REINFORCED FILL PRODUCT
DESIGN DATA SHEET
No. RF 4/2023
For Maccaferri ParaWeb and ParaLink

Date Issued: 8 June 2023
Valid Until: 21 May 2025

Reinforced Fill Products:	ParaWeb: ME 27, MD 27, MS 27, 2E 30, 2D 30, 2S 30, 2E 40, 2D 40, 2S 40, ME 45, MD 45, MS 45, 2E 50, 2D 50, 2S 50, ME 54, MD 54, MS 54, ME 63, MD 63, MS 63, 2E 75, 2D 75, 2S 75, 2E 100, 2D 100, 2S 100 ParaLink: 100, 150, 200, 250, 300, 350, 400, 450, 500, 550, 600, 650, 700, 750, 800, 850, 900, 950, 1000, 1050, 1100, 1150, 1200, 1250, 1300, 1350, 1500, 1600
Manufacturer:	Maccaferri Environmental Solutions Pvt. Ltd D40, MIDC. Ranjangoan, Tai Shirur, Dist Pune – 412 220 Maharashtra, India
Product distributor:	Maccaferri Environmental Solutions Pvt. Ltd D40, MIDC. Ranjangoan, Tai Shirur, Dist Pune – 412 220 Maharashtra, India

Important Notice and Disclaimer

This Design Data Sheet is intended for geotechnical professionals designing with Maccaferri ParaWeb and ParaLink for application in Hong Kong only. Users are solely responsible for (1) selecting the appropriate Maccaferri ParaWeb and ParaLink 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 products and/or as to the legal right of the manufacturer and product distributor to market, install or maintain the product.

Where the Maccaferri ParaWeb and ParaLink are used in permanent reinforced fill structures and slopes in Hong Kong, the design tensile strengths of the products shall comply with the values specified in Tables 3 to 7 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).

Important Notice and Disclaimer (cont'd)

This Design Data Sheet shall cease to be valid if the product data or specifications are withdrawn or re-issued in an amended form by the manufacturer.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.

Maccaferri ParaWeb and ParaLink are intended to be used as reinforcing elements in reinforced fill structures and slopes.

ParaWeb

ParaWeb is a form of geostrip that consists of parallel bundles of high tenacity polyester yarns encased in an extruded linear low density polyethylene (LLDPE) sheath. The polyester yarns have a number average molecular weight (Mn) of greater than 25,000 when determined by ASTM D4603-18 (ASTM, 2018) in conjunction with GRI GG8 and a carboxyl end group count (CEG) of less than 30 when determined by GRI GG7. It contains approximately 2% of photo-oxidation stabilizer, including carbon black, to protect against UV degradation. ParaWeb 2E/2D/2S & ParaWeb ME/MD/MS products are six types of polymer strips which differ only in dimensional tolerances specific to strip width and coating thickness. The "2" and "M" designations refer to the width of the strip while the "E", "D" and "S" designations refer to the thickness of the LLDPE sheath with "S" having the thickest coating and "E" having the thinnest coating. ParaWeb product line consists of geostrips with strength varying from 27 kN to 112 kN. A typical plan and cross section of the reinforcement is shown in Figure 1.1.

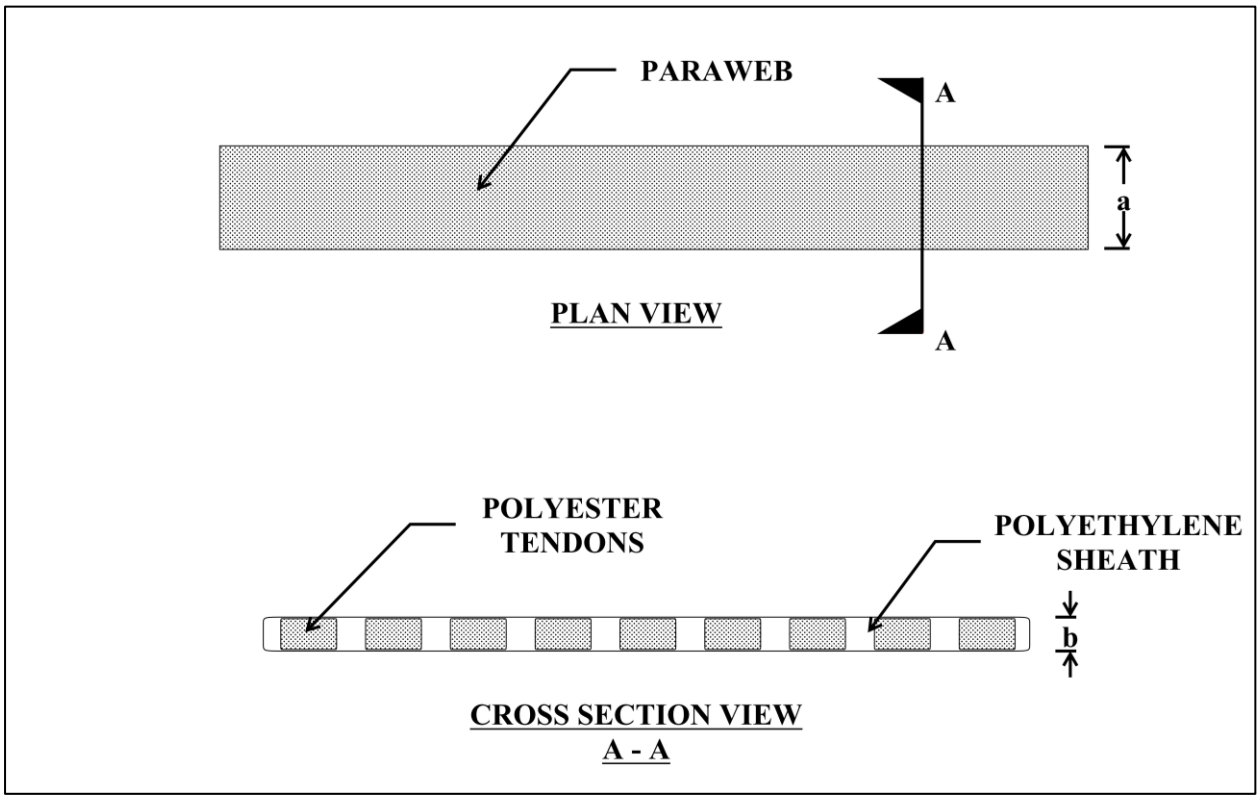


Figure 1.1 – Typical Plan and Cross Section of ParaWeb

ParaWeb (cont'd)

The typical dimensions, mass and identification of ParaWeb are given in Table 1.1.

Product Grade	Coil Length (m)	Nominal Mass			Nominal Width (a) (mm)			Nominal thickness (b) (mm)			Colour Code
		Sheath Type									
		2E	2D	2S	2E	2D	2S	2E	2D	2S	
30	100	8.7	12.7	14.8	83	83	85	1.5	1.9	2.2	Blue
40		10.9	16.7	18.5	83	84	85	1.7	2.2	2.5	Black
50		12.4	19.5	23.0	87	90	90	2.0	2.5	3.5	Yellow
75		17.9	25.6	30.0	90	90	90	2.6	3.1	4.1	Brown
100		24.1	31.1	37.7	90	90	90	3.1	3.7	6.0	Red
		ME	**MD**	**MS**	**ME**	**MD**	**MS**	**ME**	**MD**	**MS**	
27	100	6.4	8.5	9.4	46	47	48	1.8	2.2	2.5	Blue
45		10.1	13.2	14.5	48	48	49	2.7	3.3	3.6	Black
54		12.7	17.4	21.4	63	65	65	2.5	3.2	3.6	Yellow
63		14.4	20.4	22.7	63	65	66	2.8	3.7	3.9	White
Note: Sheaths Type (E, D, S) are in increasing order of sheath thickness.											

Table 1.1 – ParaWeb dimensions, mass and identification

ParaLink

ParaLink is a form of geogrid that consists of a longitudinal and transverse polyethylene strips interconnected by thermal boding of the sheaths to form a grid configuration. The polyester yarns have a number average molecular weight (Mn) of greater than 25,000 when determined by ASTM D4603-18 (ASTM, 2018) in conjunction with GRI GG8 and a carboxyl end group count (CEG) of less than 30 when determined by GRI GG7. It contains approximately 2% of photo-oxidation stabilizer, including carbon black, to protect against UV degradation. The geostrips of ParaLink product line have a sheath thickness equivalent to that of ParaWeb geostrips with "E" designation. ParaLink product line consists of geogrids with strength varying from 100 kN to 1,600 kN. A typical plan and cross section of the reinforcement is shown in Figure 1.2.

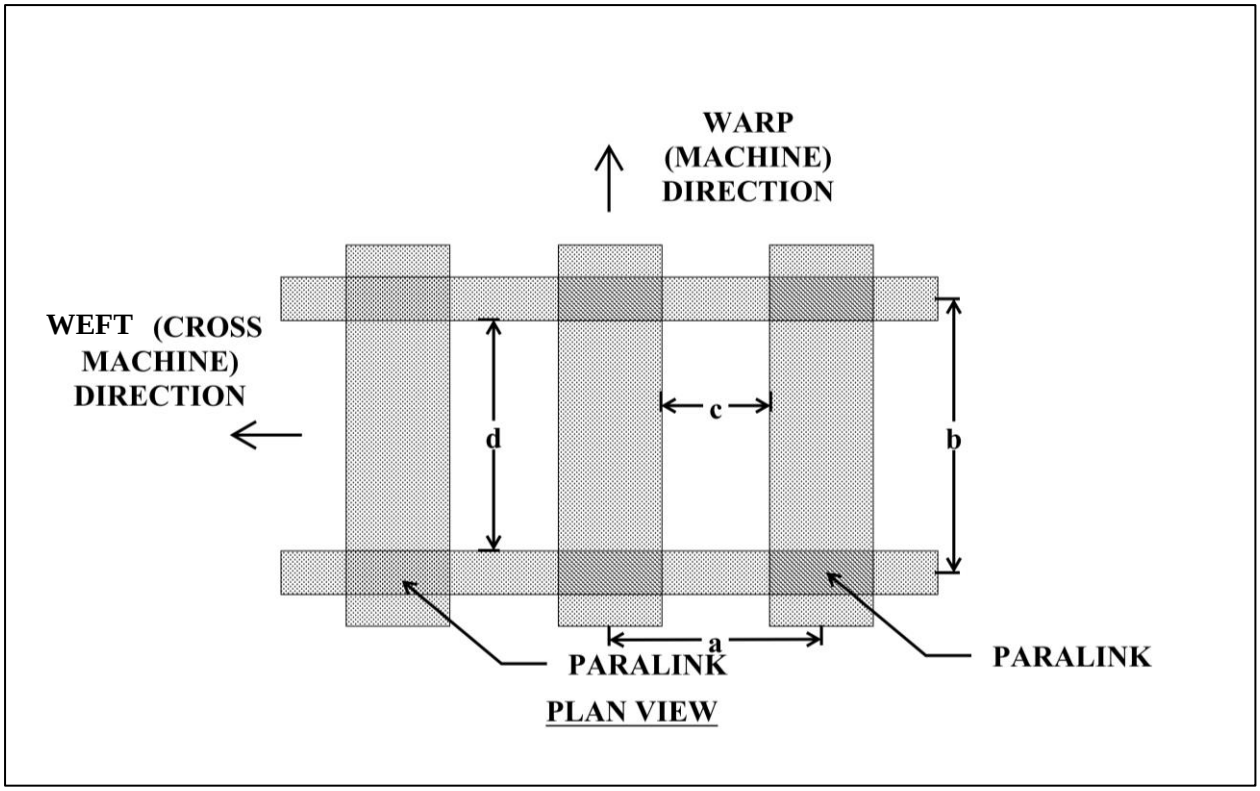


Figure 1.2 – Typical Plan of ParaLink

ParaLink (cont'd)

The typical dimensions, mass and identification of ParaLink are given in Table 1.2 below.

Product Grade	Nominal mass (g/m^2)	Grid size warp / weft a × b (mm)	Aperture size warp / weft c × d (mm)	Nominal roll weight (for standard 4.5m wide roll) (kg)	Standard roll length (m)	Colour Code
100	475	180 × 1000	98 × 940	440	200	White
150	515	180 × 1000	95 × 940	520	200	Blue double band
200	590	180 × 1000	95 × 940	590	200	No colour
250	697	180 × 1000	95 × 940	690	200	Green double band
300	789	180 × 1000	92 × 940	770	200	Violet
350	890	180 × 1000	91 × 940	660	150	Yellow double band
400	1014	180 × 1000	90 × 940	750	150	Blue
450	1124	180 × 1000	90 × 940	720	130	White double band
500	1219	180 × 1000	90 × 940	780	130	Green
550	1410	180 × 1000	90 × 940	700	100	Red double band
600	1507	180 × 1000	90 × 940	750	100	Yellow
650	1681	180 × 1000	89 × 940	930	100	Red & yellow
700	1835	180 × 1000	89 × 940	480	50	Orange
750	1970	150 × 1000	59 × 940	510	50	White & green
800	2135	150 × 1000	59 × 940	550	50	Red
850	2221	125 × 1000	34 × 940	570	50	White & yellow
900	2351	125 × 1000	34 × 940	600	50	White & blue
950	2543	125 × 1000	34 × 940	640	50	Blue & yellow
1000	2616	125 × 1000	34 × 940	660	50	Blue & green
1050	2695	100 × 1000	9 × 940	680	50	Green & red
1100	2829	100 × 1000	9 × 940	710	50	Green & yellow
1150	3018	100 × 1000	9 × 940	750	50	Yellow & blue
1200	3171	100 × 1000	9 × 940	790	50	Yellow & orange
1250	3254	100 × 1000	9 × 940	800	50	Violet & red
1300	3475	100 × 1000	9 × 940	860	50	White & red
1350	3674	100 × 1000	9 × 940	900	50	Orange & yellow
1500	3785	100 × 1000	9 × 940	930	50	Red & blue
1600	4005	100 × 1000	9 × 940	980	50	Violet & blue

Table 1.2 – ParaWeb dimensions, mass and identification

Tensile strength and load-strain properties

Quality control tensile tests are performed on both ParaWeb and ParaLink specimens in accordance with BS EN ISO 10319:2015 (BSI, 2015). The characteristic short-term tensile strengths of ParaWeb and ParaLink guaranteed by Maccaferri are provided in Table 2.1 and Table 2.2 respectively. The load-strain properties are shown in Figure 2.1 and Figure 2.2.

ParaWeb

Product Grade	Characteristic short-term tensile strength (kN per strip)	
	Sheath Type	
	2E / 2D	2S
30	30	34
40	40	45
50	50	56
75	75	84
100	100	112
	ME / MD	MS
27	27	27
45	45	45
54	54	54
63	63	63

Table 2.1 – Characteristic short-term tensile strength of **ParaWeb**

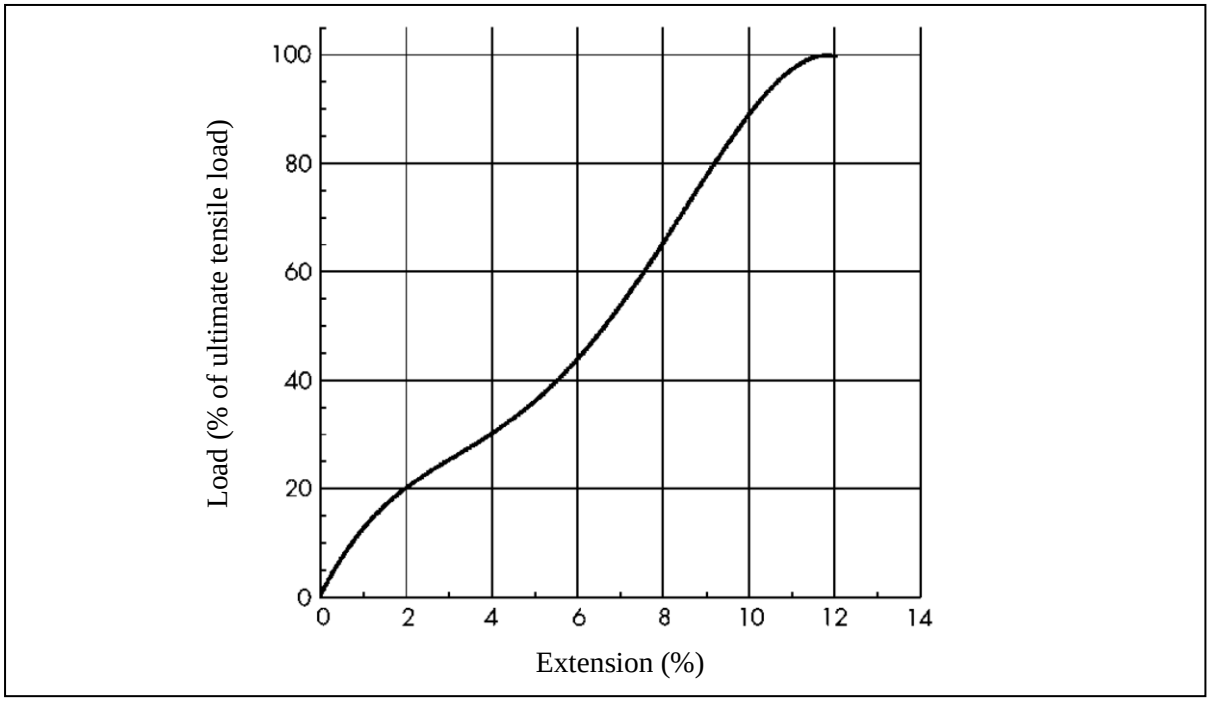


Figure 2.1 – Typical short-term load-strain properties of **ParaWeb**

ParaLink

Product Grade	Characteristic short-term tensile strength (kN per metre width)
100	100
150	150
200	200
250	250
300	300
350	350
400	400
450	450
500	500
550	550
600	600
650	650
700	700
750	750
800	800
850	850
900	900
950	950
1000	1000
1050	1050
1100	1100
1150	1150
1200	1200
1250	1250
1300	1300
1350	1350
1500	1500
1600	1600

Table 2.2 – Characteristic short-term tensile strength of **ParaLink**

ParaLink (cont'd)

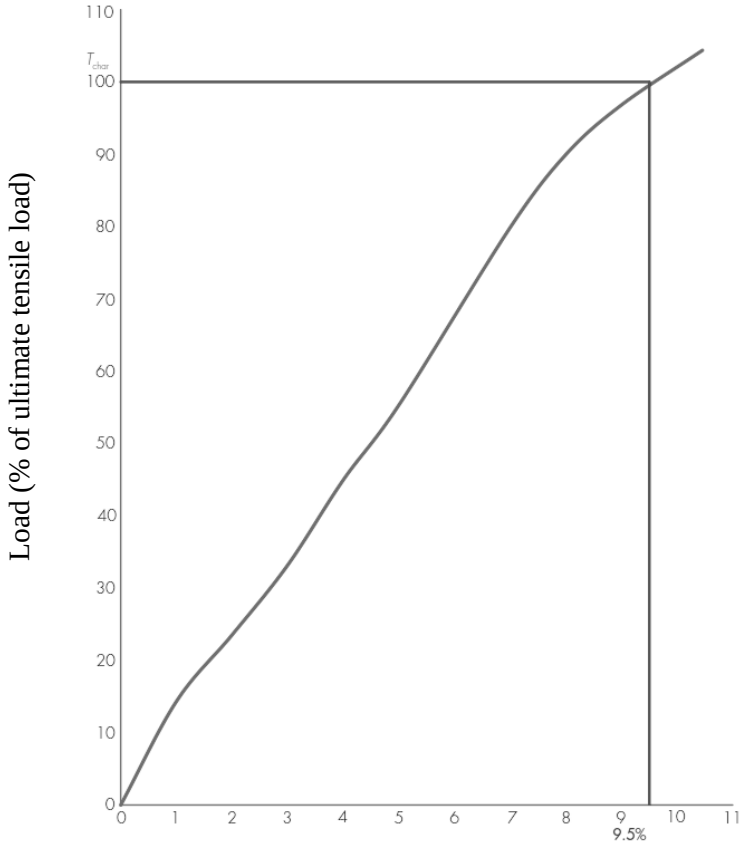


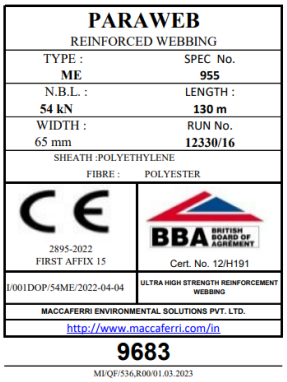
Table 2.2 – Characteristic short-term tensile strength of **ParaLink** (longitudinal direction)

Quality assurance

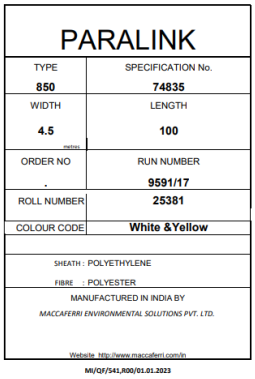
Maccaferri ParaWeb and ParaLink supplied to Hong Kong are manufactured by Maccaferri Environmental Solutions Pvt. Ltd under ISO 9001 Quality Assurance Certificate.

Identification

Maccaferri ParaWeb and ParaLink are imported into Hong Kong from India. Each roll of ParaWeb / ParaLink has an identification label with particulars of the product and its manufacturing code. They are wrapped with a tape having a designated colour (see Table 1.1 and Table 1.2). A copy of the manufacturer's test certificate will accompany each shipment of delivery and the test certificate is available from the product distributor.



Sample Label of ParaWeb



Sample Label of ParaLink

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 (see Table 2.1 and Table 2.2)
γ_m = partial material factor on tensile strength of ParaWeb / ParaLink
γ_n = partial consequence factor to account for consequence of failure

The design tensile strengths of the ParaWeb and ParaLink given in Tables 3.1 to 3.14 and Table 4.1 to 4.28, which have been agreed with Maccaferri, shall be used.

Design tensile strength - ParaWeb

Particle size of fill material (mm)	γ_m	Design tensile strength, T_D (kN per strip)	
		$\gamma_n = 1.0$	$\gamma_n = 1.1$
$D_{85} \leq 10$	1.63	16.6	15.1
$10 < D_{85} \leq 25$	1.76	15.4	14.0
$25 < D_{85} \leq 125$	2.33	11.6	10.5

Table 3.1 – Design tensile strengths of **ParaWeb ME / MD / MS 27**

Particle size of fill material (mm)	γ_m	Design tensile strength, T_D (kN per strip)	
		$\gamma_n = 1.0$	$\gamma_n = 1.1$
$D_{85} \leq 10$	1.63	18.4	16.7
$10 < D_{85} \leq 25$	1.71	17.5	15.9
$25 < D_{85} \leq 125$	2.33	12.9	11.7

Table 3.2 – Design tensile strengths of **ParaWeb 2E / 2D 30**

Particle size of fill material (mm)	γ_m	Design tensile strength, T_D (kN per strip)	
		$\gamma_n = 1.0$	$\gamma_n = 1.1$
$D_{85} \leq 25$	1.63	20.9	19.0
$25 < D_{85} \leq 125$	1.92	17.7	16.1

Table 3.3 – Design tensile strengths of **ParaWeb 2S 30**

Design tensile strength – ParaWeb (cont'd)

Particle size of fill material (mm)	γ_m	Design tensile strength, T_D (kN per strip)	
		$\gamma_n = 1.0$	$\gamma_n = 1.1$
$D_{85} \leq 10$	1.63	24.5	22.3
$10 < D_{85} \leq 25$	1.71	23.4	21.3
$25 < D_{85} \leq 125$	2.08	19.2	17.5

Table 3.4 – Design tensile strengths of **ParaWeb 2E / 2D 40**

Particle size of fill material (mm)	γ_m	Design tensile strength, T_D (kN per strip)	
		$\gamma_n = 1.0$	$\gamma_n = 1.1$
$D_{85} \leq 25$	1.63	27.6	25.1
$25 < D_{85} \leq 125$	1.92	23.5	21.3

Table 3.5 – Design tensile strengths of **ParaWeb 2S 40**

Particle size of fill material (mm)	γ_m	Design tensile strength, T_D (kN per strip)	
		$\gamma_n = 1.0$	$\gamma_n = 1.1$
$D_{85} \leq 10$	1.63	27.6	25.1
$10 < D_{85} \leq 25$	1.73	26.1	23.7
$25 < D_{85} \leq 125$	2.19	20.5	18.7

Table 3.6 – Design tensile strengths of **ParaWeb ME / MD / MS 45**

Particle size of fill material (mm)	γ_m	Design tensile strength, T_D (kN per strip)	
		$\gamma_n = 1.0$	$\gamma_n = 1.1$
$D_{85} \leq 10$	1.61	31.0	28.2
$10 < D_{85} \leq 25$	1.71	29.2	26.6
$25 < D_{85} \leq 125$	1.92	26.1	23.7

Table 3.7 – Design tensile strengths of **ParaWeb 2E / 2D 50**

Design tensile strength – ParaWeb (cont'd)

Particle size of fill material (mm)	γ_m	Design tensile strength, T_D (kN per strip)	
		$\gamma_n = 1.0$	$\gamma_n = 1.1$
$D_{85} \leq 10$	1.61	34.7	31.5
$10 < D_{85} \leq 25$	1.63	34.3	31.2
$25 < D_{85} \leq 125$	1.92	29.2	26.5

Table 3.8 – Design tensile strengths of **ParaWeb 2S 50**

Particle size of fill material (mm)	γ_m	Design tensile strength, T_D (kN per strip)	
		$\gamma_n = 1.0$	$\gamma_n = 1.1$
$D_{85} \leq 10$	1.61	33.4	30.4
$10 < D_{85} \leq 25$	1.73	31.3	28.4
$25 < D_{85} \leq 125$	1.92	28.2	25.6

Table 3.9 – Design tensile strengths of **ParaWeb ME / MD / MS 54**

Particle size of fill material (mm)	γ_m	Design tensile strength, T_D (kN per strip)	
		$\gamma_n = 1.0$	$\gamma_n = 1.1$
$D_{85} \leq 10$	1.61	39.0	35.5
$10 < D_{85} \leq 25$	1.69	37.2	33.8
$25 < D_{85} \leq 125$	1.92	32.8	29.9

Table 3.10 – Design tensile strengths of **ParaWeb ME / MD / MS 63**

Particle size of fill material (mm)	γ_m	Design tensile strength, T_D (kN per strip)	
		$\gamma_n = 1.0$	$\gamma_n = 1.1$
$D_{85} \leq 10$	1.61	46.5	42.2
$10 < D_{85} \leq 25$	1.73	43.4	39.5
$25 < D_{85} \leq 125$	1.92	39.1	35.5

Table 3.11 – Design tensile strengths of **ParaWeb 2E / 2D 75**

Design tensile strength – ParaWeb (cont'd)

Particle size of fill material (mm)	γ_m	Design tensile strength, T_D (kN per strip)	
		$\gamma_n = 1.0$	$\gamma_n = 1.1$
$D_{85} \leq 10$	1.61	52.0	47.3
$10 < D_{85} \leq 25$	1.65	51.0	46.4
$25 < D_{85} \leq 125$	1.76	47.8	43.4

Table 3.12 – Design tensile strengths of **ParaWeb 2S 75**

Particle size of fill material (mm)	γ_m	Design tensile strength, T_D (kN per strip)	
		$\gamma_n = 1.0$	$\gamma_n = 1.1$
$D_{85} \leq 10$	1.61	61.9	56.3
$10 < D_{85} \leq 25$	1.69	59.0	53.7
$25 < D_{85} \leq 125$	1.92	52.1	47.4

Table 3.13 – Design tensile strengths of **ParaWeb 2E / 2D 100**

Particle size of fill material (mm)	γ_m	Design tensile strength, T_D (kN per strip)	
		$\gamma_n = 1.0$	$\gamma_n = 1.1$
$D_{85} \leq 10$	1.60	70.1	63.7
$10 < D_{85} \leq 125$	1.63	68.7	62.4

Table 3.14 – Design tensile strengths of **ParaWeb 2S 100**

Design tensile strength – ParaLink

Particle size of fill material (mm)	γ_m	Design tensile strength, T_D (kN/m)	
		$\gamma_n = 1.0$	$\gamma_n = 1.1$
$D_{85} \leq 10$	1.60	62.6	56.9
$10 < D_{85} \leq 50$	1.69	59.0	53.7
$50 < D_{85} \leq 125$	1.76	56.9	51.7

Table 4.1 – Design tensile strengths of **ParaLink 100**

Particle size of fill material (mm)	γ_m	Design tensile strength, T_D (kN/m)	
		$\gamma_n = 1.0$	$\gamma_n = 1.1$
$D_{85} \leq 10$	1.60	93.8	85.3
$10 < D_{85} \leq 50$	1.69	88.5	80.5
$50 < D_{85} \leq 125$	1.76	85.3	77.6

Table 4.2 – Design tensile strengths of **ParaLink 150**

Particle size of fill material (mm)	γ_m	Design tensile strength, T_D (kN/m)	
		$\gamma_n = 1.0$	$\gamma_n = 1.1$
$D_{85} \leq 10$	1.60	125.1	113.7
$10 < D_{85} \leq 50$	1.69	118.0	107.3
$50 < D_{85} \leq 125$	1.76	113.7	103.4

Table 4.3 – Design tensile strengths of **ParaLink 200**

Particle size of fill material (mm)	γ_m	Design tensile strength, T_D (kN/m)	
		$\gamma_n = 1.0$	$\gamma_n = 1.1$
$D_{85} \leq 10$	1.60	156.4	142.2
$10 < D_{85} \leq 50$	1.69	147.5	134.1
$50 < D_{85} \leq 125$	1.76	142.2	129.3

Table 4.4 – Design tensile strengths of **ParaLink 250**

Design tensile strength – ParaLink (cont'd)

Particle size of fill material (mm)	γ_m	Design tensile strength, T_D (kN/m)	
		$\gamma_n = 1.0$	$\gamma_n = 1.1$
$D_{85} \leq 10$	1.60	187.7	170.6
$10 < D_{85} \leq 50$	1.69	177.1	161.0
$50 < D_{85} \leq 125$	1.76	170.6	155.1

Table 4.5 – Design tensile strengths of **ParaLink 300**

Particle size of fill material (mm)	γ_m	Design tensile strength, T_D (kN/m)	
		$\gamma_n = 1.0$	$\gamma_n = 1.1$
$D_{85} \leq 10$	1.60	219.0	199.1
$10 < D_{85} \leq 50$	1.69	206.6	187.8
$50 < D_{85} \leq 125$	1.76	199.1	181.0

Table 4.6 – Design tensile strengths of **ParaLink 350**

Particle size of fill material (mm)	γ_m	Design tensile strength, T_D (kN/m)	
		$\gamma_n = 1.0$	$\gamma_n = 1.1$
$D_{85} \leq 10$	1.60	250.2	227.5
$10 < D_{85} \leq 50$	1.69	236.1	214.6
$50 < D_{85} \leq 125$	1.76	227.5	206.8

Table 4.7 – Design tensile strengths of **ParaLink 400**

Particle size of fill material (mm)	γ_m	Design tensile strength, T_D (kN/m)	
		$\gamma_n = 1.0$	$\gamma_n = 1.1$
$D_{85} \leq 10$	1.60	281.5	255.9
$10 < D_{85} \leq 50$	1.69	265.6	241.4
$50 < D_{85} \leq 125$	1.76	255.9	232.7

Table 4.8 – Design tensile strengths of **ParaLink 450**

Design tensile strength – ParaLink (cont'd)

Particle size of fill material (mm)	γ_m	Design tensile strength, T_D (kN/m)	
		$\gamma_n = 1.0$	$\gamma_n = 1.1$
$D_{85} \leq 10$	1.60	312.8	284.4
$10 < D_{85} \leq 125$	1.68	297.9	270.8

Table 4.9 – Design tensile strengths of **ParaLink 500**

Particle size of fill material (mm)	γ_m	Design tensile strength, T_D (kN/m)	
		$\gamma_n = 1.0$	$\gamma_n = 1.1$
$D_{85} \leq 10$	1.60	344.1	312.8
$10 < D_{85} \leq 125$	1.68	327.7	297.9

Table 4.10 – Design tensile strengths of **ParaLink 550**

Particle size of fill material (mm)	γ_m	Design tensile strength, T_D (kN/m)	
		$\gamma_n = 1.0$	$\gamma_n = 1.1$
$D_{85} \leq 10$	1.60	375.4	341.2
$10 < D_{85} \leq 125$	1.68	357.5	325.0

Table 4.11 – Design tensile strengths of **ParaLink 600**

Particle size of fill material (mm)	γ_m	Design tensile strength, T_D (kN/m)	
		$\gamma_n = 1.0$	$\gamma_n = 1.1$
$D_{85} \leq 10$	1.60	406.6	369.7
$10 < D_{85} \leq 125$	1.68	387.3	352.1

Table 4.12 – Design tensile strengths of **ParaLink 650**

Particle size of fill material (mm)	γ_m	Design tensile strength, T_D (kN/m)	
		$\gamma_n = 1.0$	$\gamma_n = 1.1$
$D_{85} \leq 10$	1.60	437.9	398.1
$10 < D_{85} \leq 125$	1.61	433.6	394.2

Table 4.13 – Design tensile strengths of **ParaLink 700**

Design tensile strength – ParaLink (cont'd)

Particle size of fill material (mm)	γ_m	Design tensile strength, T_D (kN/m)	
		$\gamma_n = 1.0$	$\gamma_n = 1.1$
$D_{85} \leq 10$	1.60	469.2	426.5
$10 < D_{85} \leq 125$	1.61	464.5	422.3

Table 4.14 – Design tensile strengths of **ParaLink 750**

Particle size of fill material (mm)	γ_m	Design tensile strength, T_D (kN/m)	
		$\gamma_n = 1.0$	$\gamma_n = 1.1$
$D_{85} \leq 10$	1.60	500.5	455.0
$10 < D_{85} \leq 125$	1.61	495.5	450.5

Table 4.15 – Design tensile strengths of **ParaLink 800**

Particle size of fill material (mm)	γ_m	Design tensile strength, T_D (kN/m)	
		$\gamma_n = 1.0$	$\gamma_n = 1.1$
$D_{85} \leq 10$	1.60	531.7	483.4
$10 < D_{85} \leq 125$	1.61	526.5	478.6

Table 4.16 – Design tensile strengths of **ParaLink 850**

Particle size of fill material (mm)	γ_m	Design tensile strength, T_D (kN/m)	
		$\gamma_n = 1.0$	$\gamma_n = 1.1$
$D_{85} \leq 10$	1.60	563.0	511.8
$10 < D_{85} \leq 125$	1.61	557.5	506.8

Table 4.17 – Design tensile strengths of **ParaLink 900**

Particle size of fill material (mm)	γ_m	Design tensile strength, T_D (kN/m)	
		$\gamma_n = 1.0$	$\gamma_n = 1.1$
$D_{85} \leq 10$	1.60	594.3	540.3
$10 < D_{85} \leq 125$	1.61	588.4	534.9

Table 4.18 – Design tensile strengths of **ParaLink 950**

Design tensile strength – ParaLink (cont'd)

Particle size of fill material (mm)	γ_m	Design tensile strength, T_D (kN/m)	
		$\gamma_n = 1.0$	$\gamma_n = 1.1$
$D_{85} \leq 10$	1.60	625.6	568.7
$10 < D_{85} \leq 125$	1.61	619.4	563.1

Table 4.19 – Design tensile strengths of **ParaLink 1000**

Particle size of fill material (mm)	γ_m	Design tensile strength, T_D (kN/m)	
		$\gamma_n = 1.0$	$\gamma_n = 1.1$
$D_{85} \leq 10$	1.60	656.9	597.2
$10 < D_{85} \leq 125$	1.61	650.4	591.2

Table 4.20 – Design tensile strengths of **ParaLink 1050**

Particle size of fill material (mm)	γ_m	Design tensile strength, T_D (kN/m)	
		$\gamma_n = 1.0$	$\gamma_n = 1.1$
$D_{85} \leq 10$	1.60	688.1	625.6
$10 < D_{85} \leq 125$	1.61	681.3	619.4

Table 4.21 – Design tensile strengths of **ParaLink 1100**

Particle size of fill material (mm)	γ_m	Design tensile strength, T_D (kN/m)	
		$\gamma_n = 1.0$	$\gamma_n = 1.1$
$D_{85} \leq 10$	1.60	719.4	654.0
$10 < D_{85} \leq 125$	1.61	712.3	647.5

Table 4.22 – Design tensile strengths of **ParaLink 1150**

Particle size of fill material (mm)	γ_m	Design tensile strength, T_D (kN/m)	
		$\gamma_n = 1.0$	$\gamma_n = 1.1$
$D_{85} \leq 10$	1.60	750.7	682.5
$10 < D_{85} \leq 125$	1.61	743.3	675.7

Table 4.23 – Design tensile strengths of **ParaLink 1200**

Design tensile strength – ParaLink (cont'd)

Particle size of fill material (mm)	γ_m	Design tensile strength, T_D (kN/m)	
		$\gamma_n = 1.0$	$\gamma_n = 1.1$
$D_{85} \leq 10$	1.60	782.0	710.9
$10 < D_{85} \leq 125$	1.61	774.2	703.9

Table 4.24 – Design tensile strengths of **ParaLink 1250**

Particle size of fill material (mm)	γ_m	Design tensile strength, T_D (kN/m)	
		$\gamma_n = 1.0$	$\gamma_n = 1.1$
$D_{85} \leq 10$	1.60	813.3	739.3
$10 < D_{85} \leq 125$	1.61	805.2	732.0

Table 4.25 – Design tensile strengths of **ParaLink 1300**

Particle size of fill material (mm)	γ_m	Design tensile strength, T_D (kN/m)	
		$\gamma_n = 1.0$	$\gamma_n = 1.1$
$D_{85} \leq 10$	1.60	844.5	767.8
$10 < D_{85} \leq 125$	1.61	836.2	760.2

Table 4.26 – Design tensile strengths of **ParaLink 1350**

Particle size of fill material (mm)	γ_m	Design tensile strength, T_D (kN/m)	
		$\gamma_n = 1.0$	$\gamma_n = 1.1$
$D_{85} \leq 10$	1.60	938.4	853.1
$10 < D_{85} \leq 125$	1.61	929.1	844.6

Table 4.27 – Design tensile strengths of **ParaLink 1500**

Design tensile strength – ParaLink (cont'd)

Particle size of fill material (mm)	γ_m	Design tensile strength, T_D (kN/m)	
		$\gamma_n = 1.0$	$\gamma_n = 1.1$
$D_{85} \leq 10$	1.60	1000.9	909.9
$10 < D_{85} \leq 125$	1.61	991.0	900.9

Table 4.28 – Design tensile strengths of **ParaLink 1600**

The following notes apply to Tables 3.1 to 3.14 and Tables 4.1 to 4.28:

(a) D_{85} is the particle size corresponding to 85 % by weight of particles passing in a grading test.

(c) The partial material factor, γ_m, applies to the tensile strength of the individual grades of ParaWeb and ParaLink. 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 of the fill material shall not exceed 150 mm.

Fill-to-reinforcement interaction

According to Geoguide 6 (GEO, 2022), the design coefficients of fill-to-reinforcement interaction μ_{dsD} and μ_{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 μ_{dsD} = design coefficient of interaction against direct sliding
μ_{pD} = design coefficient of interaction against pullout
γ_m = partial material factor for fill-to-reinforcement interaction
γ_n = partial consequence factor to account for consequence of failure
α_{ds} = direct sliding coefficient
α_p = pullout coefficient

In preliminary design, the direct sliding coefficient, α_{ds} and the pullout coefficient, α_p given in Table 8, which have been agreed with Maccaferri, may be used. The partial material factor, γ_m, for fill-to-reinforcement interaction shall be taken as 1.2.

Interaction coefficient	**Fill material**
	Type I fill
Direct sliding coefficient α_{ds}	0.7
Pullout coefficient α_p	0.85

Table 8.1 – Direct sliding and pullout coefficients for **ParaWeb**

Interaction coefficient	**Fill material**
	Type I fill
Direct sliding coefficient α_{ds}	0.7
Pullout coefficient α_p	0.6

Table 8.2 – Direct sliding and pullout coefficients for **ParaLink**

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 Maccaferri for the construction of reinforced fill structures and slopes using ParaWeb and ParaLink 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

ASTM (2018). Standard Test Method for Determining Inherent Viscosity of Poly (Ethylene Terephthalate) (PET) by Glass Capillary Viscometer (ASTM D-4603-18). ASTM International, West Conshohocken, PA

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.

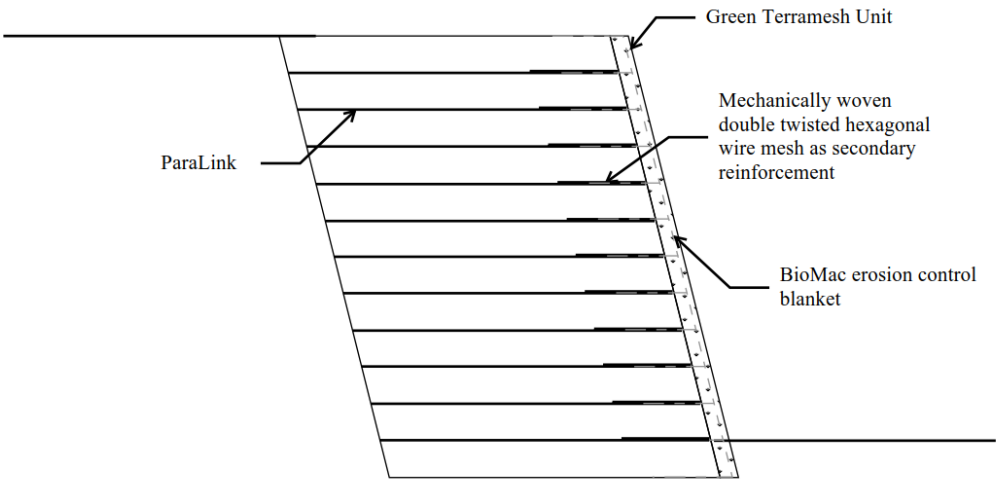
GRI, GG7. Carboxyl End Group Content of Polyethylene Terephthalate (PET) Yarns (GG7). Geosynthetic Research Institute, USA

GRI, GG8. Determination of the Number Average Molecular Weight of Polyethylene Terephthalate (PET) Yarns Based on a Relative Viscosity Value (GG8). Geosynthetic Research Institute, USA

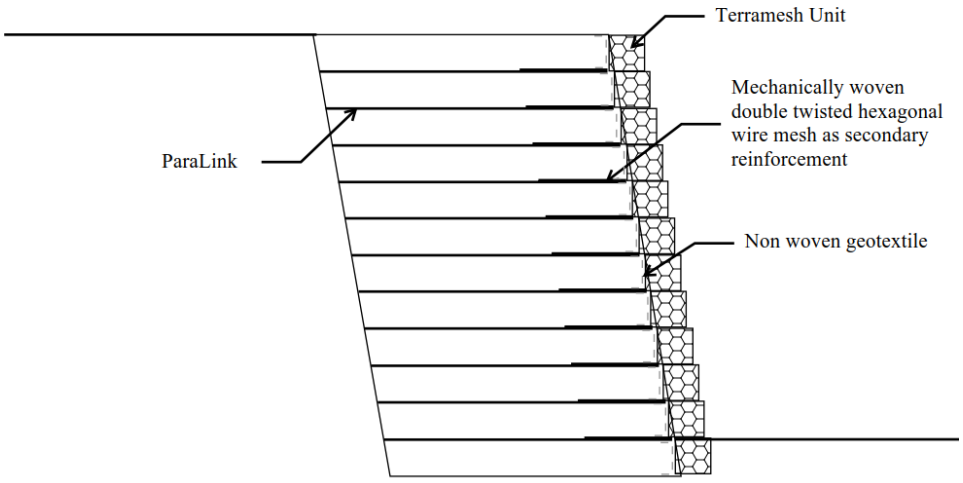
Geotechnical Engineering Office
Civil Engineering and Development Department
May 2023

Appendix A

Reinforced fill structure

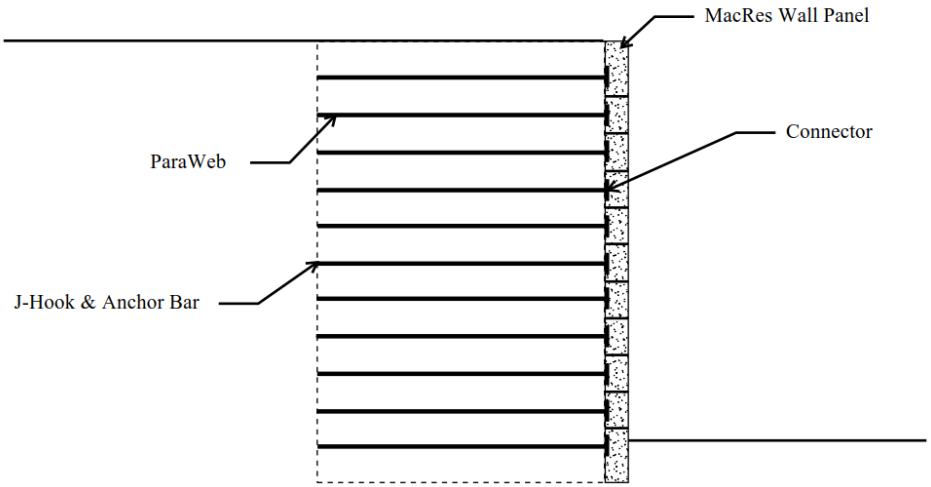


Typical Section of Reinforced Fill Structure using ParaLink with Erosion Control Mat

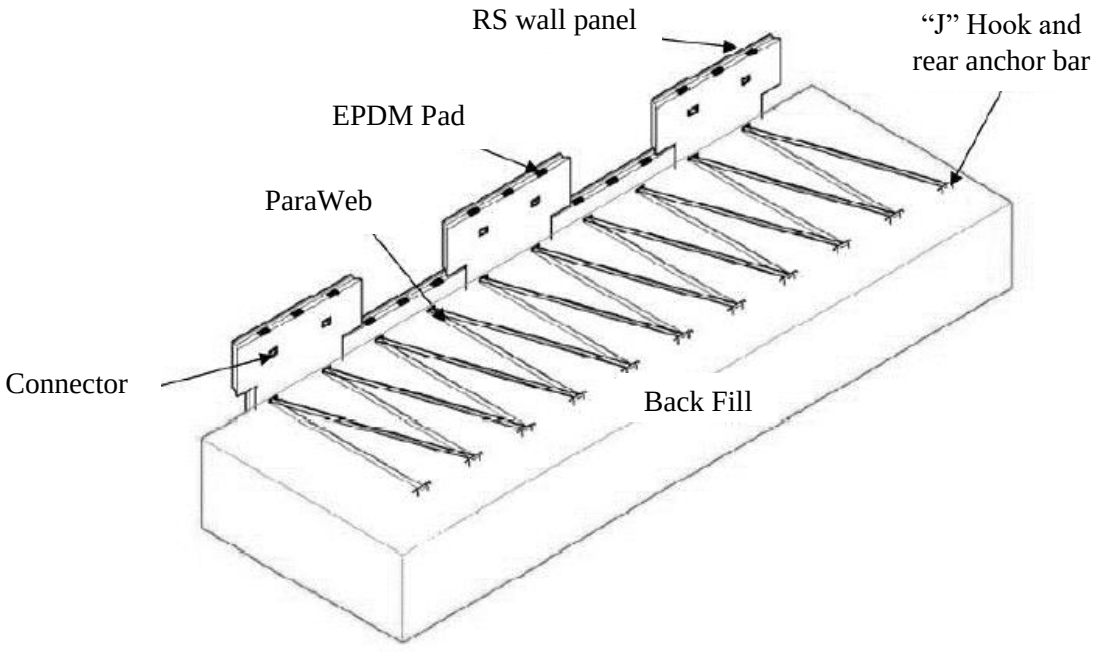


Typical Section of Reinforced Fill Structure using ParaLink with Battered Block Facing

Reinforced fill structures (cont'd)



Typical Section of Reinforced Fill Structure using ParaWeb with Elemental Facing



Typical Layout of Reinforced Fill Structure using ParaWeb with Elemental Facing