Geofiber Composite Reinforcements
TGS Composite Rebar is an alternative to the Steel Rebar used for the reinforcement of concrete structures; finding particular application where corrosion and tensile strength is a concern. Depending upon the reinforcement fiber and the resin used, the composite rebar has a tensile strength from two of over three times that of steel, and a service life in a corrosive environment of up to over 100-years. TGS Composite Rebar excels over steel when:

- Lower Life Cycle Costs (LCC) are important
- Exposed to deicing salts.
- Built in or close to seawater.
- Subjected to other corrosive agents.
- Required to maintain low electric conductivity or electromagnetic neutrality.
- Required to save weight. Composite rebar (deformed or smooth) approximately 25% of the weight of equivalent size steel bar.
- Stronger means that in some applications, the equivalent diameter of the Composite rebar can be reduced from that required for steel rebar. Additionally, it may also provide the ability to use less quantity; thereby reducing the product cost, installation cost and use costs.

All TGS Composite Rebar can be provided in straight lengths. However, when the rebar diameter is 12-mm or less, coil stock is available. All TGS Composite Rebar are tested in compliance with the recommendations of the American Concrete Institute (ACI 440). According to the recommendations of ACI 440, field bends are not allowed. As such, TGS Composite Rebar prefabricated stirrups, elbows and accessories are available and built to order.
2. As built: 10-mm & 8-mm Basalt Fiber Rebar
a. Total Weight: 24.41 MT
b. Equivalent Cost MT: $9,000 US
c. Total Project Cost: $237,690

3. Conclusions
a. Cost Savings: 32%
b. No Welding by using coils or Spools
c. Rule of Thumb:
   “If the designer saves $1US in the elimination
   of the effects of corrosion, the resulting savings
   in Life Cycle Costs (LCC) are $5USD for start
   of Corrosion and $25USD for the repair of
   concrete cracking, and an additional $125USD
   for concrete replacement at the end of the Life
   Cycle.”

Some Photos from the Job Site follow on the next page.
The use of increased fiber volume vs. pre-stressed Tendons.

To prevent flexure failures in concrete beams, the pre-stressing of the tendons along the length of a beam can be increased. However, this does not enhance the ability of the beam to resist shear forces that are often the cause of failure. To assist in the prevention of shear failures, transverse rebar reinforcement is normally just increased along the length of the beam. This provides more tensile strength perpendicular to the pre-stressed tendons. These additional rebar reinforcements are often inadequate to resist the shear failures, especially for long beams. Additionally, these reinforcement bars significantly increase the cost during casting the beams.

The use of increased fiber volume within the concrete is gaining popularity. The increased fiber volume, using TGS basalt chopped fiber, has been proven superior at resisting shear in concrete beams. Test data shows that increasing the fiber index of a pre-stressed fiber reinforced concrete beam noticeably increases its shear strength. The larger fiber volume indexes also increased the ductility of the concrete beams.

TGS basalt chopped fiber act as multi-directional, equally distributed micro-reinforcements throughout the concrete beam and its component elements. The TGS basalt chopped fiber help control and retard, if not prevent, cracking. This is accomplished by efficiently carrying the tension across the potential crack zone; spreading out and dissipating the forces that cause shear failure. The use of TGS basalt chopped fiber reinforcement within the concrete also aids in controlling the stresses during the curing and transportation phases of construction. The use of TGS basalt chopped fiber reinforcement helps to improve concrete in toughness, ductility, shear and tensile strengths, fatigue, shrinkage resistance, and durability.

The TGS basalt chopped fiber do slightly improve the compressive strength of the concrete. However, they more significantly improve the ductility of the concrete. It has been found that an addition of up to about 1.5% (about 4-kgs per cu-meter or about 8.5 pounds per cubic yard of concrete) of TGS basalt chopped fiber will result in a direct tensile strength increase of up to 40%. Ultimately, it has been found that the incorporation of TGS basalt chopped fiber is an effective way of replacing traditional reinforcing transverse steel rebar and even reducing the amount of rebar reinforcement needed in many applications. When TGS basalt chopped fiber is used in combination with TGS Composite Rebar and TGS Geogrid, the resulting structure is markedly stronger and more durable than without.
Functions of TGS Geogrid in asphalt:

- to withstand the normal stresses arising from numerous short-term impacts of vehicle wheel loads, and to redistribute them horizontally, in order to prevent excessive horizontal deformation of the extension of the lower part of the road bed structure at flexure;
- to withstand the normal stresses arising in certain section from prolonged active loads of fluctuations of temperature in the ground surface and the road surface dressing, and to redistribute them horizontally, in order to prevent excessive horizontal deformation of layers of the road structure.

Economic effect of TGS Geogrid in Asphalt

The use of TGS Geogrid makes it possible to significantly increase the time between repairs for asphalt pavement, reduce the consumption of traditional materials used during the life cycle. Filaments of TGS Geogrid, impregnated with a special compound, adding the following special properties to the mesh: strength, frost resistance, water absorption. It is used for reinforcement of the asphalt pavement on roads, runways, airport fields, access roads, including during their installation on older cement concrete or asphalt pavement, in order to prevent cracking.

Features and benefits of TGS Geogrid

In their mechanical properties, TGS Geogrid are more resistant to chemically aggressive environments that meshes manufactured using specialized glasses;

- The cost and chemical properties of TGS Geogrid, as compared to those of mesh made with specialized glasses, speak in favor of TGS Geogrid;
- The temperature at which the asphalt is laid will not damage the TGS Geogrid, as opposed to mesh made from synthetic materials;
- TGS Geogrid retains its physical and mechanical properties at low temperatures and will not lose its elasticity; TGS Geogrid allows the thickness of the asphalt pavement to be reduced, while maintaining the same service life; Given the same thickness of the asphalt pavement, all other things being equal, the use of TGS Geogrid can increase the time between repairs for repair and capital repairs of the pavement by 10 — 15%, with the lifetime of the pavement increased by 3-6 years.

The use of TGS Geogrid as a foundation for road surfaces:

- Increases:
  - load-bearing capacity of the structure
  - overall stability of the structure by up to 30-50%

- Enhances:
  - transportation and operational performance
  - service life of the road dressing

- Shortens:
  - construction times

- Reduces:
  - volume of soil required by 25%
  - extent of fill settling

Functions of TGS Geogrid stabilization of soil:

- to stabilize the foundation by reinforcing the soil, used to reinforce the soil structures when building highways, railroads, hydro-technical structures, pipelines, waste disposal sites, strengthening of soil foundations, as well as for anti-erosion protection for embankment slopes and foundations, using topsoil and grass.
- used to strengthen the retaining structures and steep slopes — with the help of soil reinforcement;
- used to prevent collapse of foundation soil;
- strengthens pile foundations.
Swimming Pools using TGS concrete reinforcements

Swimming pools contain hundreds of feet of rebar reinforcements. First a grid is made vertically and horizontally, then it is encased in concrete. It sounds simple but is made easier when TGS concrete reinforcements are used.