

CASE HISTORY

Stabilization of a road embankment on very soft clay soil, for the construction of a new Expressway in Bangkok, Thailand

PRODUCT	TENAX LBO 302 SAMP bi-oriented geogrids
LOCATION	Bangkok, Thailand, 1991
OWNER	Expressway and Rapid transit Authority of Thailand Bangkok Expressway Co. Ltd
PROJECT	Freeman Fox Intercon Consultant Ltd. Bangkok
CONTRACTOR	Kumagai Gumi Co. Ltd, Japan BBCE Joint Venture: (Bilfinger + Berger Bauaktiengesellschaft, Germany Ch. Karnchang Co. Ltd, Thailand Expert transport Co. Ltd, Thailand



Road section on marshy soil
(unconsolidated soft clay)

PROBLEM

The new Bangkok Expressway was crossing a marshy area with a very soft soil consisting of normal consolidated Bangkok clays, 20 m deep. The site investigations showed that the bearing capacity of the foundation soil was too low to support a "traditional" highway embankment.

The first idea was therefore to widen the embankment base with large berms, in order to distribute the load on a wider area, thus involving deeper soil layers and therefore increasing the global bearing capacity. It appeared fundamental to provide the enlarged base with a sufficient stiffness, in order to decrease both the vertical stresses and the differential settlements. In addition to the above considerations, a high stiffness was required for the initial construction phase to allow the heavy plant to operate on site without sinking into the extremely soft soil that was often waterlogged.



SOLUTION

The design required four horizontal layers of biaxially oriented geogrids for stabilizing this embankment. The geogrids were installed at 300 mm vertical spacing. The design engineers, considering the fundamental structural function performed by the geogrids, issued very stringent specifications for the reinforcement. The geogrid manufacturer was required to provide evidence that a professional quality control procedure would be implemented during the production process and that a certificate of conformity for the specific product would be issued for this project, including:

- Testing certificates by independent laboratories;
- Tensile creep test results, adequate to determine the design tensile strength of the geogrids for a design of 1 year under constant load (1 year was the anticipated time for the consolidation of the clay soil under the embankment);
- Tensile secant modulus at 2% and 5% elongation;
- Proof of UV stabilization.

The geogrids chosen by the Contractor, with the full approval of the design engineers, were TENAX LBO 302 SAMP bi-oriented geogrids. The TENAX engineers were able to produce a proper answer to all the project requirements. In addition, the whole production lot for the Bangkok Expressway (about 150.000 m² of geogrids) were tested and certified by SGS (Société Générale de Surveillance), a specialised international QC/QA firm.

Tab. 1

Design specs for the geogrid

	Longitudinal Direction (MD)	Transversal Direction (TD)
Tensile strength (95% lower confidence limit)	17.5 kN/m	31.5 kN/m
Elongation	12%	11%

Tab. 2

Long term strength of TENAX LBO 302 SAMP geogrid for 1 year of continuous constant load at 20°C.

	Longitudinal Direction (MD)	Transversal Direction (TD)
Tensile strength	4.70 kN/m	7.80 kN/m

tab. 3

Characteristics measured by the Quality Control on the entire production lot of TENAX LBO 302 SAMP geogrid

Measured properties	Mean value	Standard deviation	95% Lower conf. limit
Tensile strength	TD 34.66 kN/m	1.19 kN/m	32.71 kN/m
Yield point elongation	TD 9.92%	2.57%	---
Tensile mod. at 2% el.	TD 608 kN/m	50.3 kN/m	525 kN/m
Tensile mod. at 5% el.	TD 476 kN/m	29.2 kN/m	429 kN/m
Tensile strength	MD 19.8 kN/m	0.59 kN/m	18.85 kN/m
Yield point elongation	MD 19.15%	0.66%	---
Tensile mod. at 2% el.	MD 325 kN/m	18.3 kN/m	295 kN/m
Tensile mod. at 5% el.	MD 234 kN/m	9.4 kN/m	180 kN/m

CONCLUSIONS

TENAX geogrids in this project, as well as in many others, have proven to be a product with the highest technical characteristics and with guaranteed properties. TENAX LBO 302 SAMP passed severe controls before being utilized as a structural element for the stabilization of an embankment on very soft soil. The ease of installation of TENAX geogrids allowed the Contractor to maintain high installation rates and allowed to use an innovative technology for stabilizing the embankment, thus obtaining consistent savings over traditional solutions.