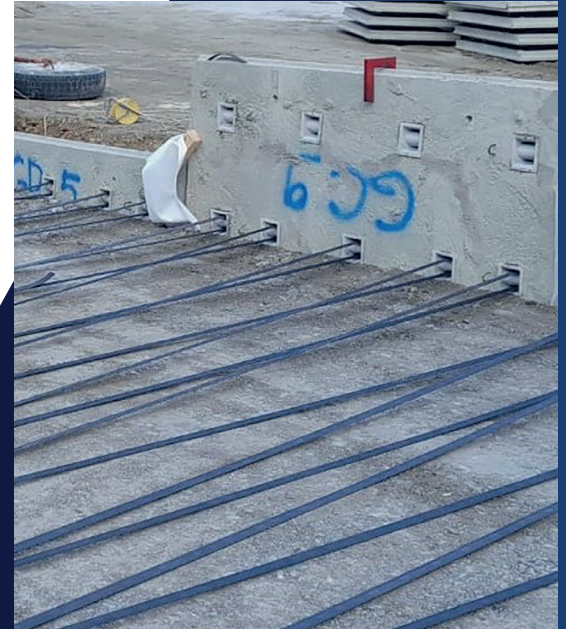
Principle

The principle is simple: due to substantial frictional forces that develop when the earth and reinforcements come into contact, the combination of suitably distributed reinforcements and select backfill produces Reinforced Earth®, an original material with numerous benefits:

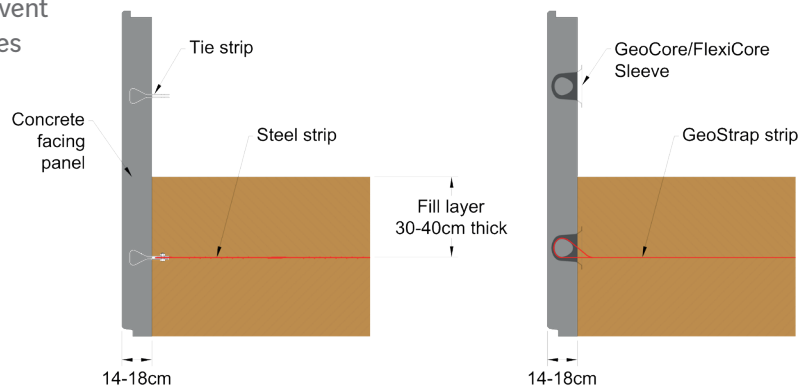
- High resistance to static and dynamic forces.
- Structures that are flexible and therefore adapt well to deformations below ground.
- Installation is quick and simple.
- Offers substantial savings.

The reinforcements, consisting of galvanized steel or synthetic notched sheets, are arranged on horizontal layers spaced approximately 80 cm apart.

The facing is made of prefabricated concrete panels separated by joints that provides the flexibility that is the key to the use of Reinforced Earth®. The facing panels are connected to the reinforcements by bolting one to the other. This construction process ensures the continuity of the facing in the event of substantial settlement below ground and facilitates assembly. In some applications, the concrete panels can be replaced by welded mesh panels.



Reinforced Earth®, which is widely used all over the world, is ideal for building all types of land-based or submerged retaining structures, such as walls, bridge abutments, storage facilities, protective barriers, etc.



Applications

The quick and easy assembly of Reinforced Earth® structures is notably due to the fact that no scaffolding is required. Each panel is automatically inserted into the space formed by the elements already in place. The correct verticality and alignment of the facing is ensured by:

- Wooden wedges installed on the outside of the facing and removed as the filling operation progresses,
- Clamps installed at the top of the panels to secure the newly placed panel to the existing.



In addition to the conventional earth-moving machinery needed to install the backfill, a light crane is required to handle the panels, which weigh between 0.8 and 2.0 tons for standard panels with a thickness of 14 cm.

The backfill is put in place as the installation of the panels progresses, in layers 35 to 40 cm thick; this is half the distance between two horizontal reinforcement layers.

The successive assembly operations are detailed briefly below. When carrying out assembly work or to obtain further, more detailed information, please refer to the detailed assembly instructions.

Unloading and storing the facing elements

The panels are transported and stored flat. Wooden blocks are used to separate each panel. Steel reinforcements are delivered in bundles weighing a maximum of 3 tonnes. Synthetic reinforcements are delivered in rolls of 100 m.

Installation of the panels, reinforcements and joints

The first row of panels is installed on a well-levelled concrete pad (not reinforced), thereby ensuring correct initial positioning.

This first row of panels is directly propped from the ground to prevent them from moving during the filling process.

The panels of the upper rows are installed as the filling operation progresses. Their verticality is ensured by temporary wedges and clamps. Elastomer bearing blocks are installed when the panels are laid (minimum two per panel), in the horizontal joints.

The vertical and horizontal joints are then covered with non-woven geotextile strips before the filling process takes place. The reinforcement layers are spaced 70 to 80 cm vertically apart, which corresponds to double the maximum thickness of the backfill layers. The reinforcing strips are installed on the compacted and roughly levelled ground and connected to the panels.



Filing and compacting

The backfill is applied using conventional earth-moving equipment, in layers 35 to 40 cm thick. The equipment must not pass directly over the reinforcements and heavy vehicles must not come closer than 1.50 m from the panels as this may affect their verticality.

The degree of compaction at any point of Reinforced Earth® structure should be 95% of the Normal Proctor Optimum or higher. For road structures in particular, compaction should be identical to that of the corresponding road backfill, and should be carried out using a P1, V1 or P2, V2 type compactor. Backfill located less than 1.50 m from the facing, however, should be compacted using a small vibratory roller (static load: 7 kg per 1 cm of generating line).

Important note

Materials must never be applied if the water content exceeds the Proctor optimum value. A surface water drainage system (backfill slopes, channels) should be provided at each backfill level.

Assembly tolerances

The alignment difference between three adjacent panels, measured using a 4.50 m long rule (placed in any direction) resting on a minimum of two panels, should not exceed 2.5 cm.



Assembly rates

Apart from very long structures on which the various operations can be separated, Geoquest projects are characterised by the interdependence of the assembly and filling phases. The rates achieved therefore depend on the organisation of the site and ease of access.

The average rate of an installation team consisting of:

- 1 team leader,
- 5 labourers,
- and 1 light crane with driver can be estimated as follows:
- for small structures with difficult access, 15 panels per day (i.e. 30 m² per day).
- for very long structures with easy access, 50 panels per day (i.e. 100 m² per day).

These rates account for the time needed to unload and store the elements and the installation and alignment of all the prefabricated elements (panels, reinforcements, bolts, joints). They do not include the installation of the backfill.

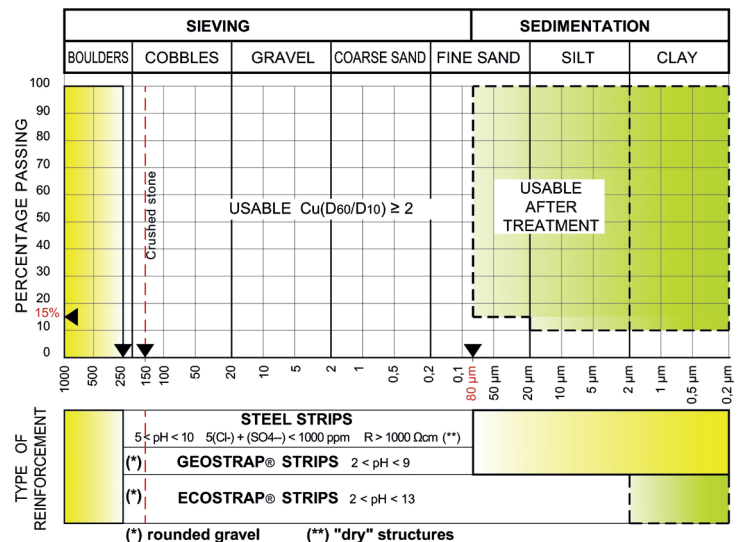
Backfill selection

The different types of reinforcements used by Geoquest allows different solutions for a wide range of backfill. On the grading curve, the checks relate to D_{max}, 80 µm passing percentage and coefficient of uniformity Cu.

In the presence of granular natural backfill combined with hot-dip galvanised steel reinforcements, the pH, chloride and sulphate ion content, saturated soil resistivity and absence of organic matter must be checked.

For synthetic reinforcements, only the pH must be checked. GeoStrap® reinforcements can be used for natural granular backfill with a pH of 9 or less.

EcoStrap® reinforcements enable the use of alkaline materials such as treated fine soil or recycled sand and gravel. Any treatment of the material must be defined in accordance with good practice.



The electrochemical characteristics comply with NFP 94-270 and EN 14475.