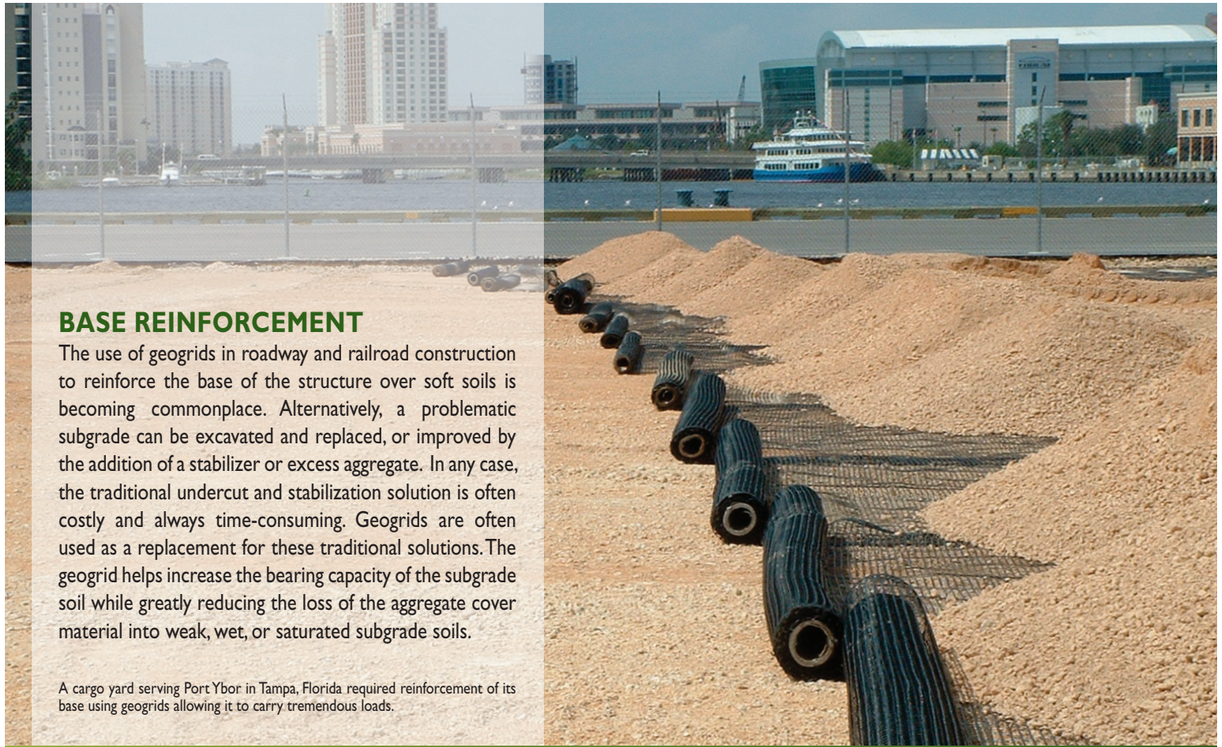

BASE REINFORCEMENT

The use of geogrids in roadway and railroad construction to reinforce the base of the structure over soft soils is becoming commonplace. Alternatively, a problematic subgrade can be excavated and replaced, or improved by the addition of a stabilizer or excess aggregate. In any case, the traditional undercut and stabilization solution is often costly and always time-consuming. Geogrids are often used as a replacement for these traditional solutions. The geogrid helps increase the bearing capacity of the subgrade soil while greatly reducing the loss of the aggregate cover material into weak, wet, or saturated subgrade soils.

A cargo yard serving Port Ybor in Tampa, Florida required reinforcement of its base using geogrids allowing it to carry tremendous loads.

ASPHALT REINFORCEMENT

An increasingly popular application for geogrids is asphalt reinforcement as an asphalt interlayer. The typical reason for employing this technique is to reduce the thickness of required asphalt layers on roadways. But, the designer can also factor decreased life cycle costs for the roadways that utilize these geogrid reinforcements. The geogrid interacts with the asphalt just as it would with aggregate or soil. This interaction reinforces the aggregate materials within the asphalt layer, minimizing stress cracking and lateral movement.

Geogrids are used as an interlayer in this roadway application to reinforce the aggregate materials and minimize cracking.

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GEOGRIDS

Geogrids are an invaluable tool in transportation and civil construction. They allow engineers to build where it other wise would not be possible or would be cost prohibitive using traditional methods. Geogrids are structured polymeric materials usually made from sheets of high-density polyethylene or polypropylene or by weaving or knitting and coating various high-tenacity polymer yarns. The resulting geogrid structure possesses open spaces (called apertures) ranging from 0.5 to 4.0 in. (1 to 10 cm), which enhance interaction with the soil or aggregate they are embedded within. The high tensile strength with minimal elongation, or tensile modulus, makes them especially appropriate for soil reinforcement. By adding geogrids to soil or other geotechnical materials, the designer is able to create a composite material where one element relies on the other to provide a complete system. This system, or the calculated interaction of one element with the other, is designed for an extensive range of applications. The use of geogrids also provides, in most cases, extensive cost savings and decreased life cycle costs when compared to other structural solutions.

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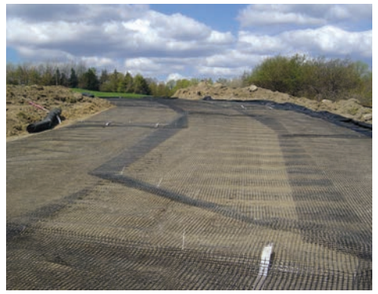
COMMON APPLICATIONS OF GEOGRIDS

The following applications represent common uses of geogrids in geotechnical structures. Each application may have its own design method but sometimes the same design method can be modified for different applications. In all applications, the designer must analyze the interaction of the geogrid with the geotechnical material being used to achieve the intended performance of the structure being designed. This required performance might include smaller surface deformations due to loading, increase life cycle performance or providing a similar function while using a smaller footprint for standard geotechnical structures.



Geogrids are installed to stabilize access roads to wind turbine construction locations.

Geogrids provided reinforcement allowing engineers to build this massive retaining wall, within a limited footprint, in this Interstate 5/805 project in San Diego County, California.

RETAINING WALLS

The use of geogrids in retaining wall applications is viewed as an extremely efficient and cost saving method of design application. The common term used for these structures is mechanically stabilized earth (MSE). Logic would dictate, however, that technically all uses of geosynthetics in geotechnical applications can be termed "mechanically stabilized." A better term for retaining walls utilizing a composite design method is mechanically stabilized earth walls (MSEW). MSEWs have become especially important in highway construction as their use reduces the required width of new right of way and facilitates construction within existing or limited right of way. Properly designed MSEW structures can provide exceptional performance without the need for expensive imported, fill materials.

BRIDGE/RAILWAY ABUTMENTS

Similar in theory and design to MSEW systems, abutment designs must utilize greater care in overall long-term deformation. Since all abutments are generally tied into structural railway or roadways, the geogrid design must provide greater resistance to long-term settlement or load deformations, comparable to the connected structural systems. This is easily accomplished by decreasing the overall material strain vs. load percentage within the design for the structure.

REINFORCED SOIL SLOPES

Another design principle similar to MSEW's is reinforced steepened soil slopes (RSS). The same basic principles utilized in wall designs are used in slope designs with the exception of the facing. Since the faces of slopes are generally not as steep as retaining walls, different design elements are incorporated for erosion protection and aesthetic "green" landscaping techniques. RSS structures are generally less expensive to construct, based on comparable footprints, than MSEWs and can be designed to blend into surrounding landscaping with proper landscape architectural techniques. By doing so, the designer is able to attain a more profitable project profile while minimizing the architectural impact.

REINFORCED FOUNDATIONS OVER PILES

Sometimes when foundation soils are so poor that common consolidation techniques will not work or required consolidation times are not feasible, driven piles are used to bear loads on a layer of soil or rock capable of handling the load. Geosynthetic pads can then be designed to carry loads from the soft soils in-between to the load bearing piles. This design technique minimizes the costs of expensive structural foundation pads; this is especially true for very large scale projects where structural foundation pads would be so expensive that they may hinder the project all together.

Geogrids provided reinforcement in the bridge abutment of the new Interstate 35W bridge that replaced the bridge that collapsed in catastrophic fashion on Aug. 1, 2007. This photo shows the final stage of construction including the finished retaining wall, the bridge deck, and the downtown Minneapolis skyline.

Construction in progress of a 242-ft-high geogrid reinforced slope. The completed slope allowed for a 500 ft extension of a runway at Yeager Airport in Charleston, West Virginia.

REINFORCED EMBANKMENTS OVER SOFT FOUNDATIONS

A popular technique for creating stable foundations over soft soils is termed reinforced embankments over soft foundations (RESF). RESFs are recognized as a cost-effective alternative to traditional techniques for constructing earthen embankments over low-strength foundations. Designers create these RESF systems as a way to consolidate soft foundation soils. Doing so speeds the release of subsurface pore pressures and creates a foundation capable of long-term stability in a given time frame at a reduced cost comparable to alternate solutions.

Geogrids provide embankment reinforcement on this rail track refurbishing in Hallstadt, Germany.