

# REINFORCED FILL PRODUCT DESIGN DATA SHEET

No. RF 3/2023  
For GeoStrap 5

Date Issued: 22 November 2023  
Valid Until: 21 November 2025

Reinforced Fill Products:	GeoStrap 5 25 kN, 37.5 kN, 50 kN, 65 kN reinforcements
Manufacturer:	Soletanche Freyssinet S.A.S., 280 Avenue Napoleon Bonaparte – CS 60002 – 92506 Rueil-Malmaison Cedex, France
Product distributor:	Reinforced Earth Pacific Ltd., Unit 705-6, 7/F, Tower 1, Cheung Sha Wan Plaza, 833 Cheung Sha Wan Road, Kowloon, Hong Kong

## Important Notice and Disclaimer

This Design Data Sheet is intended for geotechnical professionals designing with GeoStrap 5 reinforcements for application in Hong Kong only. Users are solely responsible for (1) selecting the appropriate GeoStrap 5 reinforcements for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and other safety, regulatory or other requirements. Civil Engineering and Development Department of HKSAR Government makes no representation as to the presence or absence of patent rights subsisting in the product and/or as to the legal right of the manufacturer and product distributor to market, install or maintain the product.

Where the GeoStrap 5 reinforcements are used in permanent reinforced fill structures and slopes in Hong Kong, the design tensile strengths of the product shall comply with the values specified in Tables 3 to 6 of this Design Data Sheet, and the design shall be in accordance with Geoguide 6 – Guide to Reinforced Fill Structure and Slope Design (GEO, 2022).

This Design Data Sheet shall cease to be valid if the product data or specifications are withdrawn or re-issued in an amended form by the manufacturer. Applications for amendment to this Design Data Sheet shall be made to the Deputy Head of Geotechnical Engineering Office (Island) of the Civil Engineering and Development Department by the manufacturer for all cases of changes in the products, the manufacturing details or the conditions of use, or of changes of the product distributor.

This Design Data Sheet is subject to change without notice. Users of this Design Data Sheet are advised to check the prevailing requirements as stipulated in the latest version of the Design Data Sheet by referring to the Civil Engineering and Development Department's website at <https://www.cedd.gov.hk/eng/public-services-forms/geotechnical/reinforced/index.html>.

## GeoStrap 5 reinforcement

GeoStrap 5 reinforcements are intended to be used as reinforcing elements in reinforced fill structures and slopes. GeoStrap 5 reinforcement is a geosynthetic strip comprising a number of discrete channels of individually tensioned, closely packed, high-tenacity polyester (PETP) tendons and encased in a low-density polyethylene (LDPE) sheath. A typical cross section of the reinforcement is shown in Figure 1.

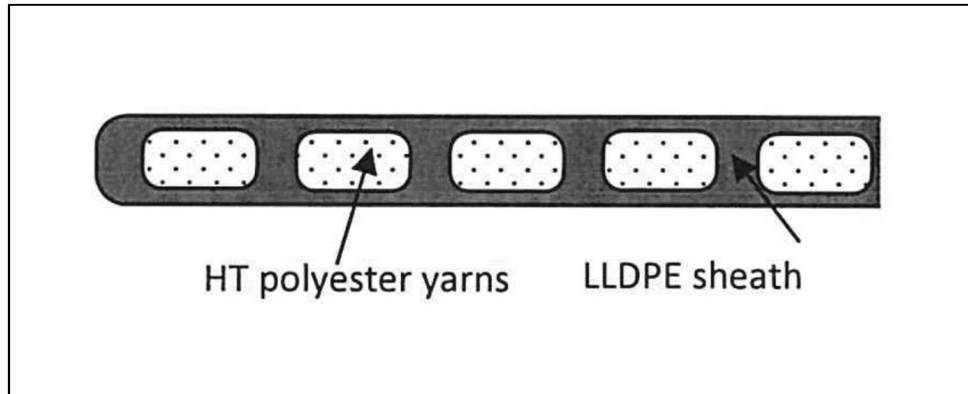


Figure 1 – Cross section of GeoStrap 5 reinforcement

The typical dimensions, mass and identification of GeoStrap 5 25 kN, 37.5 kN, 50 kN and 65 kN reinforcements are given in Table 1.

Product grade	Strap dimensions		Coil dimensions		Mass per unit area (g/m)	Colour code		
	Width (mm)	Thickness (mm)	Length (m)	Diameter (m)		France	Korea	India
GeoStrap 5 25 kN (Korea & India only)	49.5±0.5	2.50	150	0.7	103	N/A	White	Grey
GeoStrap 5 37.5 kN	49.5±0.5	2.75	100	0.6	111	Yellow	Red	Yellow
GeoStrap 5 50 kN	49.5±0.5	3.25 (Korea) 3.50 (France & India)	100	0.7	138	Green	Blue	Green
GeoStrap 5 65 kN	49.5±0.5	4.00	100	1.0	179	Orange	White	Orange

Table 1 – Typical dimensions, mass and identification of reinforcements

## Tensile strength and load-strain properties

Quality control tensile tests are performed on specimens in accordance with BS EN ISO 10319:2015 (BSI, 2015). The characteristic short-term tensile strengths guaranteed by Soletanche Freyssinet S.A.S. are provided in Table 2. The load-strain properties of the reinforcements are shown in Figure 2. The actual strain at break is approximately 9%, 11% and 13% for Korea-, France- and India-manufactured reinforcements respectively.

Product grade	GeoStrap 5 25 kN	GeoStrap 5 37.5 kN	GeoStrap 5 50 kN	GeoStrap 5 65 kN
Characteristic short-term tensile strength (kN/m)	25	37.5	50	65

Table 2 – Characteristic short-term tensile strength

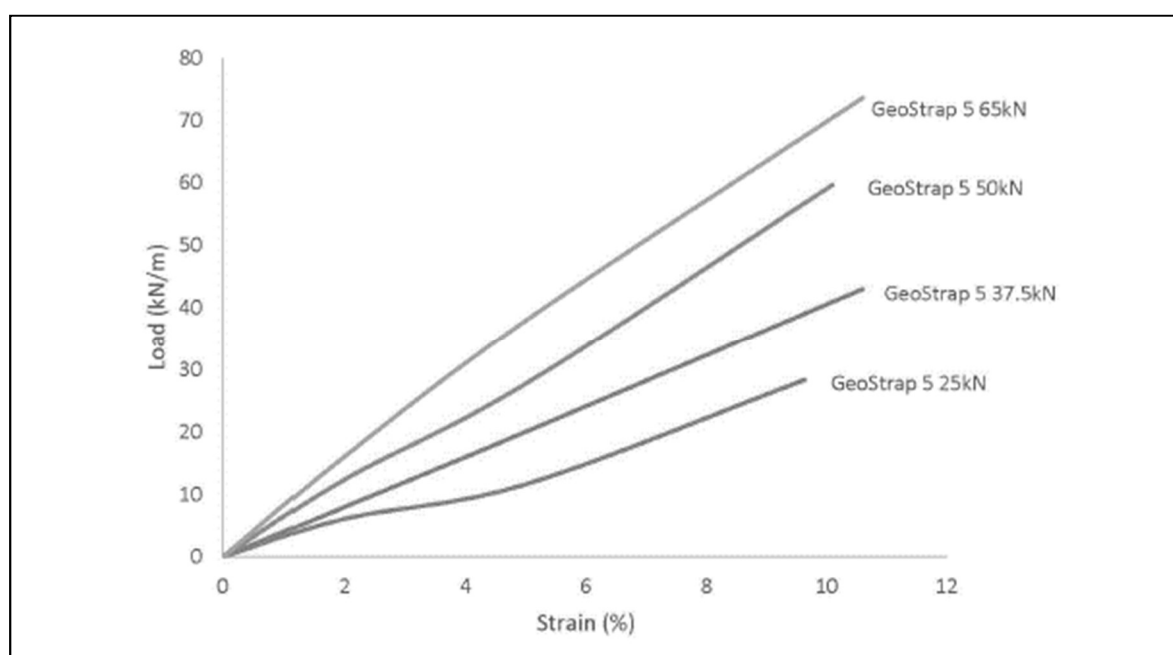


Figure 2 – Typical short-term load-strain properties

## Quality assurance

The GeoStrap 5 product line is owned by Soletanche Freyssinet S.A.S. GeoStrap 5 reinforcements supplied to Hong Kong are manufactured by 1.) V. Louison & Cie in Saint Chamond of France, 2.) Daihan Cork Co., Ltd in Gyeonggi-do of Korea, and 3.) Reinforced Earth India Pvt. Ltd. in Gujarat of India. V. Louison & Cie, Daihan Cork Co., Ltd, and Reinforced Earth India Pvt. Ltd. manufacture GeoStrap 5 reinforcements under ISO 9001 Quality Assurance Certificate. Independent audits are carried out periodically by AB Certification (France), KCA (Korea), and TÜV India (India).

## Identification

GeoStrap 5 reinforcements are imported into Hong Kong from France, Korea and India. Each coil of GeoStrap 5 reinforcement are wrapped in transparent packaging film and with individual colour-coded tape and unique label with production information attached to the coil. Product grade is embossed directly on the sheath of the reinforcement. A copy of the manufacturer’s certificate of conformity will accompany each delivery.


	
TYPE	GEOSTRAP 5 <span style="float: right;">CE</span>
COIL SERIAL NO	326
CHARACTERISTIC STRENGTH	37.50 kN
LENGTH / WEIGHT	100m /11.3Kg
WIDTH	50 mm
PRODUCTION BATCH NUMBER	G550/0097/0621/D
SHEATH	POLYETHYLENE
YARN	HIGH TENACITY POLYESTER

Figure 3 – Product identification label (France)

<b>GEOSTRIP</b>	
TYPE	GEOSTRAP 5
CHARACTERISTIC STRENGTH	50 kN <span style="float: right;">=39</span>
LENGTH/WEIGHT	100 m/ROLL, 14.8 kg
WIDTH	50 mm
LOT .NO	17092203
SHEATH	POLYETHYLENE
YARN	HIGH-TENACITY POLYESTER
Made in South Korea	

Figure 4 – Product identification label (Korea)


	
TYPE	GEOSTRAP <sup>®</sup> 5
CHARACTERISTIC STRENGTH	50 kN
LENGTH / WEIGHT	100 m / 13.7 kg
WIDTH	50 mm
PRODUCTION BATCH NO.	G550/0161/0923/E
COIL SERIAL NO.	252
SHEATH	POLYETHYLENE
YARN	HIGH TENACITY POLYESTER
<b>MADE BY TERRE ARMÉE</b>	

Figure 5 – Product identification label (India)

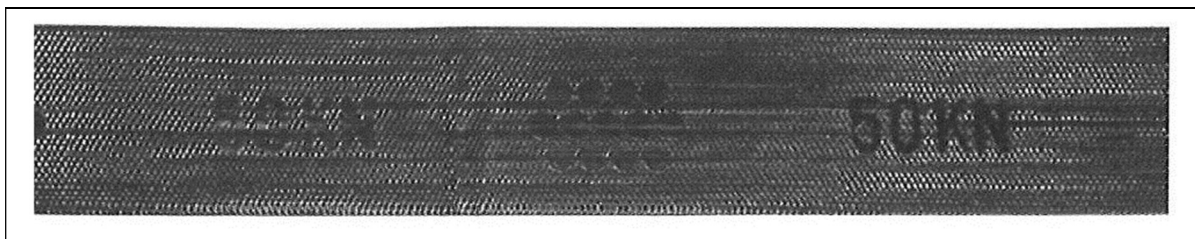


Figure 6 – Face marking on reinforcement (France)

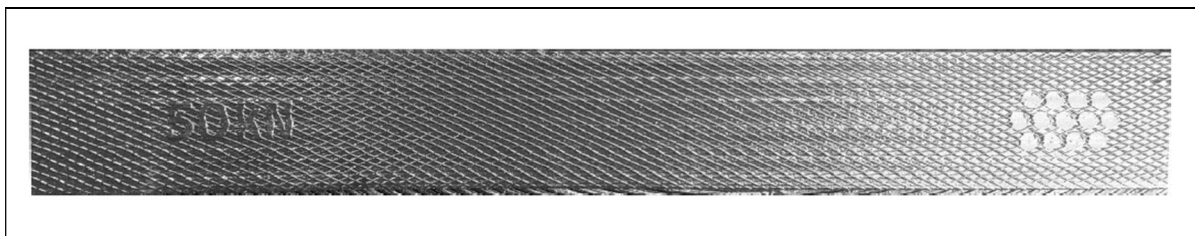


Figure 7 – Face marking on reinforcement (Korea)

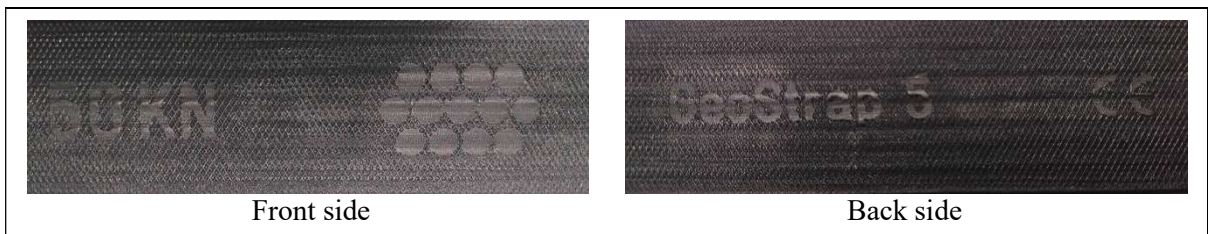


Figure 8 – Face marking on reinforcement (India)

## Design Aspects

### Design tensile strength

According to Geoguide 6 - Guide to Reinforced Fill Structure and Slope Design (GEO, 2022), the design tensile strength,  $T_D$ , per unit width of reinforcement is:

$$T_D = \frac{T_{ult}}{\gamma_m \gamma_n}$$

where  $T_{ult}$  = characteristic short-term tensile strength guaranteed by Soletanche Freyssinet S.A.S. (see Table 2)

$\gamma_m$  = partial material factor on tensile strength of reinforcement

$\gamma_n$  = partial consequence factor to account for consequence of failure

The design tensile strengths of the GeoStrap 5 reinforcements **made in France and/or Korea** in the longitudinal direction given in Tables 3 – 6, which have been agreed with Soletanche Freyssinet S.A.S., shall be used.

Particle size of fill material (mm)	$\gamma_m$	Design tensile strength (kN) (Made in Korea only)	
		$\gamma_n = 1.0$	$\gamma_n = 1.1$
$D_{85} \leq 10$	2.31	10.8	9.8
$10 < D_{85} \leq 50$	2.34	10.7	9.7

Table 3 – Design tensile strengths of GeoStrap 5 25 kN reinforcement

Particle size of fill material (mm)	$\gamma_m$	Design tensile strength (kN) (Made in France & Korea only)	
		$\gamma_n = 1.0$	$\gamma_n = 1.1$
$D_{85} \leq 10$	2.31	16.2	14.7
$10 < D_{85} \leq 50$	2.34	16.0	14.6

Table 4 – Design tensile strengths of GeoStrap 5 37.5 kN reinforcement

Particle size of fill material (mm)	$\gamma_m$	Design tensile strength (kN) (Made in France & Korea only)	
		$\gamma_n = 1.0$	$\gamma_n = 1.1$
$D_{85} \leq 10$	2.31	21.6	19.6
$10 < D_{85} \leq 50$	2.34	21.4	19.5

Table 5 – Design tensile strengths of GeoStrap 5 50 kN reinforcement

Particle size of fill material (mm)	$\gamma_m$	Design tensile strength (Made in France & Korea only) (kN)	
		$\gamma_n = 1.0$	$\gamma_n = 1.1$
$D_{85} \leq 10$	2.31	28.1	25.5
$10 < D_{85} \leq 50$	2.34	27.8	25.3

Table 6 – Design tensile strengths of GeoStrap 5 65 kN reinforcement

The design tensile strengths of the GeoStrap 5 reinforcements **made in India** in the longitudinal direction given in Tables 7 – 10, which have been agreed with Soletanche Freyssinet S.A.S., shall be used.

Particle size of fill material (mm)	$\gamma_m$	Design tensile strength (Made in India only) (kN)	
		$\gamma_n = 1.0$	$\gamma_n = 1.1$
$D_{85} \leq 10$	2.50	10.0	9.1
$10 < D_{85} \leq 50$	2.61	9.6	8.7

Table 7 – Design tensile strengths of GeoStrap 5 25 kN reinforcement

Particle size of fill material (mm)	$\gamma_m$	Design tensile strength (Made in India only) (kN)	
		$\gamma_n = 1.0$	$\gamma_n = 1.1$
$D_{85} \leq 10$	2.43	15.4	14.0
$10 < D_{85} \leq 50$	2.50	15.0	13.6

Table 8 – Design tensile strengths of GeoStrap 5 37.5 kN reinforcement

Particle size of fill material (mm)	$\gamma_m$	Design tensile strength (Made in India only) (kN)	
		$\gamma_n = 1.0$	$\gamma_n = 1.1$
$D_{85} \leq 10$	2.38	21.0	19.1
$10 < D_{85} \leq 50$	2.41	20.7	18.8

Table 9 – Design tensile strengths of GeoStrap 5 50 kN reinforcement

Particle size of fill material (mm)	$\gamma_m$	Design tensile strength (Made in India only) (kN)	
		$\gamma_n = 1.0$	$\gamma_n = 1.1$
$D_{85} \leq 10$	2.36	27.5	25.0
$10 < D_{85} \leq 50$	2.38	27.3	24.8

Table 10 – Design tensile strengths of GeoStrap 5 65 kN reinforcement

The following notes apply to Tables 3 to 10:

- (a) The design tensile strengths given in Tables 3 to 10 are in kN per strip.
- (b)  $D_{85}$  is the particle size corresponding to 85 % by weight of particles passing in a grading test.
- (c) The partial material factor,  $\gamma_m$ , applies to the tensile strength of the individual grades of GeoStrap 5 reinforcements. It has taken into account the environmental effects on material durability, construction damage and other special factors including hydrolysis, creep and stress rupture for a 120-year design life at a design temperature of 30°C.
- (d) The fill material used within the reinforced fill block shall comply with the requirements specified for Type I materials given in Geoguide 6 (GEO, 2022). In addition, the maximum particle size and the  $D_{85}$  value of the fill material shall not exceed 150 mm and 50 mm respectively.



## Fill-to-reinforcement interaction

According to Geoguide 6 (GEO, 2022), the design coefficients of fill-to-reinforcement interaction  $\mu_{dsD}$  and  $\mu_{pD}$  relating to direct sliding resistance and pullout resistance respectively are:

$$\mu_{dsD} = \frac{\alpha_{ds} \tan \phi'}{\gamma_m \gamma_n}$$

$$\mu_{pD} = \frac{\alpha_p \tan \phi'}{\gamma_m \gamma_n}$$

where

- $\mu_{dsD}$  = design coefficient of interaction against direct sliding
- $\mu_{pD}$  = design coefficient of interaction against pullout
- $\gamma_m$  = partial material factor for fill-to-reinforcement interaction
- $\gamma_n$  = partial consequence factor to account for consequence of failure
- $\alpha_{ds}$  = direct sliding coefficient
- $\alpha_p$  = pullout coefficient

In preliminary design, the direct sliding coefficient,  $\alpha_{ds}$  and the pullout coefficient,  $\alpha_p$  given in Table 7, which have been agreed with Soletanche Freyssinet S.A.S., may be used. The partial material factor,  $\gamma_m$ , for fill-to-reinforcement interaction shall be taken as 1.2.

Interaction coefficient	Fill material
	Type I fill
Direct sliding coefficient $\alpha_{ds}$	0.7
Pullout coefficient $\alpha_p$	0.8

Table 7 – Direct sliding and pullout coefficients

The design coefficients of fill-to-reinforcement interaction should be verified by tests in accordance with the requirements of Clause A.61 and Clause A.62 given in the Appendix A of Geoguide 6 (GEO, 2022).

## Facings

The typical facing types recommended by Soletanche Freyssinet S.A.S. for the construction of reinforced fill structures and slopes using GeoStrap 5 reinforcements are presented in Appendix A. The suitability of these facing types should be carefully assessed by the designer and suitably modified to suit the individual design situations and contract requirements. The various design situations that need to be considered in the design of reinforced fill structures and slopes are discussed in Geoguide 6 (GEO, 2022).

## Compliance Testing

The materials used for the construction of the reinforced fill structures or slopes should be inspected and tested on a regular basis during construction. Testing is required to ensure that the materials conform to the specification. Particular attention should be given to materials which can change properties; these include reinforcing elements and fill. Fill from different sources may have different material parameters and should be checked for compliance. Each main delivery of reinforcement should be sampled, tested and properly labelled.

The requirements for the testing of materials are recommended in the Appendix A of Geoguide 6 (GEO, 2022).

## References

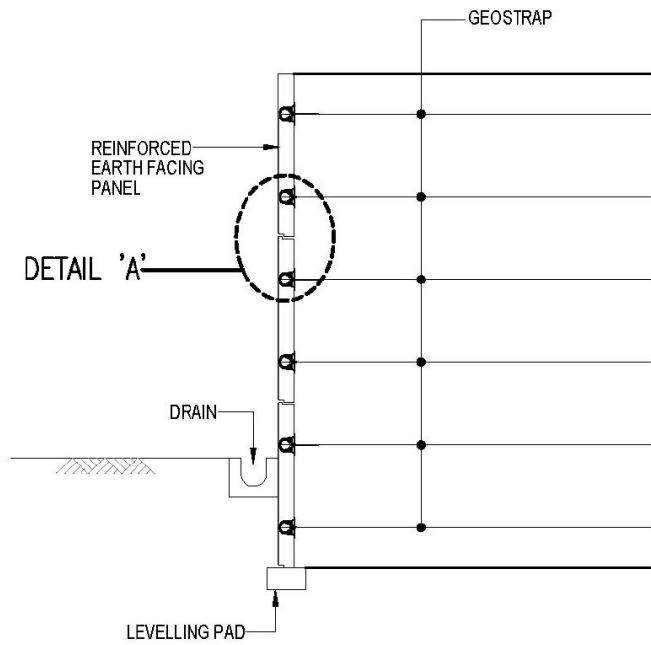
BSI (2015). Geotextiles – Wide width tensile test (BS EN ISO 10319:2015). British Standards Institution, London.

GEO (2022). Guide to Reinforced Fill Structure and Slope Design (Geoguide 6) (Continuously Updated E-Version released on 27 October 2022). Geotechnical Engineering Office, Civil Engineering and Development Department, HKSAR Government, 218 p.

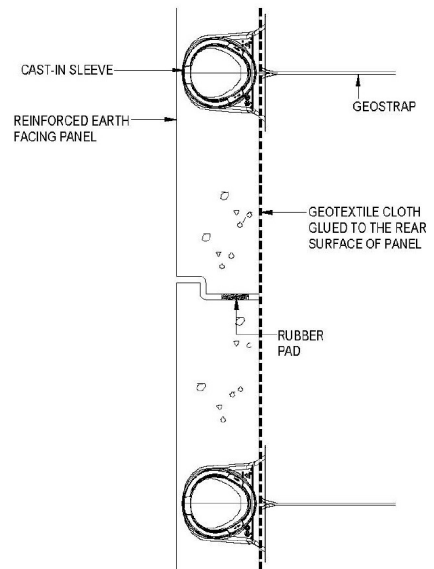
**Geotechnical Engineering Office  
Civil Engineering and Development Department  
November 2023**

# Appendix A

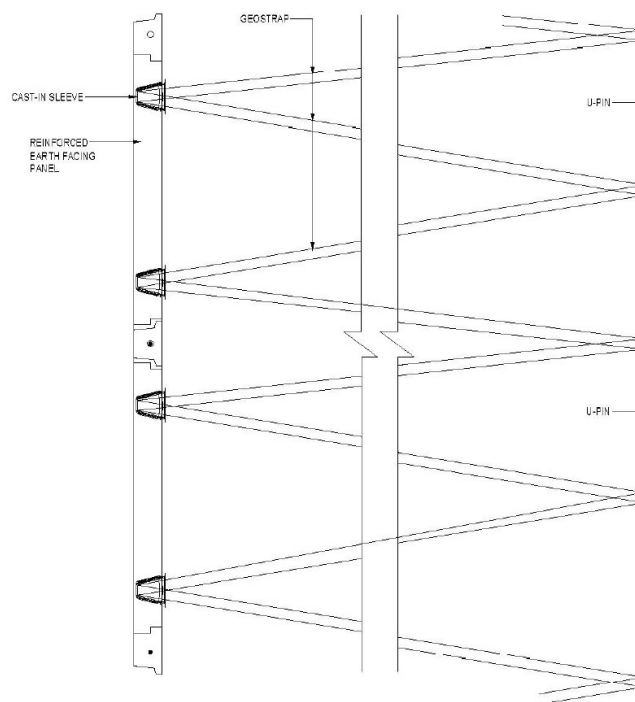
## Reinforced fill structures



**Typical diagrammatic sectional view**



**Typical schematic connection detail A**



**Typical diagrammatic plan view**