SLOPE STABILIZATION OF ERMELO-MAJUBA ELECTRIFIED COAL RAILWAY LINE

MPUMALANGA, SOUTH AFRICA, 2021

CLIENT	Eskom - Group Capital Division Generation Coal Projects
CONTRACTOR	Job_SA Engineering & Management (Pty) Ltd.
LOCATION	Mpumalanga, South Africa
DATE	2021, September – October
KEY MATERIALS	
High Tensile Steel Mesh (HTS)	80mm x 3m Diamond mesh, 1'770kN/m, Qty = 7'200m^2
Glass Fiber Soil Nails	Glasspree® Permanent Soil Nails, Length = 4m, Qty = 1'170 lm
	Offset grid pattern: 3m x 3m

The Challenge

The Ermelo-Majuba railway line is of strategic importance to Eskom as it is the main coal line to the power station. Ongoing rock and debris fall incidences onto the railway line pose both a hazard and a risk to the train and power-station respectively.

Weathering of the cut-face (rock and earth) through natural processes together with the nature of the rock type requires routine clean-up and maintenance operations in order to keep the railway line safe and operational.

Due to the remote location and access constraints to sections of the line, Eskom needed a long term, robust solution.

The Solution

Engagement talks between the contractor and the client together with the relative technical support from Geo Equip Africa resulted in the implementation of a flexible, active system.

The High Tensile Steel (HTS) mesh with its high tensile strength greater than 1.7kN/m^2 provides the perfect 'active', yet flexible ground support to mitigate localised slip failures.

'Active' in the sense that the pull out (retarding) forces of the Sireg® fiber anchors exert a tensile force on the HTS mesh, resulting in a tight yet flexible fit to the undulating ground contours.

The lightweight Sireg® anchors, offering superior strength parameters to conventional steel anchors where the perfect choice.

4 times lighter than steel, the transport cost savings were carried over to the client! The ease of anchor handling made for fast and light work!

Sireg® anchors have a long history in Europe and parts of the Middle east.

The weight-cost transport benefit to remote and landlocked countries in Africa make it an attractive alternative.

GEO EQUIP AFRICA

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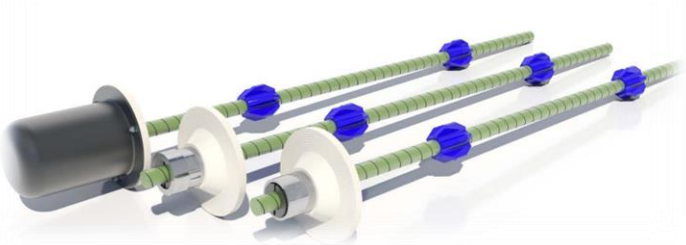
Round Straight Bars	Bar designation	Nominal Bar Diameter	Nominal Bar Area	f^*_{fu} – Guaranteed Tensile Strength = f_{fk} – Characteristic Tensile Strength	E_f – Tensile Elastic Modulus	Ultimate Strain	Minimum Guaranteed Ultimate Tensile Force	Linear Weight *
Glasspree FL 6 mm	M6	6.3 mm	32 mm²	900 MPa	46 GPa	1.9%	> 27 kN	50 g/m
Glasspree FL 10 mm	M10	9.5 mm	71 mm²	900 MPa	46 GPa	1.8%	> 59 kN	150 g/m
Glasspree FL 13 mm	M13	12.7 mm	129 mm²	850 MPa	46 GPa	1.6%	> 96 kN	230 g/m
Glasspree FL 16 mm	M16	15.9 mm	199 mm²	800 MPa	46 GPa	1.6%	> 130 kN	390 g/m
Glasspree FL 20 mm	M19	19.1 mm	284 mm²	780 MPa	46 GPa	1.5%	> 182 kN	610 g/m
Glasspree FL 22 mm	M22	22.2 mm	387 mm²	750 MPa	46 GPa	1.4%	> 241 kN	740 g/m
Glasspree FL 25 mm	M25	25.4 mm	510 mm²	750 MPa	46 GPa	1.3%	> 297 kN	950 g/m
Glasspree FL 30 mm	M29	28.7 mm	645 mm²	600 MPa	46 GPa	1.3%	> 365 kN	1370 g/m
Glasspree FL 32 mm	M32	32.3 mm	819 mm²	580 MPa	46 GPa	1.2%	> 437 kN	1560 g/m
Glasspree FL 35 mm	M35	34.9 mm	957 mm²	580 MPa	46 GPa	1.2%	> 517 kN	1980 g/m
Glasspree FL 38 mm	M38	38.1 mm	1139 mm²	580 MPa	46 GPa	1.2%	> 622 kN	2210 g/m
Glasspree FL 40 mm	M40	40.0 mm	1256 mm²	580 MPa	46 GPa	1.2%	> 687 kN	2440 g/m

***Tolerances:** ± 8% (min ±15 g/m)
Other types on request

WHY SHOULD GFRP BE CONSIDERED

- ✓ *Tensile stress greater than that of steel*
- ✓ *Light weight – one fourth to one fifth of the equivalent steel bar*
- ✓ *Impervious to chloride ion and chemical attack*
- ✓ *Transparency to magnetic fields and radio frequencies*
- ✓ *Thermally and electrically non-conductive*
- ✓ *Admixtures to reduce corrosion not needed*
- ✓ *High fatigue endurance*
- ✓ *Easy handling and installation*
- ✓ *Cutability – easily "consumed" by common excavation equipment*



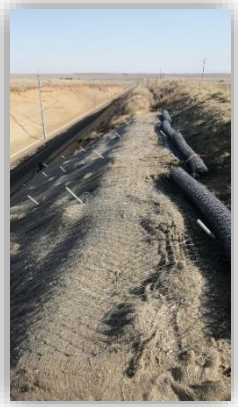
- ✓ *Better field handling damage tolerance than epoxy coated steel*
- ✓ *High friction coefficient – quartz sand coated surface bonds to concrete and other grouts*
- ✓ *Easy handling and installation*

DURGLASS® AND GLASSPREE® SPECIFICATIONS*		
Density	ASTM D792	1.95 g/cm³
Ultimate tensile strength	ASTM D7205	760 - 1000 MPa
Tensile modulus of elasticity	ASTM D7205	40 - 46 GPa
Shear strength	ASTM D7617	100 - 200 MPa
Fiber content	ASTM D2584	> 65%

* Based on ASTM International's testing method.

(a) Ground prep & drill in Sireg® anchors.

(b) Place natural erosion and growth medium mat.



(c) Prepare the HTS mesh for coverage.

(d) Ensure the HTS mesh is aligned and placed flat along the ground.

(e) Anchor / Mesh connection is critical. Ensure the transfer of tensile force into the HTS net. Locked / Clamped.

(f) An offset anchor grid pattern, maximizing anchorage support.

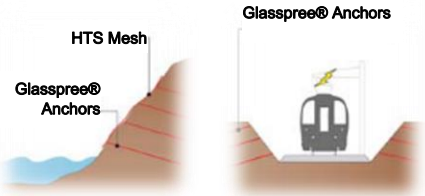
(g) Experienced installation crews achieving good daily coverage. Less time on site, equals savings to the client.

(h) Hydroseeding, to promote / fast-track vegetation growth!

DIFFERENCES BETWEEN GFRP AND STEEL[1]

- ✓ *GFRP is linear elastic to failure whereas steel yields*
- ✓ *GFRP is anisotropic whereas steel isotropic*
- ✓ *Due to the lower modulus of the GFRP bars, serviceability often controls design*
- ✓ *Lower creep-rupture threshold than steel*
- ✓ *Coefficient of thermal expansion different in longitudinal and radial directions*
- ✓ *The degradation mechanism of GFRP is benign to the surrounding concrete unlike steel that expands and causes failure*

1/ Source: The American Concrete Institute, ACI 440,1R-2015



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