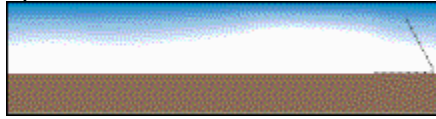


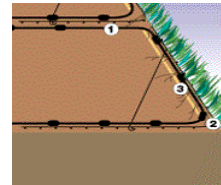
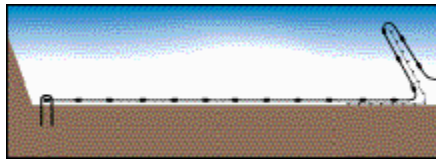
Geogrid Material & Installation Specification for Permanent Steep Slope and Wall Construction

Installation Procedure

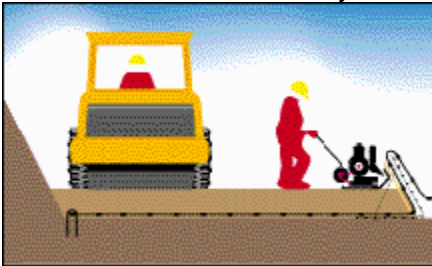
1. Pre-cut the geogrids, shape the steel mesh formworks and prepare both the hooked bars. After the levelling and compaction of the foundation soil, place and line up the formworks connecting each other by mean of a steel or plastic wire. Steel mesh shall be minimum ϕ 8.00 mm, 200 x 200 mm mesh size.



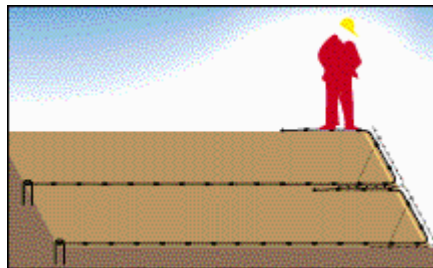
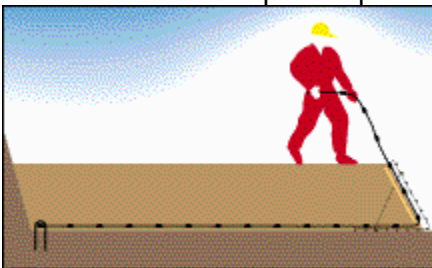
2. Place the Tenax reinforcement geogrids in horizontal layers perpendicular to the face and along the internal face of the steel formworks, anchor the grids to the soil by means of "U" shaped staples and temporarily leave the last portion of the grids outside the formworks. The last portion of the grid shall correspond to the total wrapping length (about 1.5 m). Place the hooked bars to fix the formworks. Place a pre-planted cow grass or the selected species on the internal side of the steel mesh formwork against the geogrid.



3. Place suitable thickness of soil on the geogrids & compact it until reaching a compaction effort not lower than 90% of Standard Proctor. Compaction of fill material about 1,00 m close to the face shall be carried out using light hand-held compactors, like plate vibrating compactors, while the other part of the reinforced block may be compacted with heavy rollers.



4. Repeat phase 3 to reach the required geogrid spacing. Wrap the final portion of the grids, previously kept outside the formworks, toward the inner slope & slightly stretch it and anchor it to the soil by means of "U" shaped staples .



5. Repeat the phases 1 - 4 until completion of the work.

Material Specification

The reinforcing element shall be a geogrid manufactured from extrusion and longitudinal drawing of high-density polyethylene polymer of the highest quality, under strict Quality Control procedures.

The geogrid, when unrolled, shall be a plane monolithical structure, with a uniform distribution of long shaped apertures, which identify longitudinal ribs and transversal bars.

The longitudinal ribs shall have gone through a process of molecular orientation for increasing the mechanical characteristics and for ensuring a high long-term resistance under sustained loading.

The junctions between the longitudinal ribs and the transversal bars shall be an integral part of the geogrid structure. The geogrid shall be inert to all chemicals naturally found in soils and shall have no solvents at ambient temperature. It shall be susceptible to hydrolysis, shall be resistant to aqueous solutions of salts, acids and alkalis, shall be non-biodegradable and shall have a suitable content of carbon black to inhibit attack by ultra violet light.

The geogrid shall be supplied in rolls, with labels that allow a total traceability with reference to the Quality Assurance System, according to the requirements of ISO Standard.

Geogrid type A (TT160)

The geogrid shall comply in full with the following specification:

- Quality Control: The geogrid shall be manufactured in accordance with the Quality Assurance requirements ISO 9002:94. If required the manufacturing lot shall be certified to conform with ISO 9002 by an external QC/QA firm approved by the Department of Trade and Industry in the Country of the manufacturer.
- Polymer: **High Density Polyethylene**.
- Colour: **black**.
- U.V. protection: carbon black.
- Unit weight: **1000 g/m²**.
- Tensile Strength: expressed as the 95% confidence limit value, shall be **160.0 kN/m** with a peak strain of around **13.0 %** approximately, when tested according to GRI-GG1 at an extension rate of 50 mm/minute at 20°C. The tensile strength at 2% strain, obtained from the same test, shall be **45.0 kN/m** minimum.
- Junction strength: shall be not less than 80% of the Tensile Strength in accordance with test method GRI-GG2.
- The Long Term Design Strength, at a strain not exceeding 10% in 120 years, shall be **65.0 kN/m** at a mean temperature of 20°C when tested in accordance with test method ASTM D 5262.

Geogrid type B (TT120)

The geogrid shall comply in full with the following specification:

- Polymer: **High Density Polyethylene**.
- Colour: **black**.
- U.V. protection: carbon black.
- Unit weight: **800 g/m²**.
- Tensile Strength expressed as the 95% confidence limit value, shall be **120.0 kN/m** with a peak strain of around **13.0 %** approximately, when tested according to GRI-GG1 at an extension rate of 50 mm/minute at 20°C. The tensile strength at 2% strain, obtained from the same test, shall be **36.0 kN/m** minimum.
- Junction strength: shall be not less than 80% of the Tensile Strength in accordance with test method GRI-GG2.
- The Long Term Design Strength, at a strain not exceeding 10% in 120 years, shall be **48.0 kN/m** at a mean temperature of 20°C when tested in accordance with test method ASTM D 5262.

Geogrid type C (TT090)

The geogrid shall comply in full with the following specification:

- Quality Control: The geogrid shall be manufactured in accordance with the Quality Assurance requirements ISO 9002:94. If required the manufacturing lot shall be certified to conform with ISO 9002 by an external QC/QA firm approved by the Department of Trade and Industry in the Country of the manufacturer.
- Polymer: **High Density Polyethylene**.
- Colour: **black**.
- U.V. protection: carbon black.
- Unit weight: **600 g/m²**.
- Tensile Strength: expressed as the 95% confidence limit value, shall be **90.0 kN/m** with a peak strain of around **13.0 %** approximately, when tested according to GRI-GG1 at an extension rate of 50 mm/minute at 20°C. The tensile strength at 2% strain, obtained from the same test, shall be **26.0 kN/m** minimum.
- Junction strength: shall be not less than 80% of the Tensile Strength in accordance with test method GRI-GG2.
- The Long Term Design Strength, at a strain not exceeding 10% in 120 years, shall be **37.0 kN/m** at a mean temperature of 20°C when tested in accordance with test method ASTM D 5262.

Geogrid type D (TT060)

The geogrid shall comply in full with the following specification:

- Quality Control: The geogrid shall be manufactured in accordance with the Quality Assurance requirements ISO 9002:94. If required the manufacturing lot shall be certified to conform with ISO 9002 by an external QC/QA firm approved by the Department of Trade and Industry in the Country of the manufacturer.
- Polymer: **High Density Polyethylene**.
- Colour: **black**.
- U.V. protection: carbon black.
- Unit weight: **400 g/m²**.
- Tensile Strength: expressed as the 95% confidence limit value, shall be **60.0 kN/m** with a peak strain of around **13.0 %** approximately, when tested according to GRI-GG1 at an extension rate of 50 mm/minute at 20°C. The tensile strength at 2% strain, obtained from the same test, shall be **17.0 kN/m** minimum.
- Junction strength: shall be not less than 80% of the Tensile Strength in accordance with test method GRI-GG2.
- The Long Term Design Strength, at a strain not exceeding 10% in 120 years, shall be **25.0 kN/m** at a mean temperature of 20°C when tested in accordance with test method ASTM D 5262.

Geogrid type E (TT045)

The geogrid shall comply in full with the following specification:

- Quality Control: The geogrid shall be manufactured in accordance with the Quality Assurance requirements ISO 9002:94. If required the manufacturing lot shall be certified to conform with ISO 9002 by an external QC/QA firm approved by the Department of Trade and Industry in the Country of the manufacturer.
- Polymer: **High Density Polyethylene**.
- Colour: **black**.
- U.V. protection: carbon black.
- Unit weight: **300 g/m²**.
- Tensile Strength: expressed as the 95% confidence limit value, shall be **45.0 kN/m** with a peak strain of around **11.5 %** approximately, when tested according to GRI-GG1 at an extension rate of 50 mm/minute at 20°C. The tensile strength at 2% strain, obtained from the same test, shall be **11.0 kN/m** minimum.
- Junction strength: shall be not less than 80% of the Tensile Strength in accordance with test method GRI-GG2.
- The Long Term Design Strength, at a strain not exceeding 10% in 120 years, shall be **21.2 kN/m** at a mean temperature of 20°C when tested in accordance with test method ASTM D 5262.

TENAX Secondary Reinforcement (LBO 220 SAMP Geogrid)

The reinforcing element shall be a geogrid manufactured from extrusion and longitudinal plus transversal drawing of polypropylene polymer of the highest quality, under strict Quality Control procedures.

The geogrid, when unrolled, shall be a plane monolithical structure, with a uniform distribution of rectangular apertures which identify longitudinal and transversal ribs.

The longitudinal and transversal ribs shall have gone through a process of molecular orientation for increasing the mechanical characteristics and for ensuring a high long term resistance under sustained loading. The junctions between the longitudinal and the transversal ribs shall be an integral part of the geogrid structure and shall in no case be obtained by weaving, knitting or bonding single threads or other tensile elements.

The geogrid shall be inert to all chemicals naturally found in soils and shall have no solvents at ambient temperature. It shall be susceptible to hydrolysis, shall be resistant to aqueous solutions of salts, acids and alkalis, shall be non-biodegradable and shall have a suitable content of carbon black to inhibit attack by ultra violet light.

The geogrid shall comply in full with the following specification:

- Quality Control:
The geogrid shall be manufactured in accordance with the Quality Assurance requirements ISO 9002:94. If required the manufacturing lot shall be certified to conform with ISO 9002 by an external QC/QA firm approved by the Department of Trade and Industry in the Country of the manufacturer.
- Polymer: Polypropylene.
- Standard colour: black.
- U.V. protection: carbon black.
- Unit weight: 230 g/m².
- Tensile Strength: expressed as the 95% confidence limit value, shall be 20 kN/m and 20kN/m with a peak strain of 11.0 % and 10.0 % approximately in the longitudinal and transverse directions respectively, when tested according to GRI-GG1 at an extension rate of 50 mm/minute at 20±0.5°C. The tensile strength at 5% strain, obtained from the same test, shall be 14 kN/m in both the longitudinal and transverse directions.

The geogrid shall be supplied in rolls, with labels which allow a full traceability with reference to the Quality Assurance System, according to the requirements of ISO 10320 Standard.