HIGH STRENGTH GEOGRIDS FOR BASAL REINFORCEMENT
Construction over weak foundation soils

- Bypassing the poor ground through relocation of the project to a more suitable site or through the use of a deep foundation
- Removing and replacing the unsuitable soils
- Designing the planned structure to accommodate the poor/marginal ground
- Modifying (improving) the existing soils, either in-place or by removal, treatment and replacement of the existing soils
Ground Modification Methods

- Vertical Drains and Accelerated Consolidation
- Lightweight Fills
- Deep Compaction
- Aggregate Columns
- Column Supported Embankments
- Soil Mixing
- Grouting
- Pavement Support Stabilization
- Reinforced Soil Structures
Design of embankments with reinforced soil foundations on poor ground

**Basal Reinforcement on weak foundation:**
Improve embankment stability by increasing the foundation bearing capacity

**Basal Reinforcement over columns or piles:**
Columns transfer embankment loading to a firm stratum. Geogrid layer is used to bridge across the column to distribute the load and optimize column design.

**Basal Reinforcement over spanning voids:**
Reinforcement spans over sinkholes and voids and supports embankment load
### Basal Reinforcement over columns or piles

<table>
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<th>Method</th>
<th>Description</th>
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| **Beam Method** | - FHWA-NHI-16-028  
- Multiple layers of low strength geosynthetic reinforcement equally spaced within a select granular structural fill that act as a single rigid beam |
| **Catenary Method** | - BS 8006:200  
- High strength geosynthetic that acts as a catenary single layer at the interface between the columns and the soil structure |

[Diagram: Load Transfer Platform, Embankment, Soft Compressible Soil, Geosynthetic Reinforcement, Column (typ.)]  
Collins 2005
GEOGRIDS

1. Biaxial geogrid
   - polypropylene
   - max tensile strength 3000 lb/ft

2. Uniaxial geogrid
   - polyester yarns with LLDPE coating
   - max tensile strength 102,000 lb/ft
Basal Reinforcement over columns or piles

Load Transfer Platform – Catenary Method

Span across pile caps carrying all or a portion of the load and transferring it to the columns

• Increase pile spacing
• Decrease pile cap size
• No need of raking piles
Basal Reinforcement over columns or piles

Load Transfer Platform – Catenary Method

- Single layer of high strength geogrid/geotextile
- Parabolic deformation
- Calculate stresses on top of pile cap:
  - Marston’s Formula
  - Hewlett and Randolph
CH: High Speed Train, Italy (2002 – 2007)

- Piles installed at 2 m centres on a square grid.

- The length of the piles varied depending on the height of the embankment and the results of the settlement analysis.

- No pile caps were used and the high tensile polyester geogrid was installed with a thin layer of sand separating the geogrid and the pile top.
CH: High Speed Train, Italy (2002 – 2007)

• The strength of the reinforcement ranged from 900 to 1050 kN/m (61,000 lb/ft to 71,700 lb/ft) depending on the height of the embankment.

• Two layers of geogrid, one in the longitudinal and the second in the transverse direction were installed.

• In the transverse direction the geogrid was anchored using 0.5 m of gravel, around which the grid was rapped, to achieve the required anchorage length.
Reinforced Granular Mattress (RGM) with high strength geogrids

- Adhesive interface between soft foundation and granular fill of the mattress
- Relatively stiff platform to ensure an even distribution of loads onto the foundation and a more uniform stress field within the soft foundation
CH: Port of Guaymas, Sonora Mexico (2016)

- Port Authority: Administración Portuaria Integral de Guaymas API
- Important hub for Mexico and southern US
- Up to 3 million tons of minerals
Challenge

Port has developed through land reclamation from the sea

Load increase during recent years

Saturated foundation soil with poor characteristics

Settlements

Construction of warehouse in the mineral storage area
Solution
Installation
THANK YOU!

QUESTIONS??