SWaM2019

NATIONAL CONFERENCE ON STORMWATER MANAGEMENT-
MANAGING STORMWATER RUNOFF

MALAYSIAN STORMWATER ORGANISATION

Erosion and Sediment Control with Geosynthetics

By: *Ir. Marcus Jong Ching Joo (Technical Services Manager)*
B.Eng (Hons), MBA, MIEM, P.Eng, APEC Eng., IntPE (My)

TENCATE GEOSYNTHETICS

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TENCATE GEOSYNTHETICS

Introduction
Definition of Geosynthetics

***GEO*SYNTHETICS can be simply defined as**

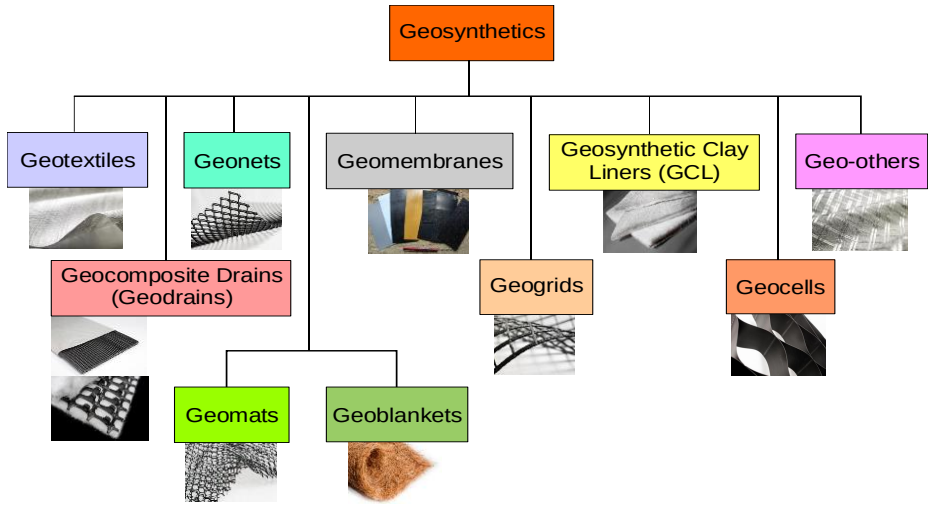
SYNTHETIC *MATERIALS* (Polymers) used for

***GEO*-ENGINEERING applications**

(Geo- Technical, Geo- Hydraulic, Geo- Environment and Others)

Introduction

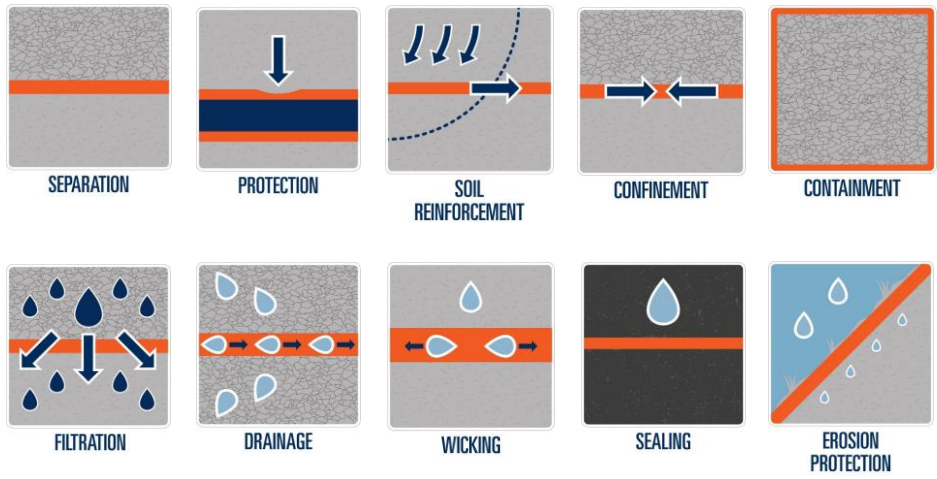
Classification of Geosynthetics



TENCATE GEOSYNTHETICS 6

Functional Application

Functions of geosynthetics



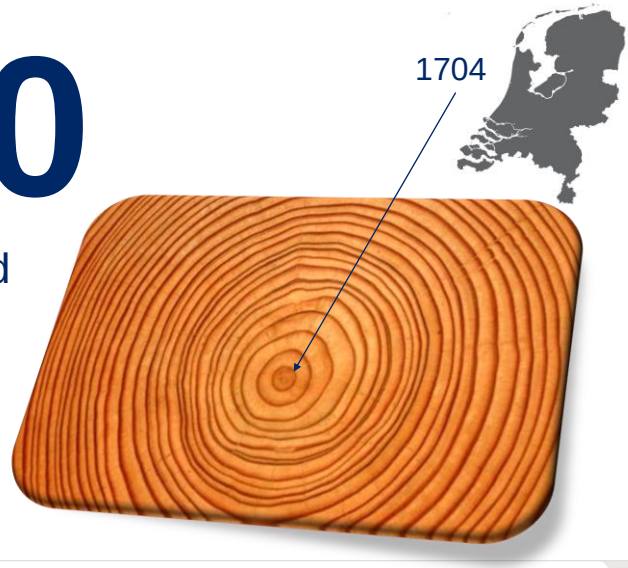
TENCATE GEOSYNTHETICS 7

Royal TenCate Group

Long Established Multinational Company

300

years old



TENCATE GEOSYNTHETICS 8

OUR MISSION

To be the leading global provider of geosynthetic products and solutions that enhance the world's infrastructure, protect the environment and conserve natural resources.

Corporate Headquaters Production Offices Sales Offices

TENCATE GEOSYNTHETICS 9

Global Production Facilities

Act Global, Produce Local


Linz, Austria


Bezons, France


Nijverdal, The Netherlands


Jefferson, Georgia, USA


Cornelia, Georgia, USA


Commerce, Georgia, USA


Shah Alam, Malaysia


Senawang, Malaysia


Zhuhai, China

TENCATE GEOSYNTHETICS

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TenCate Geosynthetics Brands

Global brands you can depend upon

TENCATE Polyfelt®

TenCate Polyfelt®, a renowned trademark for more than 30 years, encompasses a wide range of nonwovens and composites combined with nonwoven elements for various market infrastructures.

TENCATE Mirafi®

Established in the early 1970s, TenCate Mirafi® represents a family of high performance woven geotextiles for soil reinforcement and heavy duty stabilization applications.

TENCATE Miragrid®

Developed in the late 1980s and first trademarked in 1992 by Mirafi, Inc., TenCate Miragrid® geogrids have since been used around the world for soil reinforcement applications.

TENCATE Geotube®

TenCate is the pioneer of Geotube® technology. Since the North Sea Flood in 1953, TenCate Geotube® now covers the globe with engineered containment systems designed for water infrastructures and environmental dewatering.

TENCATE GEOSYNTHETICS

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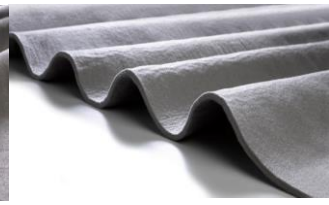
Products & Branding

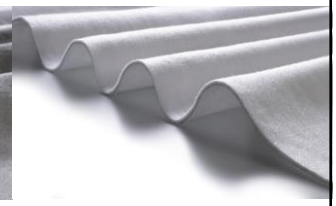
TenCate Polyfelt® covers a wide range of nonwoven geotextiles and composites for infrastructure and environmental applications

TENCATE Polyfelt®

TS (Nonwoven)

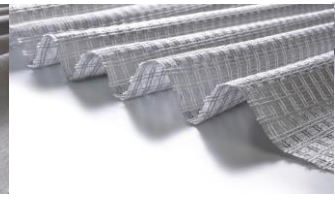


TS (Heavy duty nonwoven)

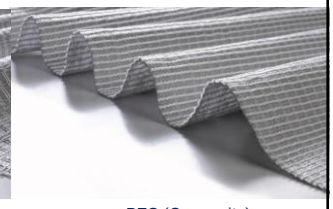


KE (Nonwoven)

PGM (Paving fabric)



PGMG (Paving composite)

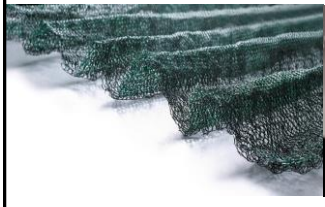


PEC (Composite)

Products & Branding

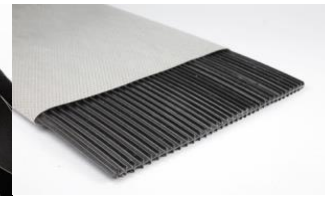
TenCate Polyfelt® covers a wide range of nonwoven geotextiles and composites for infrastructure and environmental applications

TENCATE Polyfelt®

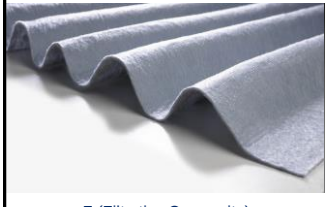


Polymat (Geomat)

Envirocell (Geocell)

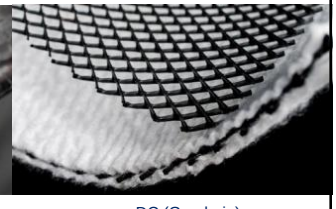


Alidrain (PVD)



F (Filtration Composite)

Environmat (GCL)



DC (Geodrain)

Products & Branding

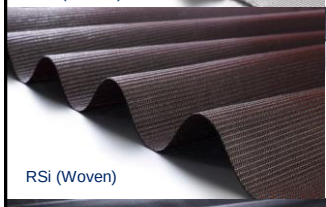
TenCate Mirafi® covers high performance woven geotextiles for soil reinforcement

TENCATE Mirafi®


PET (Woven)


SR (Woven)


GR (Woven)


RSi (Woven)


H2Ri (Woven)


HPa (Woven)


FW (Woven)


GRM (Woven)


PP (Woven)

Products & Branding

TenCate Miragrid® covers high performance geogrids for soil reinforcement applications

TENCATE Miragrid®

GX (Geogrid)

Products & Branding

TenCate Geotube® covers engineered containment systems designed for hydraulic and marine applications, and dewatering applications

TENCATE Geotube®

Geobag

Sand Filled Mattress

Concrete Mattress

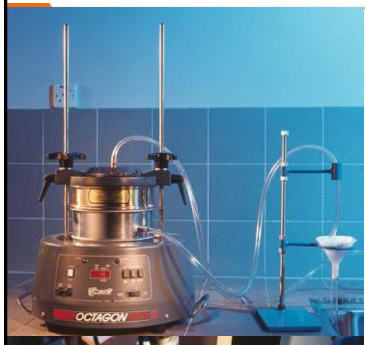
Geotube® Marine

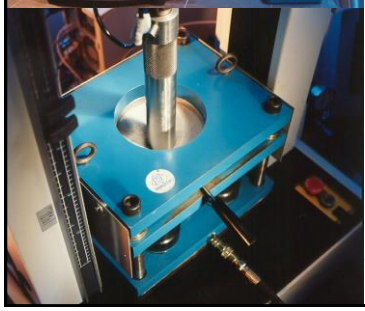
Geotube® Dewatering

Silt Curtain

Our Focus Market Segments
(Visit our website: www.tencategeo.asia)

TenCate Geosynthetics Quality System





kiwa certified
CERTIFIED MANAGEMENT SYSTEM
ISO9001:2015

STANDARDS MALAYSIA
ACCREDITED LABORATORY
MS ISO/IEC 17025
TESTING
SAMM NO. 207

GAI-LAP
Accreditation #: GAI-LAP-45-02

Accreditation


Accreditation #:
GAI-LAP - 45 - 02
TEL (610) 522-8440

Geosynthetic Institute
475 Kedron, Ave.
Folsom, PA 19033

Geosynthetic Testing Laboratory
TenCate Geosynthetics Asia Sdn. Bhd.

is granted accreditation
for designated geosynthetic test methods in accordance with the Geosynthetic Accreditation Institute - Laboratory Accreditation Program (GAI-LAP), as published in its annual directory.
This accreditation is valid until June 30, 2020.

Robert M. Koerner, Ph.D., P.E.
Director Emeritus

George R. Koerner, Ph.D., P.E. & CQA
Auditor

GRI GII GSI GAI GCI

(GAI-LAP since 2004)
Accredited by :
Geosynthetics Accreditation Institute (GAI) USA


SN: 0101

STANDARDS MALAYSIA

Certificate of Accreditation

No: SAMM 207 Valid until: 6 February 2020

This is to certify that

GEOSYNTHETIC TESTING LABORATORY
TENCATE GEOSYNTHETICS ASIA SDN. BHD.
SHAH ALAM, SELANGOR
MALAYSIA.
(FIELD OF TESTING: MECHANICAL)

has been granted accreditation in respect of the scope of accreditation described in the schedule, subject to the terms and conditions governing the *Skim Akreditasi Makmal Malaysia* (SAMM), the Laboratory Accreditation Scheme of Malaysia.

"This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer joint ISO-ILAC-IAF Communiqué dated January 2009)".

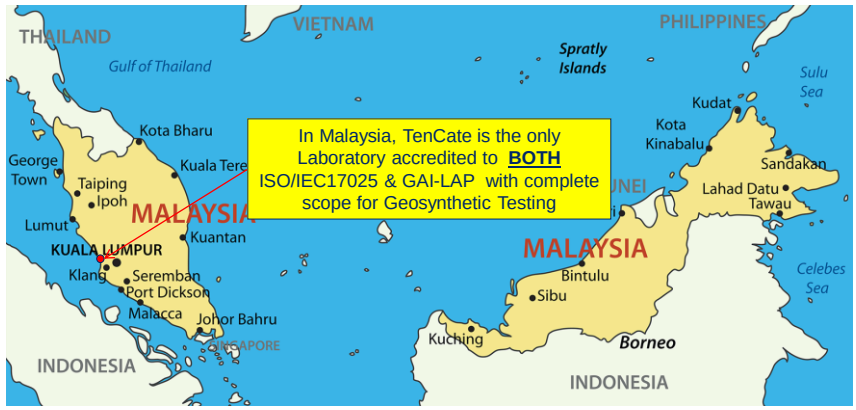
(DATUK FADILAH BAHARIN)
Director General
Department of Standards Malaysia

Date of issue: 10 September 2016

STANDARDS MALAYSIA
ACCREDITED LABORATORY
MS ISO/IEC 17025
TESTING
SAMM NO. 207

(ISO/IEC 17025 since 2001)
Accredited by :
Department of Standards Malaysia

Laboratory with ISO/IEC 17025 & GAI-LAP Accreditation on Geosynthetic in M'sia



- Testing/Servicing Lab
- Manufacturer Lab

In Pursuit of Excellence

International Awards

IFAI INTERNATIONAL ACHIEVEMENT AWARDS

IEM The Institution of Engineers, Malaysia


2010
Award of Excellence
Incheon Bridge Project, South Korea
2012
Outstanding Achievement Award
Qingjing Lake, Sino-Singapore
Tianjin Eco-City, China
IFAI AWARD OF
EXCELLENCE
INTERNATIONAL ACHIEVEMENT AWARDS
2011
Award of Excellence
Hetaoyu Mine Coal Processing Plant,
Gangsu Province, China
2013
Award of Excellence
Embraport Container and Bulk Fuel Terminal,
Santos, Brazil


2014
Outstanding Achievement Award
Central Angostura Coffer Dam, Chile
2016
Jabor Landfill, Malaysia
IFAI AWARD OF
EXCELLENCE
INTERNATIONAL ACHIEVEMENT AWARDS
2017
INDOT I-69 Section P3, US
2015
Outstanding Achievement Award
Lach Huyen Bridge, Haiphong, Vietnam

THE INSTITUTION OF ENGINEERS MALAYSIA

Established *May 1959*

Presented in recognition to Company's Contribution to the Engineering Industry in Malaysia

This certificate is awarded to

TenCate Geosynthetics Asia Sdn Bhd

In recognition for contribution in the Engineering Industry (Material and Proprietary System)

Erosion Problems
Definition of erosion

As defined by the Collins Dictionary of Geology:

- *Erosion* is *the wearing away of any part of the Earth's surface by natural agencies. These include mass wasting and the action of waves, wind, streams and glaciers. Fundamental to the process of erosion is that material must be picked up and carried away by such agents.*

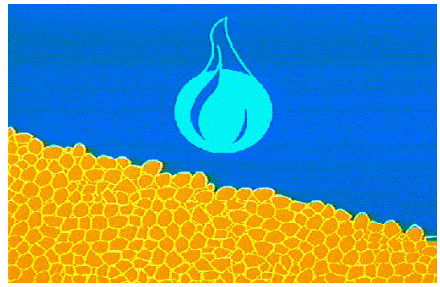
Erosion Problems
Definition of erosion

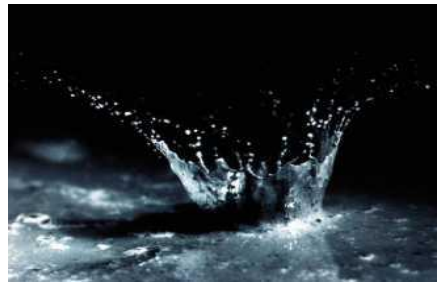
Factors contribute to erosion:

- *Rainwater*
- *Overland flow (Surface run-off)*
- *Tides*
- *Winds induced storm surges and waves*
- *Climate change (Sea water rise, stronger wind, etc.)*
- *Human factors within river catchments, along the coast and offshore*
- *Others*

Erosion Problems
The impact of water forces

- **Rain water impact**
  - Rain water will soak up exposed soil surface and dislodge soil particles



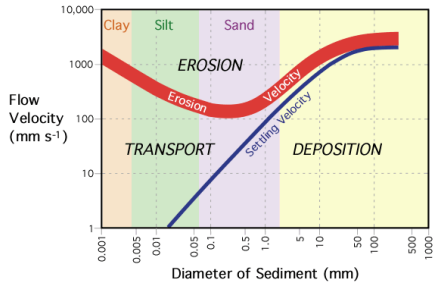


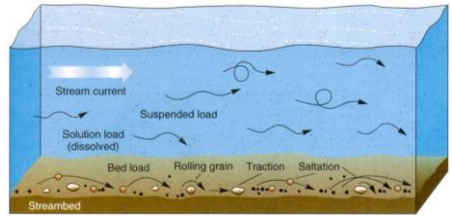
Erosion Problems
Overland erosion process

- The overland flow of water erodes the ground surface
- Thin, uniform layers of soil are peeled off the land surface in a process called sheet erosion
- When little rivulets of running water gather together and cut small channels in the soil, the process is called rill erosion
- When rills enlarge to form bigger ravines that are too large to be removed by normal tillage operations, they progress onto the process of gully erosion

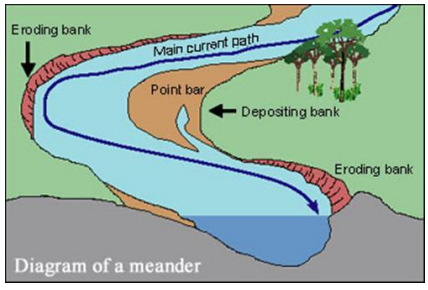
Erosion Problems
Water current influence

- Water current (velocity) is key to whether soil particles are eroded or deposited
- Erosion is a sequence of 3 closely related events
  - Detachment
  - Entrainment
  - Transport
- Deposition is the settling down of soil or sediment to the bottom





Erosion Problems
Problems – riverbank erosion



Erosion Problems

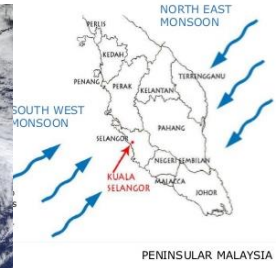
Astronomical tidal influence on navigation and coastal structures

Erosion Problems

Winds induced storm surges and waves

- Wind is one of the key contribution factors towards erosion, creating storm surges and waves
- Worst, tropical cyclone landfall creating storm surges and huge waves
  - **Hurricanes**
  - **Typhoons**
  - **Cyclones**

Tropical cyclones/ hurricanes/ typhoons



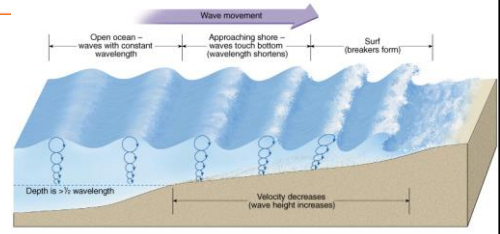
Monsoon

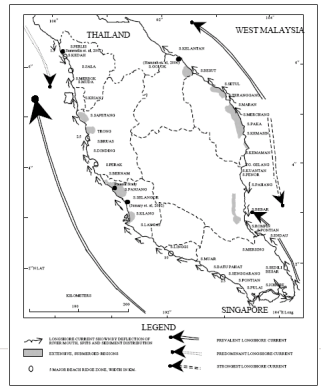
Waves

Erosion Problems

Coastal erosion process

- **Waves** carry energy across a water body and dispenses the energy when it meets the coast
- Waves typically approach a shoreline at an angle that generates a **longshore current** which is responsible for **littoral drift** along the coastline
- Sediment may be removed from a coastal section during a specific season but replenished during other seasons to maintain a stable coastline
- On a macro view, **coastal erosion** is evidenced by loss of land to water due to permanent retreat of the coastline brought about by the disruption to a stable littoral process





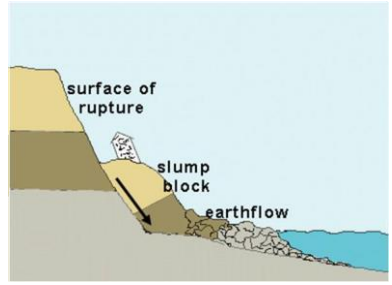
Erosion Problems

Problems – coastal erosion

Erosion Problems

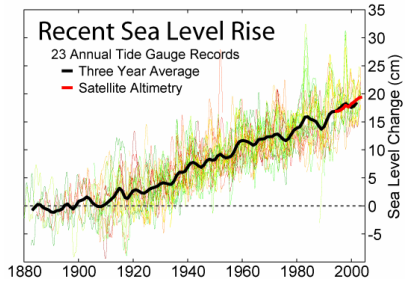
Contribution of slope instability to rate of erosion

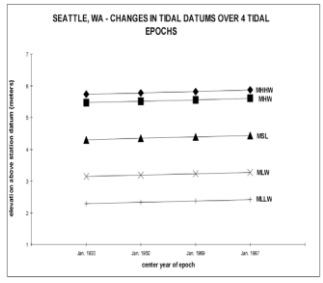
- Slope instability or failure is not part of the erosion mechanism but often helps speed up the rate of riverbank or coastal erosion by loosening and moving material closer to the forces of erosion



Erosion Problems

Climate change- permanent sea level rise

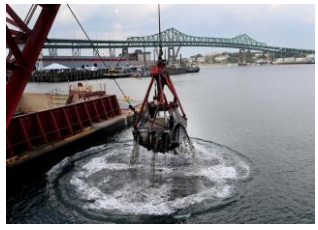




Erosion Problems
Human activities

Dam construction

Reclamation



Dredging works

Deforestation

TENCATE GEOSYNTHETICS

Erosion Problems
Others- Ship induced waves

TENCATE GEOSYNTHETICS

Erosion Problems

Others- Tsunami

TENCATE GEOSYNTHETICS

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MALAYSIAN STORMWATER ORGANISATION

Water infrastructure protection with Geotube® System

By: ***Ir. Marcus Jong Ching Joo (Technical Services Manager)***

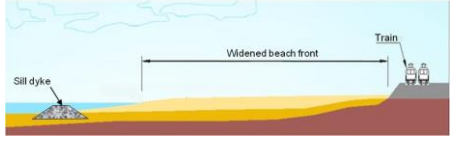
B.Eng (Hons), MBA, MIEM, P.Eng, APEC Eng., IntPE (My)

TENCATE GEOSYNTHETICS

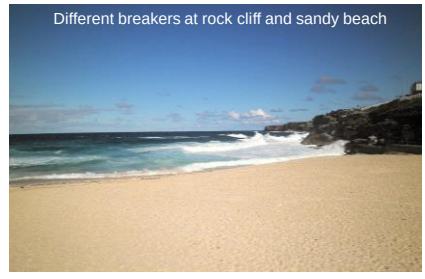
Erosion Protection Systems
Overview

- To prevent erosion from occurring a variety of preventative measures are used to reduce the water forces acting on the riverbank or coastline.
- Generally these measures fall into one of three categories:
  - **Geometrical measures**, where the shape of the structure is altered in order to reduce the water forces below a minimum threshold. Examples include creating a gentle sandy beach front, etc.
  - **Stabilisation measures**, where the exposed structure is protected from erosion by stabilizing the susceptible soil. Examples include the provision of revetments, seawalls, etc.
  - **External measures**, where the exposed structure is protected from erosion by the provision of a protective structure, placed at some distance. Examples include groynes, breakwaters, etc.

Erosion Protection Systems
Geometrical measures

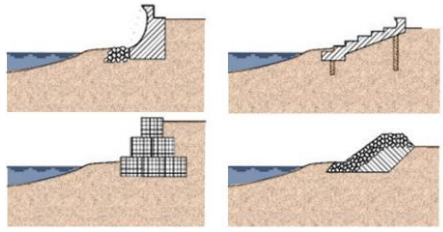


Different breakers at rock cliff and sandy beach

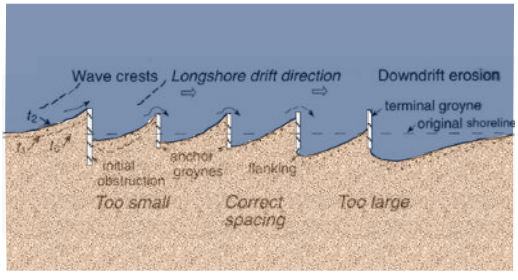


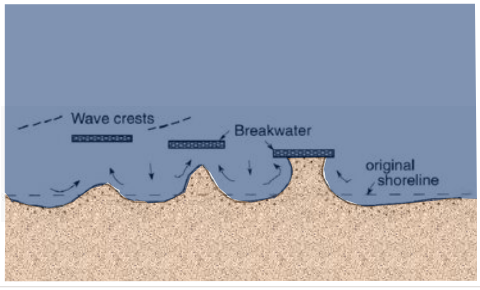
Beach nourishment to moderate breakers

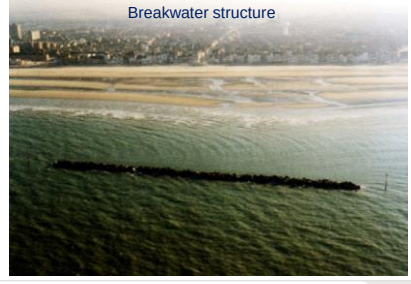
Erosion Protection Systems
Stabilisation measures



Erosion Protection Systems
External measures



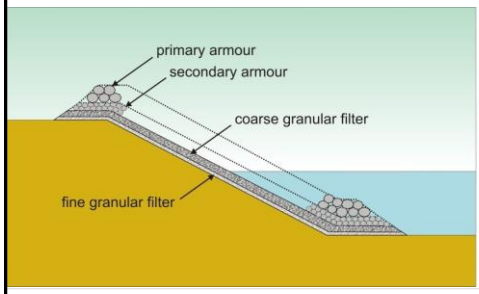


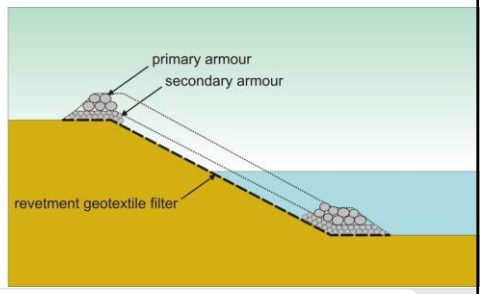


Geotextile filters – Applications & Design

Revetment filters

- The geotextile filter replaces one or more layers of granular filters
- The geotextile filter placed on top of the graded slope
- Armour material (usually rock) are dropped onto the geotextile filter at a specified height or lower.
- The geotextile filter has to perform the filtration role.
- The geotextile filter also has to survive the installation process.





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Pulau Ubin & Pulau Tekong Reclamation, Singapore

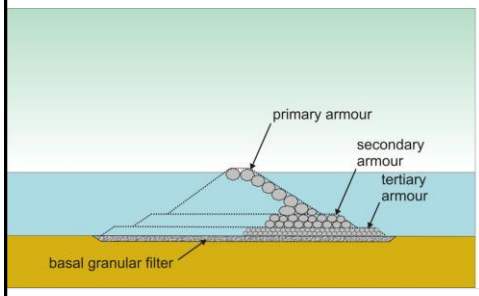
Reclamation of 1,480 ha of land to enlarge Pulau Ubin and Pulau Tekong.
1.3 million m^2 of Polyfelt® TS006 used as filter geotextile under rock revetment to protect reclaimed land.

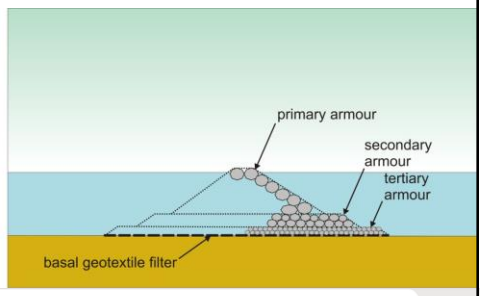
TENCATE GEOSYNTHETICS 48

Geotextile filters – Applications & Design

Basal filters

- When dykes and breakwaters are located on rock or overconsolidated clay foundations erosion across the base generally does not occur
- If located on a sand foundation then erosion and scour may lead to undermining and instability; and a basal geotextile filter is applied
- When normally consolidated to slightly overconsolidated clays are encountered, a basal filter which also perform the subgrade stabilisation function is also applied
- Installation of such basal filters can much more difficult.



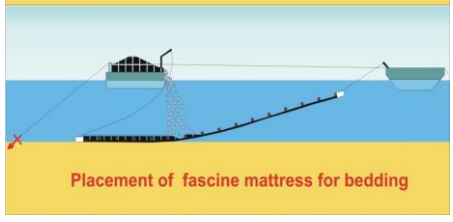


Geotextile filters – Applications & Design

The difficulties of installing narrow panel width basal geotextile filters in water

Geotextile filters – Applications & Design

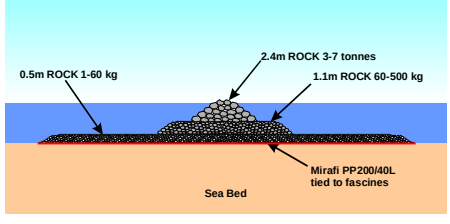
Installation of basal geotextile filters



Kerteh Breakwater, Malaysia

Three offshore breakwaters were constructed to protect the eroding beach front of the base camp complex housing Petronas and Exxon.

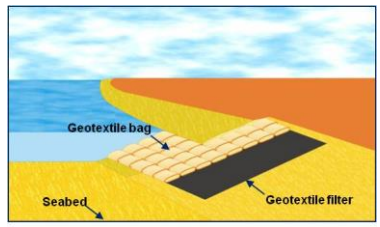
Mirafi® PP200L filter geotextile was used to form the basal fascine mattress of the breakwaters.



Geotextile Containment Systems – Applications & Design

Geotextile bag applications – revetment and dyke structures

- Generally pillow shaped of various sizes; fills about 0.3 to 3 m^3 of sand
- Stringent exposure durability requirements except for temporarily exposed structures



TENCATE GEOSYNTHETICS 53

Ayer Merbau Coastal Protection, Singapore

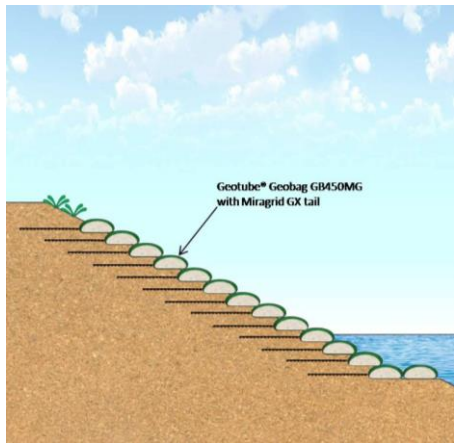
Ayer Merbau is part of Jurong Island, formed by amalgamation of a group of small islands situated about 3.5 km off the southern shore of Singapore.

Geotube® GB450MC geobags used as coastal erosion protection units.

TENCATE GEOSYNTHETICS 54

Sungkai River Bank Erosion Protection, Malaysia

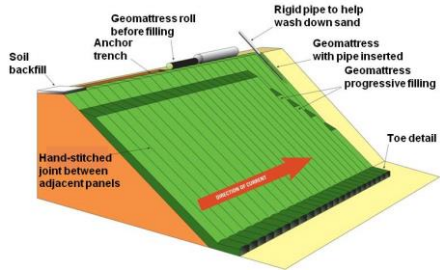
A water treatment plant along Sungkai River requires erosion protection.
Geotube® GB450MG geobags with geogrid reinforcement tail used as riverbank erosion protection units.



Geotextile Containment Systems – Applications & Design

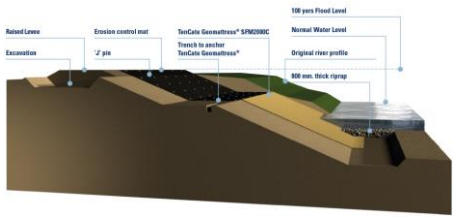
Geotextile mattress applications – revetment structures

- Double fabric layer, stitch-bonded to each other
- Fills to sand thickness of about 0.18 to 0.3 m
- Top layer exposed for extended period so fabric requires stringent exposure durability requirements



Segamat River Upgrading Works, Malaysia

In 2012, 515 mm of rain over 4 days resulted in Segamat River overflowing the banks and flooding the town. Geotube® SFM2000C geomattress and Erosion Control Mat used as riverbank erosion protection for 8 km of Segamat River with wider channel and raised levee upgraded section.



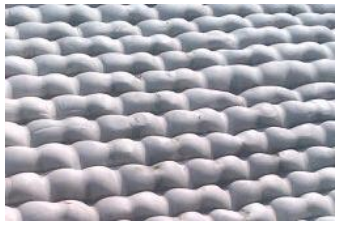
Geotextile Containment Systems – Applications & Design

Geotextile mattress applications – revetment structures

- Double fabric layer, linked either by conjoined woven filter points or through connecting internal thread
- The internal space created between the two fabric layers are filled with micro-concrete
- Form a robust and durable concrete mattress

CFM : Flexible mattress

CSM : Standard continuous mattress



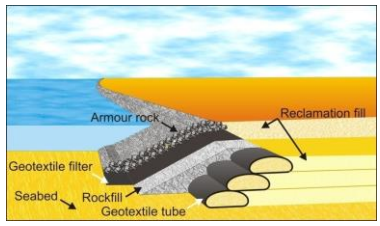
CRM : Regular filter-point mattress

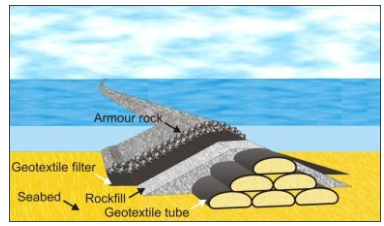
Sinthay River Valley Irrigation, Myanmar

1.5 km of irrigation canals were constructed to allow all year round multiple crop cultivation to be carried out. Geotube® CFM geomattress filled with micro-concrete was used for erosion protection of the newly constructed irrigation canals.

Geotextile Containment Systems – Applications & Design

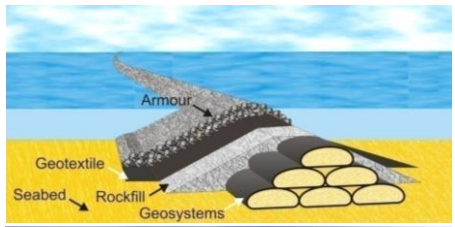
Geotextile tube applications – dyke structures

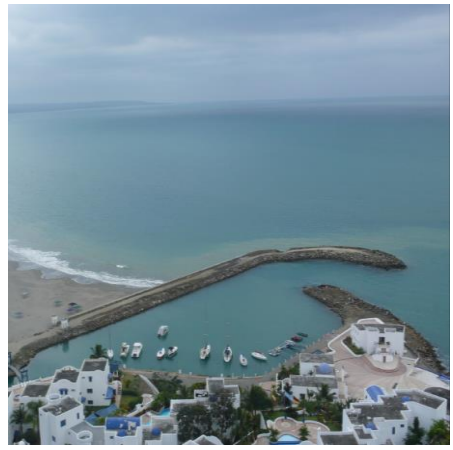




Stella Maris Marina, Equador

Breakwater construction to protect the new marina and its entrance for yatchs.
Geotube® GT1000M units of diameter of 4.3 m filled to 2 m high, stacked 3 levels to replace rockfill core in the breakwater construction.

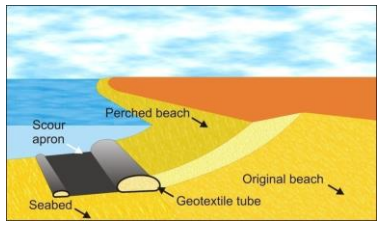


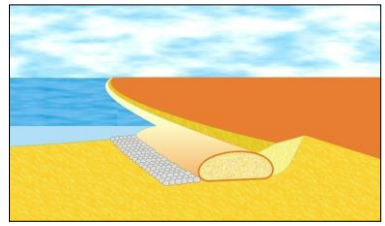


TENCATE GEOSYNTHETICS 61

Geotextile Containment Systems – Applications & Design

Geotextile tube applications – dyke structures

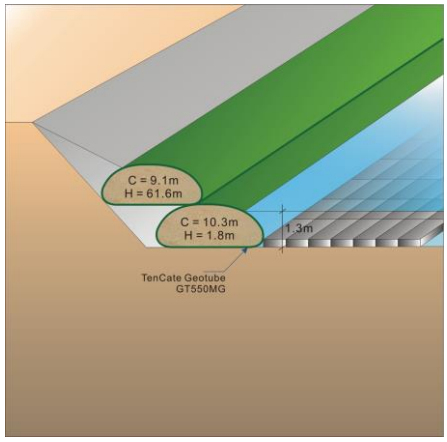




TENCATE GEOSYNTHETICS 62

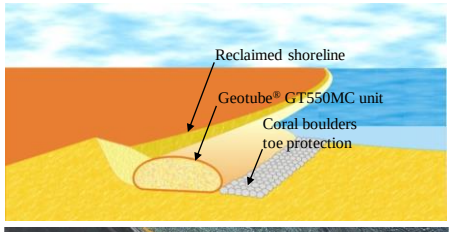
Rio La Antigua Riverbank Protection, Mexico

Geotube® GT550MG units used for riverbank erosion protection.
Geotube® units with circumference 10.8m filled to 1.8m high used for bottom layer.
Geotube® units with circumference 9.1m filled to 1.6m high used for top layer.



Gan International Airport, Maldives

Coastal erosion was threatening the safety of the end of the GIA runway.
Its remoteness and lack of natural resources mean armour units need huge haulage distances and costs.
2 km of coastline protected with Geotube® GT550MC units of diameter of 3.4 m filled to 1.8 m high.

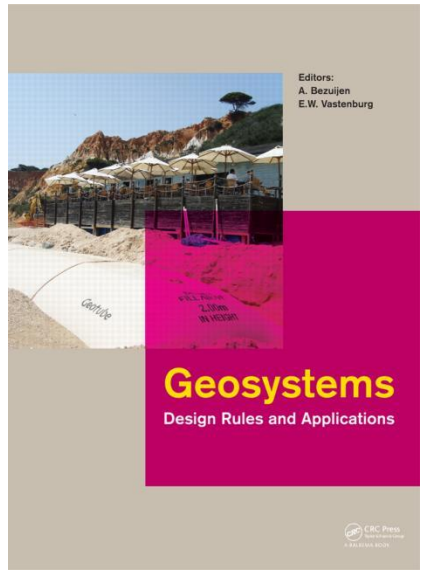


Geotextile Containment Systems – Applications & Design

Design rules

Geosystems. Design Rules and Applications

- Based on research commissioned by the Dutch Rijkswaterstaat and Delft Cluster
- Originally published as CUR-publication 217 (in Dutch)
- Published in English in 2013 with new developments added and text improved
- Covers sand-filled geotextile bags, geotextile mattresses and geotextile tubes



Geotextile Containment Systems – Applications & Design

Design Issues

- Design life of the hydraulic structure
  - Likely determined on an economic basis
  - Impacts on the product specification for durability requirements
- Required level of service of the hydraulic structure
  - In terms of an acceptable overtopping limit or risk of damage
- Geometrical boundary conditions
  - Profile
  - Crest elevation
  - Toe levels
- Hydraulic boundary conditions
  - Water levels (should include the influence of tides and surges)
  - Wave conditions
  - Current flow conditions

Geotextile Containment Systems – Applications & Design

Design Issues

- From a technical standpoint the geotextile containment systems need to fulfil the following:
  - Internal stability
    - The geotextile used to fabricate the geotextile containment unit, including seams and closure, need to withstand the stresses encountered during the installation process (commonly referred to as the **tensile strength requirement**).
    - The geotextile should prevent loss of fines during installation and under in-service wave and flow attacks (commonly referred to as the **sand tightness requirement**).
  - External stability
    - The sand filled geotextile containment structure should be stable against wave and current attacks (commonly referred to as the **hydraulic stability requirement**).
    - The sand filled geotextile containment structure should be stable against sliding, overturning, bearing and global slip failures (commonly referred to as the **geotechnical stability requirement**).
  - Durability
    - The geotextile used to fabricate the geotextile containment unit need to last over the design life of the structure (commonly referred to as the **durability requirement**). This includes durability of the polymer material due to chemical degradation in a buried state as well as durability against UV, abrasion, mechanical damage from impacting debris, etc. during the state of exposure.

SWaM2019

NATIONAL CONFERENCE ON STORMWATER MANAGEMENT- MANAGING STORMWATER RUNOFF

MALAYSIAN STORMWATER ORGANISATION

Turbidity control with Geotube® Silt Curtain

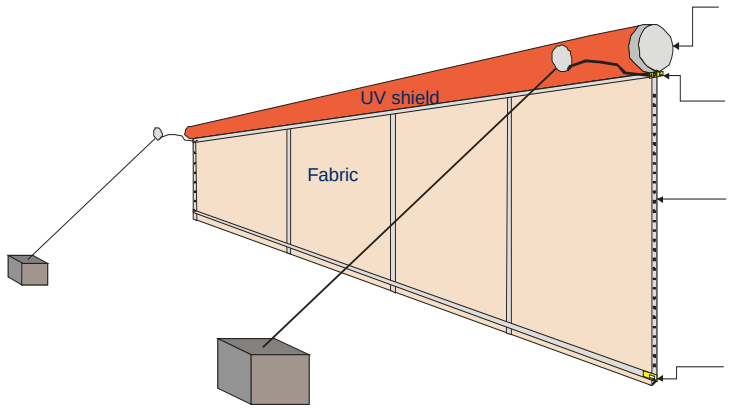
By: ***Ir. Marcus Jong Ching Joo (Technical Services Manager)***

B.Eng (Hons), MBA, MIEM, P.Eng, APEC Eng., IntPE (My)

TENCATE GEOSYNTHETICS

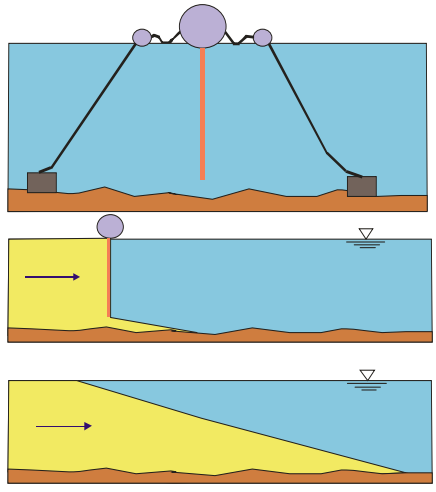
TenCate Geotube® Silt Curtain

Components of Silt Curtain



TENCATE GEOSYNTHETICS

TenCate Geotube® Silt Curtain



Typical section of silt curtain system

With silt curtain

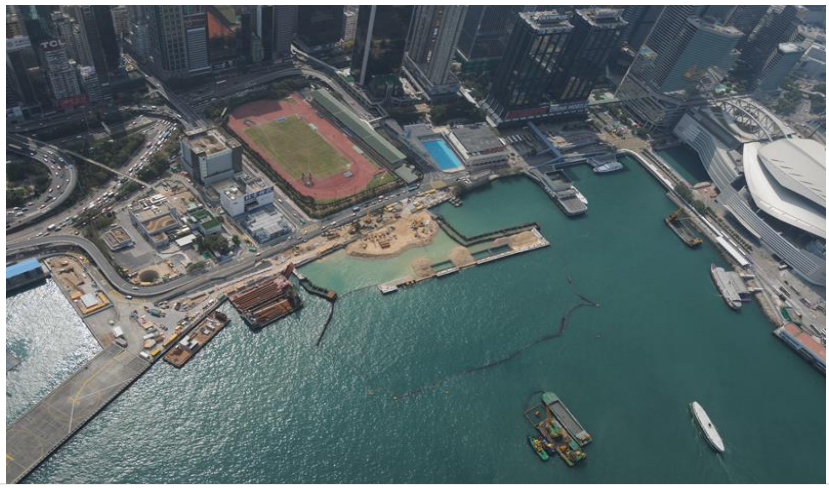
Without silt curtain

TENCATE GEOSYNTHETICS

TenCate Geotube® Silt Curtain

Applications

Reclamation Works



TENCATE GEOSYNTHETICS

TenCate Geotube® Silt Curtain

Applications

Dredging Works

TENCATE GEOSYNTHETICS

TenCate Geotube® Silt Curtain

Applications

Piling Works

TENCATE GEOSYNTHETICS

TenCate Geotube® Silt Curtain

Applications

Bridge and other Structural Constructions

TENCATE GEOSYNTHETICS

TenCate Geotube® Silt Curtain

Applications

Constructions and Protection of Existing Water Intakes

TENCATE GEOSYNTHETICS

TenCate Geotube® Silt Curtain

Applications

Sand Filling Activities

TENCATE GEOSYNTHETICS

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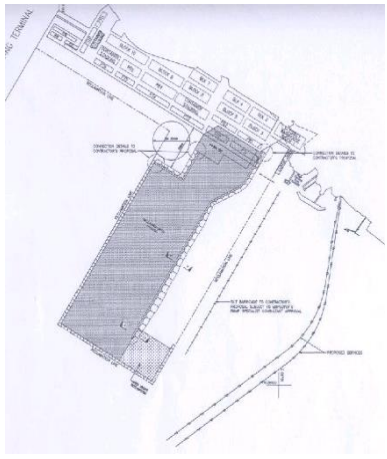
Case Study – Semakau Island, Singapore

TENCATE GEOSYNTHETICS

TenCate Geotube® Silt Curtain

Case Study – Reclamation of Pasir Panjang Terminal, Phase 3 and 4, Singapore



TENCATE GEOSYNTHETICS

SWaM2019

NATIONAL CONFERENCE ON STORMWATER MANAGEMENT-
MANAGING STORMWATER RUNOFF

MALAYSIAN STORMWATER ORGANISATION

Reinforced wall and slope at waterways

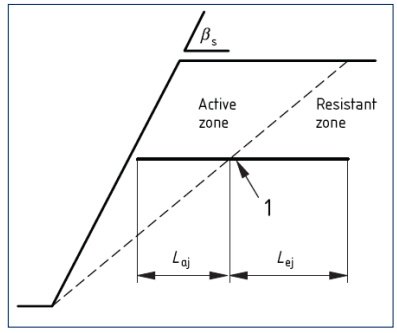
By: *Ir. Marcus Jong Ching Joo (Technical Services Manager)*
B.Eng (Hons), MBA, MIEM, P.Eng, APEC Eng., IntPE (My)

TENCATE GEOSYNTHETICS

Reinforced Soil Wall & Slope with Geosynthetics

Basic Principles

- **Earth retaining structures can be classified based on two principal categories; external and internal stabilised systems. Internal stabilised system is identified by reinforced soils with multiple layers of horizontal reinforcing elements. Geosynthetics reinforced soild structures is an internal stabilised system.**



(BS8006-1, 2010)

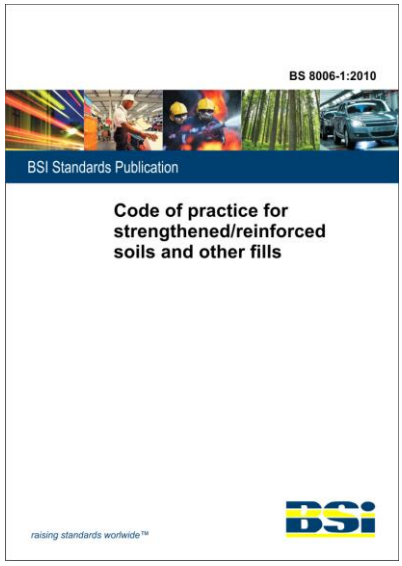
Reinforced Soil Wall & Slope with Geosynthetics

Basic Principles

- **Some part of Great Wall, China was built using an early version of internal stabilised system, consisting of a mixture of clay and gravel reinforced with tamarisk branches (NCMA, 1997).**

(Askideas, 2016)

BS8006 – Code of Practice for Strengthened/ Reinforced Soils and Other Fills

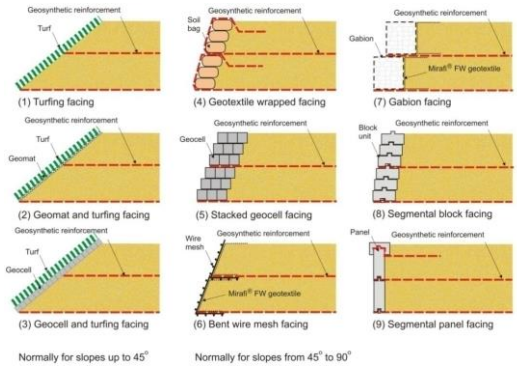


- BS8006:1995 was a “game-changer” as far as reinforced soil practice was concerned
- Limit state code of practice
  - Ultimate limit states - collapse modes
  - Serviceability limit states - deformation modes
- Use of partial factors to generate acceptable levels of safety
  - Derived by calibration with existing global factor of safety methods
- Applications covered:
  - Retaining walls
  - Reinforced slopes
  - Basal reinforced embankments
- Deals with metallic and geosynthetic reinforcements
- Extensive use in many countries – has become a ‘text book’
- Updated version published in 2010 – BS8006-1:2010

Reinforced Soil Wall & Slope with Geosynthetics

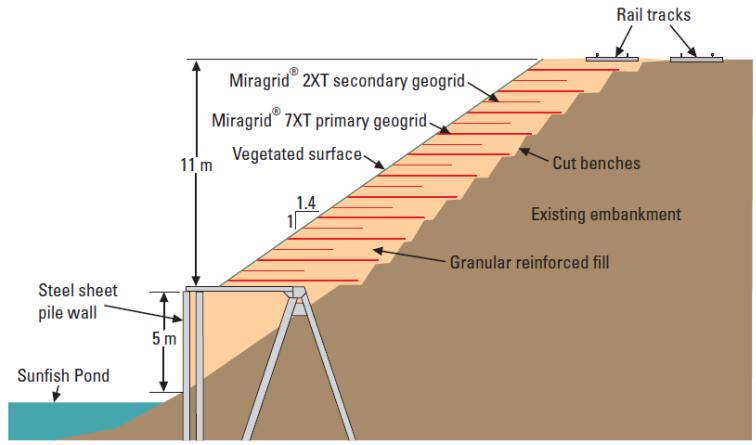
Facing

- Facing serves the following purposes
  - Protect against surficial erosion
  - May help restrain surface bulging
  - Act as a formwork to achieve steep geometry
  - Aesthetics



Hamilton Reinforced fill of shallow slopes, Canada

Expansion project commuter rail system between Hamilton, Ontario and Toronto, approximately 50km long of construct second railway track. The Miragrid® geogrids with 35 kN/m and 90kN/m tensile strength respectively were used to reinforced to reinforce the 1V:1.4H shallow slope along with a Geomat to foster vegetation growth.



Typical cross section through the reinforced fill slope

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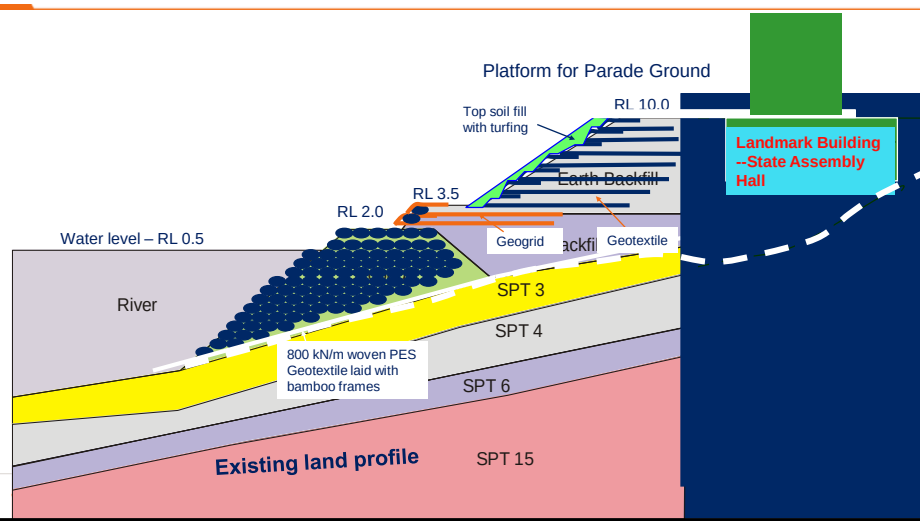
River Reclamation and Reinforced Slope for State Assembly Hall, Sarawak

River reclamation was done with Geobag bund system, and one layer of Mirafi PET800 to cater for global stability. At the height above water level (RL 2.0), the slope is constructed with Miragrid GX and Polyfelt PEC up to the platform level of RL 10.0



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Greenhill, Shah Alam, Malaysia

Construction of Green Reinforced Soil Slopes with Innovative Geosynthetics Material at Mukim Pantai Timur, Daerah Kota Tinggi, Johor Darul Takzim

Material Grade: GX80/30, GB420MG2 , TS80, TS20, CF350
Quantity: 8800m^2,450 units geobag, 2800m^2, 1900m^2, 900m^2
Year of Completion: 2018

Client: Desaru Development Holding One Sdn. Bhd.
Consultant: Straits Consulting Engineers Sdn. Bhd.
Contractor: Suhati Sdn. Bhd.

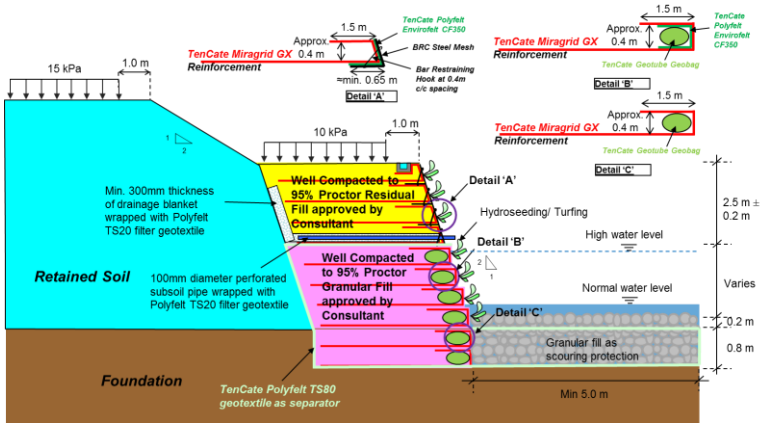
Construction of Green Reinforced Soil Slopes with Innovative Geosynthetics Material at Mukim Pantai Timur, Daerah Kota Tinggi, Johor Darul Takzim

Desaru Coast is a project development in Mukim Pantai Timur, Daerah Kota Tinggi, Johor, Malaysia. It is one of the world's biggest water park set against the backdrop of a Malaysian fishing village. A largest wave pool can be found in this water park. Visitor will get to experience the fun in the theme park and premium hospitality in this beautiful place.

Peninsular Malaysia

Construction of Green Reinforced Soil Slopes with Innovative Geosynthetics Material at Mukim Pantai Timur, Daerah Kota Tinggi, Johor Darul Takzim

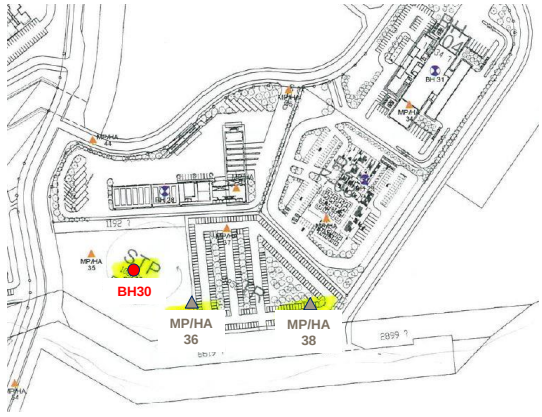
Approximate 130m of reinforced soil slope has been designed to create a drainage channel to divert water to the sea. Based on the ground profile and drainage channel level, maximum height of 4.5m reinforced soil slope was constructed incorporate with TenCate Miragrid® and TenCate Geotube® geobag to form a 63° reinforced soil slope.



Typical Section – Reinforced Soil Slope

Construction of Green Reinforced Soil Slopes with Innovative Geosynthetics Material at Mukim Pantai Timur, Daerah Kota Tinggi, Johor Darul Takzim

One borehole and 2 mackintosh probe/hand auger were collected near the reinforced soil slope are to investigate the site soil properties and condition. Based on soil investigation report, the foundation mainly consist of silt and sand, generally 1.0m to 6.0m stiff to very stiff sandy silt follow by 6.0m to 9.0m dense to very dense gravelly sand and subsequently the hard layer. Hence, foundation is considered stable to build a reinforced soil slope.



BH location

Construction of Green Reinforced Soil Slopes with Innovative Geosynthetics Material at Mukim Pantai Timur, Daerah Kota Tinggi, Johor Darul Takzim

Existing gentle slope has been removed to designed base level to build a 63° reinforced soil slope. With water run off in front of the reinforced soil slope, proper design needs to be carried out to ensure the stability of the reinforced soil slope. TenCate Miragrid® GX geogrid and TenCate Geotube® geobag are used as an engineering solution for the construction of the reinforced soil slope. TenCate Miragrid® GX80/30 is incorporate into the design to enhance the stability of the slope. TenCate Geotube® green composite fabric geobag is used at the bottom part of the reinforced soil slope to prevent soil erosion by water flow.

Existing slope at site

Excavation at site to remove existing soil

Construction of Green Reinforced Soil Slopes with Innovative Geosynthetics Material at Mukim Pantai Timur, Daerah Kota Tinggi, Johor Darul Takzim

TenCate Geotube® Geobag was filled with sand and stack together to the designed water level. At the same time, TenCate Miragrid® GX80/30 was laid one layer by layer with 0.4m vertical spacing to the designed slope height. Steel mesh was used as a frame work to form a 63° slope angle. Other than that, granular was placed with 1.0m embedded height at the toe of the reinforced soil slope to prevent scouring. Proper compaction was done until the completion of slope construction.

TenCate Geotube® geobag placed at the bottom of reinforced soil slope with TenCate Miragrid® geogrid

Steel mesh is used to form a 60° slope angle

Construction of Green Reinforced Soil Slopes with Innovative Geosynthetics Material at Mukim Pantai Timur, Daerah Kota Tinggi, Johor Darul Takzim

TenCate Polyfelt® Envirofelt CF350 was installed at the surface of reinforced soil slope to enhance vegetation growth. Reinforced soil slope cover with green grass turfing provides environmentally friendly aesthetic outlook.

TenCate Polyfelt® Envirofelt CF350 covered reinforced soil slope surface to enhance vegetation growth

Overview of reinforced soil slope

Construction of Green Reinforced Soil Slopes with Innovative Geosynthetics Material at Mukim Pantai Timur, Daerah Kota Tinggi, Johor Darul Takzim

Reinforced soil slope with green surface

SWaM2019

NATIONAL CONFERENCE ON STORMWATER MANAGEMENT- MANAGING STORMWATER RUNOFF

MALAYSIAN STORMWATER ORGANISATION

Conclusion

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Conclusion

1) Geosynthetic solutions are very effective towards erosion and sediment control

2) Geosynthetic solutions are also environmental friendly and aesthetically pleasing

3) Proper engineering study and evaluation are needed to derive to the successful geosynthetics solutions

Thank You

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