International Geosynthetics Society

# GEOSYNTHETICS IN WALLS: MSEW - Mechanically Stabilized Earth Wall Applications & Benefits



## Retaining walls

Retaining walls using geosynthetics have proven to outperform traditional walls such as concrete cantilever walls or mass gravity walls, preferred in many markets such in the public and private sectors. Many are the reasons, such as:

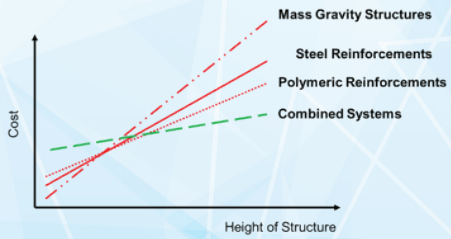
Cost: the use of common materials such as soil available on site and non-specialized machines are cheaper than specialized techniques such as reinforced concrete

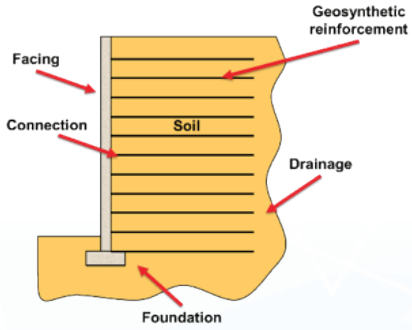
- Time: the construction uses prefabricated element (ie. Blocks or panels as facing) allowing a faster construction requiring no curing time
- Environment: the use of local materials such as backfill it reduces the impact on the environment (less carbon footprint). Even the face can be from local source and enhance the environment
- Skill development: the construction does not require specialized construction techniques and might be used for the growth of unskilled labor (however to the reduction of performance)

## Components

A geosynthetic wall is divided in the following components

- Facing
- Foundation
- Geosynthetic reinforcement
- Connection
- Drainage
- Soil




*Component of a geosynthetic wall*

## Facing

Many different types of facings are available to comply with the aesthetic requirement and also structural requirements. Precasted unit facing such as panels or blocks, rock looking facing and temporary facing are the most used.

Precast facing units are blocks in mass concrete with different finish and colors, which can be carried by hand with typical dimensions of 200mm height, 300mm deep and 350mm wide with a weight of 30-35kg.

*Precasted facing: Blocks*

Increasing the size of the facing, reinforced concrete panels with a thickness of 140mm typically with a dimension of 2m2 are often preferred where construction is faster and the quality of the finish should comply with aesthetic requirement such as smooth concrete or even patterns and colored.

Rock looking facings are often used where rock is available on site (from excavation or a quarry nearby) or due to the engineering requirements such as water management. To hold the rock in place, preformed facings made of steel are used with height of 0.5m to 1m with a depth of about 1m.

*Rock looking facing*

Sometimes retaining walls are temporary and do not require to fulfill aesthetic requirements as their function is only to retain the soil for a limited time such as during the construction phase of a project.

Wrapped around walls are the preferred solution as the reinforcement is used in the face and wrapped back to retain the fill. The height of the layer is limited to about 0.5 to 0.7m in order to prevent excessive bulging.

## Foundation

Although the foundation of a geosynthetic retaining wall is designed using the same design principles of a cantilever wall (ie. Meyerhof or Terzaghi), geosynthetic walls exert a lower pressure on the insitu soil as the construction in stages allows the insitu soil to consolidate during construction working in effective stress. Furthermore, settlements usually occur during construction as the loading (construction) is in stages compared to concrete structure where most of the loading is applied instantaneously.

## Geosynthetic reinforcement

The geosynthetic shall comply with reinforcement function requiring short and long-term performance, such as developing the design strength at a value of strain compatible with the soil within as well as to hold the strength for a period of time (from months for temporary structures to 120 years for permanent structures). Geotextiles, geogrids and geostraps are the most common geosynthetics used as their properties are in line with the requirements for the reinforcement function:

- Strength
- Stiffness
- Durability (time and environment)
- Bond within soil

## Connection

The connection between the facing and the reinforcement is paramount to the stability of the structure as it ensures the facing is stable under the pressure of the soil.

*Concrete block to enhance bonding*

The connection varies to suit the reinforcement and the facing. For modular blocks, the connection between the geosynthetic reinforcement and the block is pure friction, although certain blocks enhance the connection with pins or bar to hold in place the reinforcement.

For panels, the connection is casted in the panel allowing for a bodkin connection or a loop in case of a geostrap.

*Loop connection for geostraps*

For rockfill facing the connection if by friction between the facing (in steel) and the geosynthetic. Interface friction test to calculate the friction coefficient should be performed in order to perform the correct design


*Geogrid – steel mesh pullout test*

## Drainage

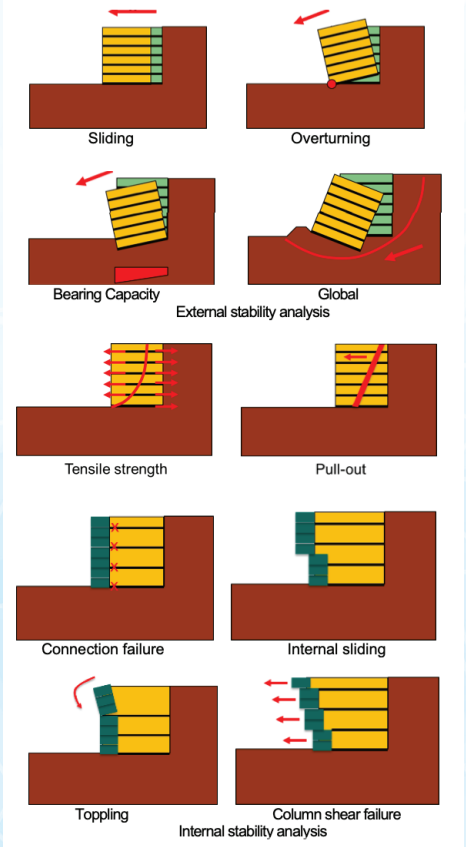
One of the main cause of failure for geosynthetic walls is mismanagement of water. Water may infiltrate the backfill, from surface and even from drainage structures within the wall. It is good practice to ensure water is drained in subsoil drains and taken out from the structure. Subsoil drain at the back of the geosynthetic wall allow to intercept any phreatic water at the back of the structure, if necessary curtain drain (continuous or band) can be added.

*Subsoil drain and band drain at the back of a GSY wall*

When drainage structures such as culvert, drainage pipes, or even water line are within the wall, a drainage control shall be considered in order to highlight any leak before compromising the structure.

## Soil

The soil to be used in a geosynthetic wall should be granular in order to bond with the geosynthetic and to have good frictional properties. Different design guideline restricts the fine content (less than 200 microns or 0.075) to usually 15% and the maximum size should be one third of the layer thickness (usually 80mm). the compaction of the soil is very important as it ensures the bonding with the geosynthetic as well as the mechanical requirement. A compaction of 93% mod. AASHTO is the minimum requirement, however it might go up to 98% mod AASHTO if it is a critical structure such as a bridge abutment or a mine tipwall. Other properties which should be considered are the soil PH, chlorites and sulfates as it affects the durability of the geosynthetic reinforcement and the facing.



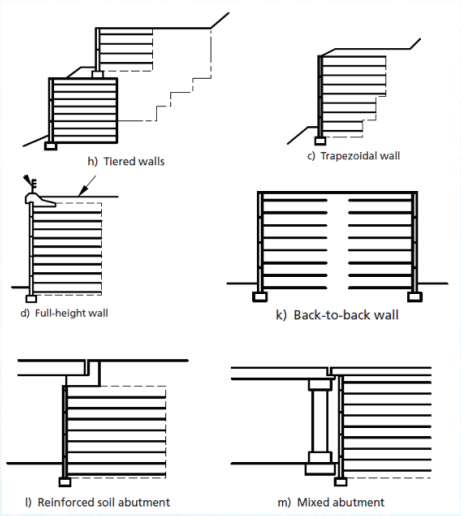

## Design

Many design guidelines are available for the design of geosynthetics wall based on working stress and limit state principles. The analysis to perform are the following:

## Typical geosynthetic walls

Geosynthetic wall can be used for:

- Stepped walls
- Trapezoidal walls
- Full height walls
- Part-height walls
- Dam
- Embedded wall
- Tiered wall
- Infinite walls
- Environmental wall
- Back to back wall
- Reinforced soil abutment
- Mixed abutment




*Typical Geosynthetic Walls*

## About the IGS

The International Geosynthetics Society (IGS) is a non-profit organization dedicated to the scientific and engineering development of geotextiles, geomembranes, related products and associated technologies. The IGS promotes the dissemination of technical information on geosynthetics and their appropriate uses through a newsletter (IGS News), two official journals (Geosynthetics International and Geotextiles and Geomembranes), conferences and technical seminars, dedicated task forces, over 40 National Chapters, special publications, and multiple other communications and outreach methods.

## Contact Us

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