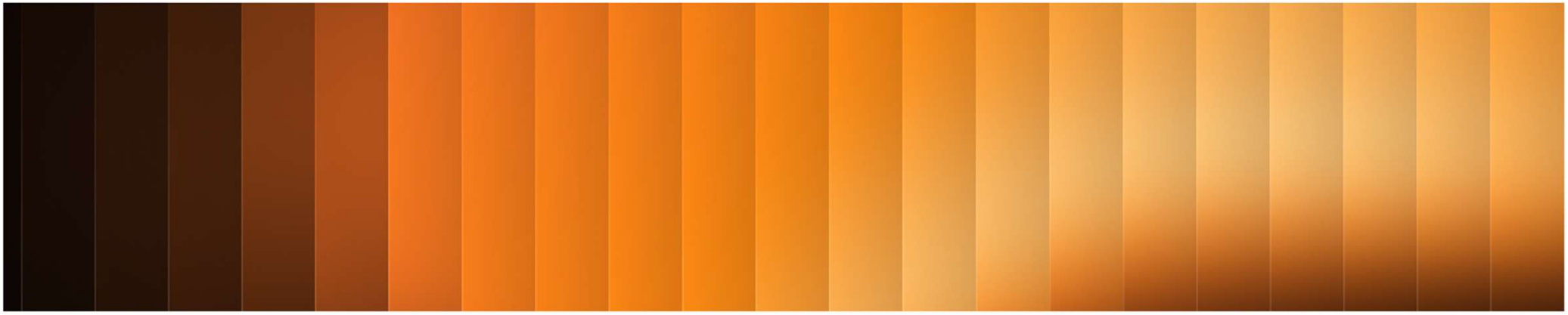


Analysis of Geogrid – Reinforced Soils
MIDAS GTS NX

Rohith Swaminathan
Technical Team Lead, Midas IT Europe

MIDAS GTS NX

Agenda

01. Introduction to Geosynthetics

02. Reinforced Soil

03. Finite Element Modelling of Geogrids in Midas GTS NX

04. Analysis and Results

05. Comparison with other methods

Introduction to Geosynthetics

Polymeric materials in Civil and Environmental Engineering

Rohith Swaminathan, MidasIT EU

Geosynthetics – where the geogrid sits

MIDAS GTS NX

Geocomposites

One or more geosynthetics combined with another material.

Geogrids

Reinforcement, to improve the strength of soil or other materials.

Geomembranes

Thin, relatively impervious barriers for containment.

Geonets

Relatively thin, planar sheets used for drainage.

Geopipes

Buried plastic pipes used for drainage.

Geotextiles

Separation, filtration, reinforcement and drainage.

Geosynthetic clay liners

Thin (≤ 10 mm) barrier layers used in waste containment.

***Reinforcement member** of the family : only purpose is to add tensile strength to soil*

What a geogrid is

Structural materials designed for reinforcing soil or aggregate, with large openings that interlock with the surrounding material.

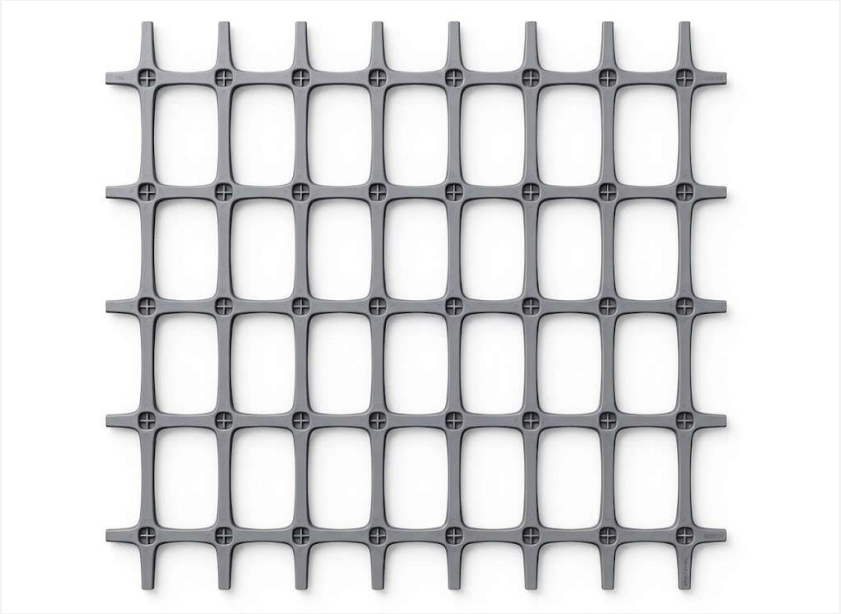
Manufacture
Extruded polyolefin sheets or woven and knitted filaments.

Large apertures
Openings that let the fill penetrate and interlock with the ribs

Tensile strength
Typically, in the range 35 to 110 kN/m.

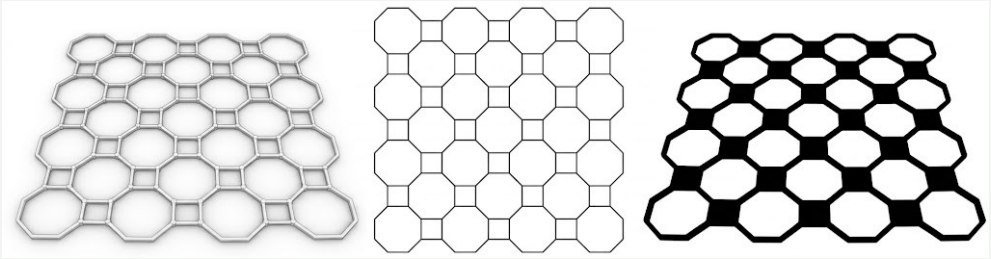
Coating
Often coated to protect against environmental degradation

Aperture geometry and interlock



Extruded biaxial grid

Punched and drawn from a polyolefin sheet; ribs run at right angles, giving two clearly defined strength directions.



Multi-axial aperture patterns

Octagonal and triangular apertures spread stiffness more evenly around the plane, rather than concentrating it on two axes.

In GTS NX, the rib directions become the 1- and 2-directions of the Geogrid material — set the Material CSys to match them, and use E2 and Tensile Strength 2 only where the product genuinely carries load across the roll.

Reinforced Soil

Geogrid – Soil – Interaction in Geotechnical Structures

Reinforced Soil

Soil that is strengthened by tensile elements such as metal strips, geotextiles or geogrids. The benefit comes from two distinct effects, and both must be present for the reinforcement to work.

a

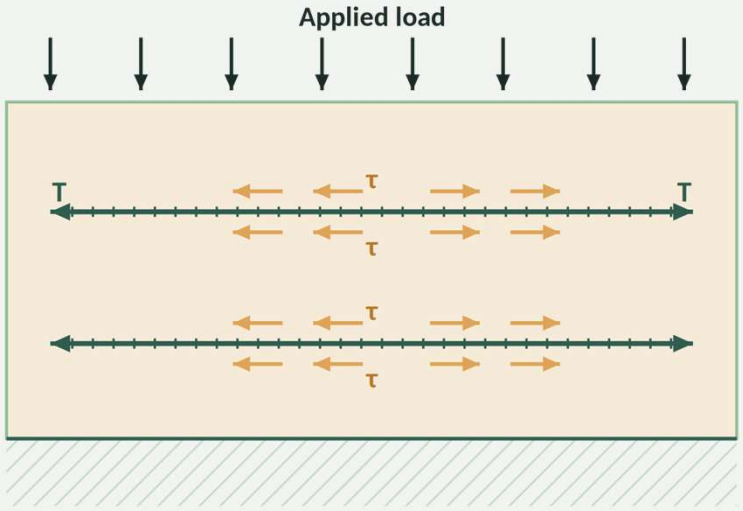
Increased tensile strength

Soil carries almost no tension of its own. The reinforcement supplies the tensile capacity the soil mass lacks.

b

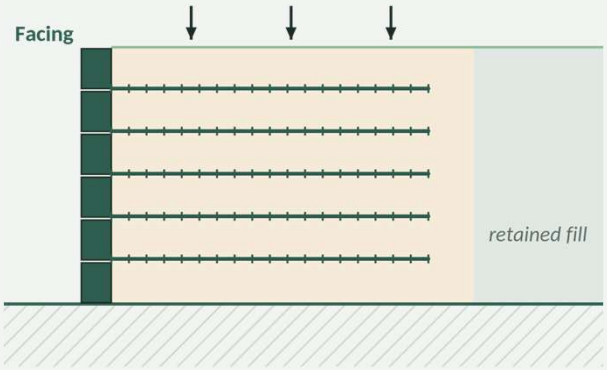
Shear resistance at the interfaces

Friction developed at the soil–reinforcement interfaces transfers that tension back into the surrounding fill.



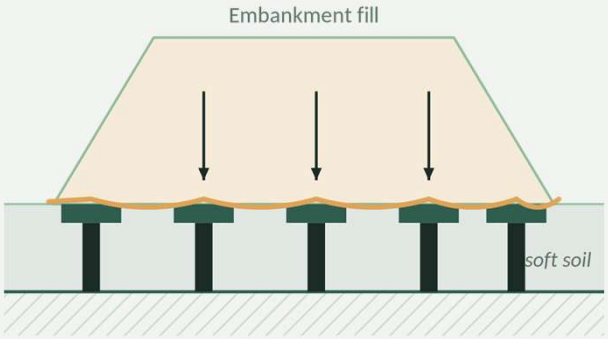
Load applied to a reinforced fill: the layers pick up tension T, and interface friction τ carries it into the soil.

Application in Geotechnical Structures



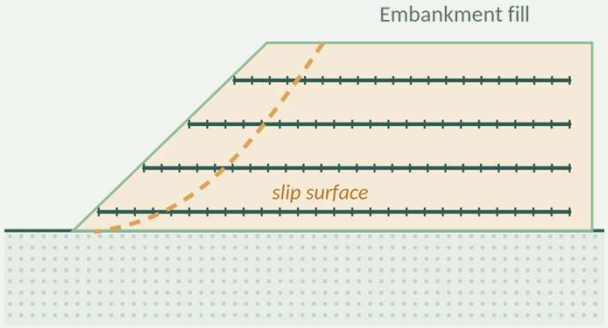
Reinforced soil walls

Geogrid layers tie the facing back into the fill, allowing a near-vertical face without a heavy retaining structure.



Pile-supported embankments

A basal geogrid spans between pile caps, carrying the embankment load onto the piles and away from the soft soil.



Embankment stability

Layers placed across potential slip surfaces add tensile resistance and raise the factor of safety.

Finite Element Modelling of Geogrids in Midas GTS NX

Behavior modes, input parameters, tensile-strength conversion and property assignment

MIDAS GTS NX

What the Geogrid model is

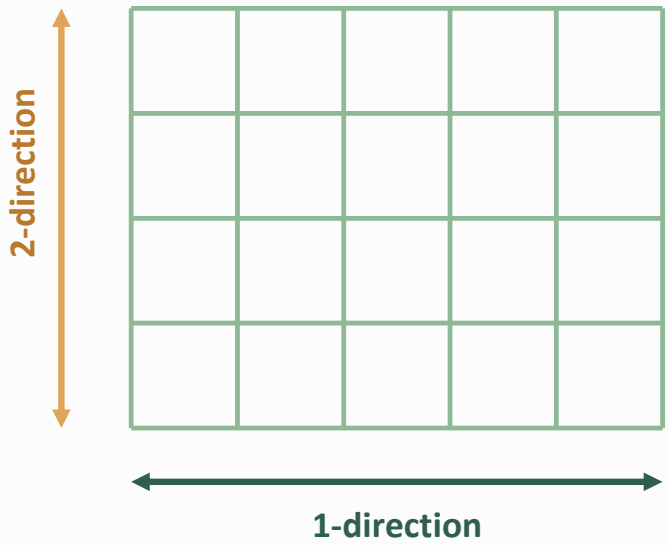
Orthotropic
Stiffness is defined independently along the 1- and 2-directions of the element.

Tension only
The material carries axial tension; it offers no resistance in compression.

Restricted assignment
It can be assigned only to a 1D or 2D Geogrid property — no other property type.

Independent directions
1-direction and 2-direction behave separately; there is no coupling between them.

Element axes



Each direction has its own modulus and its own tensile strength.

Two behavior modes

The 'Tensile Strength' check box decides how the reinforcement responds to overload

Tensile Strength — unchecked

- Tension-only, nonlinear elastic behaviour
- No limit on the force the reinforcement can carry
- Use for quick checks or when capacity is not governing

Tensile Strength — checked

- Plastic behavior once load exceeds the tensile strength
- Excess load must redistribute into the surrounding soil
- Use where rupture of reinforcement is a design case

Comparison study

MIDAS GTS NX

Design sheet (BS 8006: 2010) vs FE analysis in Midas GTS NX

650 kN

Geogrid axial capacity

The product strength used as the input to both checks.

≈ 350 kN

Design sheet

Axial force developed, computed to BS 8006:2010.

≈ 77 kN

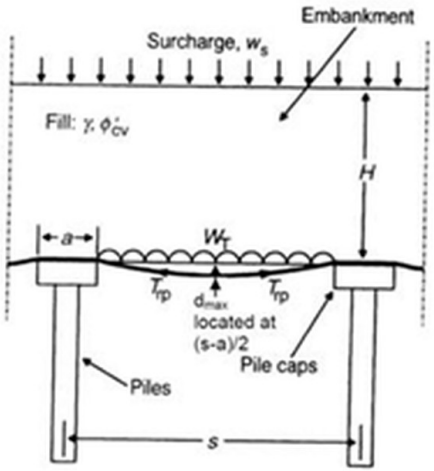
GTS NX model

Axial force in the geogrid element, same properties.

Neither result is wrong.

The two calculations do not assume the same support conditions beneath the reinforcement. Once that is recognised, the gap between 350 kN and 77 kN is explainable — and reproducible in either direction.

Why the design sheet gives higher force

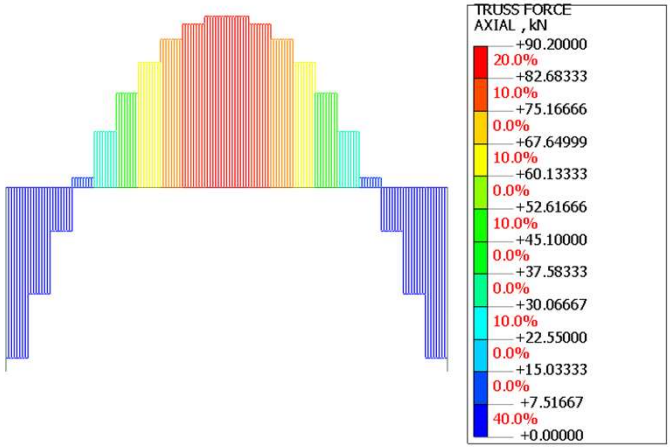


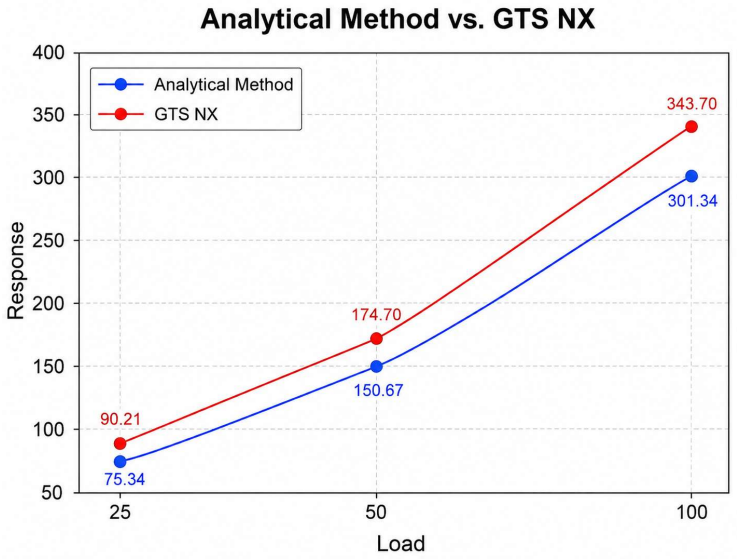
BS 8006:2010 definition of variables: the reinforcement spans s − a between pile caps, loaded by W_t from the fill and surcharge.

$$T_{rp} = \frac{W_T(s-a)}{2a}\sqrt{1+\frac{1}{6\epsilon}}$$

BS 8006:2010 gives Marston's formula and the Hewlett and Randolph method for the distributed load carried by the reinforcement.

The reinforcement is checked as if it spans between the pile caps with no soil beneath it — the condition drawn in the figure.





FE Analysis result – Linear Static with similar conditions as BS 8006: 2010

Key takeaways

In FE the soil is continuous, so the reinforcement is never the only load path

Continuous soil in FE

- The primary function of geogrids is to act as a tensile reinforcement in soil, primarily focused on soil confinement.
- Geogrids are more reliable in preventing horizontal soil movement and slope failure than reducing vertical settlement.
- The surcharge is carried largely by the soil elements
- The geogrid picks up only what the soil cannot
- The 'no soil' condition (BS 8006:2010) cannot arise unless the elements beneath the grid are deactivated
- The BS 8006 support condition is a design check, not a state the soil will reach in service

Thanks for watching :)

Modelling and Analysis of Geogrids in MIDAS GTS NX

Rohith Swaminathan, MidasIT,Europe

2026.08.20

MIDAS GTS NX