

Engineered Plastics

UHMW-PE
Sliding Fenders
Ecoboard
SeaPile
SeaTimber
SeaCamel

Section 6



Trelleborg Marine Systems

www.trelleborg.com/marine

Ref. M1100-S06-V1.1-EN


TRELLEBORG

UHMW-PE FACINGS

Trelleborg FQ1000 ultra high molecular weight polyethylene (UHMW-PE) is the first choice material for facing steel fender panels and other heavy duty applications. It combines very low friction with excellent impact strength and a wear resistance much better than steel.

Most popular is FQ1000-DS which is 'double-sintered' and work-hardened for extra durability. The standard colour is black, but if other colours are needed then FQ1000-V 'virgin' grade also comes in yellow, white, grey, blue, green and red.

FQ1000 UHMW-PE materials are compounded to resist ozone and UV radiation. They do not degrade or rot and are easily recycled at the end of their useful service life.



Features

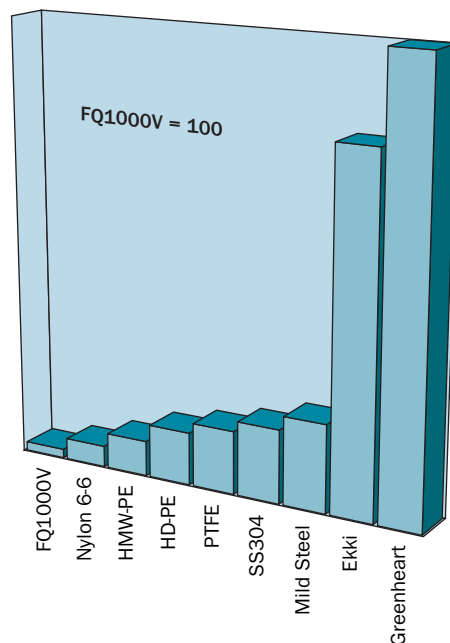
- ▮ Very low friction coefficient
- ▮ Excellent abrasion resistance
- ▮ UV and ozone resistant
- ▮ Does not rot, split or crack
- ▮ 100% recyclable

Applications

- ▮ Fender panel (frame) face pads
- ▮ Rubbing strips
- ▮ V-fender shields
- ▮ Lock entrance and wall protection
- ▮ Bridge buttress protection
- ▮ Beltings on workboats

Refer to Section 12 (Fender Design) for guidance on using UHMW-PE as a fender facing.

Relative Abrasion



UHMW-PE FACINGS

Property	Test Method	Unit	Typical Value	
			FQ1000-V	FQ1000-DS
Density	ISO 1183-1	g/cm ³	0.94–0.95	0.95–0.96
Notched Impact Strength (Charpy)	ISO 11542-2	kJ/m ²	140–170	100–130
Abrasion Index (Sand-slurry)	ISO/DIS 15527(Draft)	FQ1000V = 100	100–110	130–150
Yield Strength	ISO/R 50mm/min	N/mm ²	15–20	15–20
Elongation at Break*	ISO/R 50mm/min	%	>50	>50
Dynamic Friction (PE-Steel)	Pm = 1N/mm ² V=10m/min	–	0.15	0.15
Hardness	ISO 868 / DIN 53505 3s value, 6mm sample	Shore D	63	63–66
Operating Temperature	–	°C	–80 to +80	–80 to +80
Thermal Expansion	DIN 53752	K ⁻¹	≈2×10 ⁻⁴	≈2×10 ⁻⁴

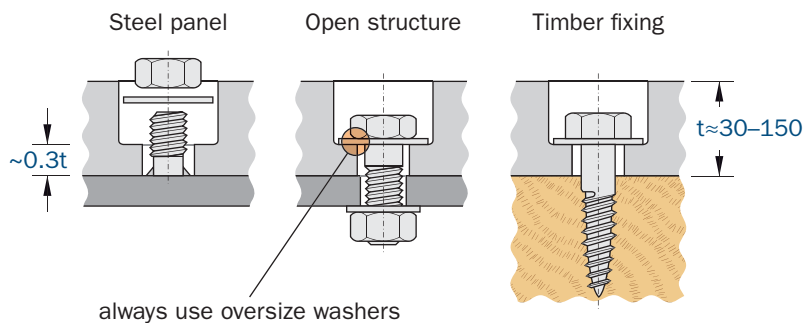
FQ1000-V is virgin grade material.

FQ1000-DS is double sintered (regenerated) material.

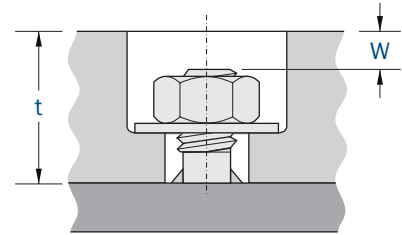
All values for black, UV stabilized material.

Values for coloured materials will vary.

* Alternative test methods such as ASTM D638 give higher values circa 350%.



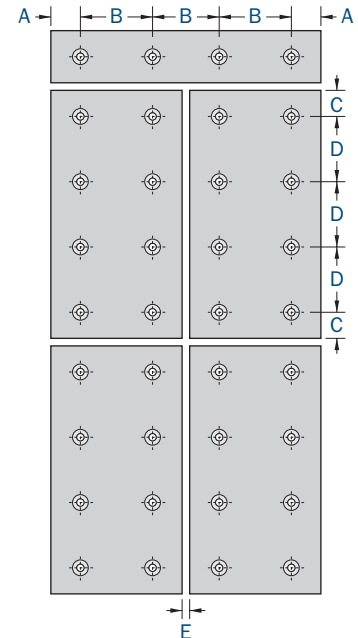
Wear allowances



t	W
30	3–5
40	7–10
50	10–15
70	18–25
100	28–40

Small increases in facing thickness can greatly extend service life for minimal extra cost.

Typical dimensions



A	45–80
B	250–350
C	45–80
D	300–450
E	5–10

Dimensions will depend on pad thickness and application.

SLIDING FENDERS

HD-PE Sliding Fenders are the ideal alternative to timber facings with the added advantage of low-friction and better wear properties. HD-PE does not split or decay and is totally resistant to borers.

Environmentally friendly, HD-PE can be used instead of tropical hardwoods, lasts much longer, and can be fully recycled at the end of its useful life.

Features

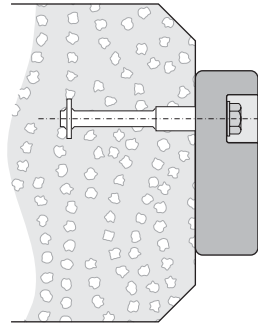
- | Low friction coefficient
- | Resists marine borers
- | High abrasion resistance
- | UV and ozone resistant
- | Does not rot, split or crack
- | Easy to cut and drill
- | 100% recyclable

Applications

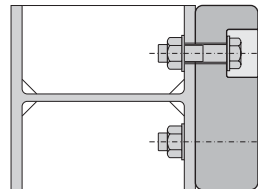
- | Fender pile rubbing strips
- | Facing strips for berths
- | Workboat beltings
- | Lock protection
- | Lock gate mitres



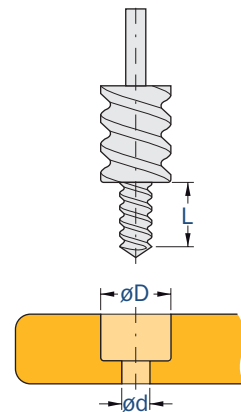
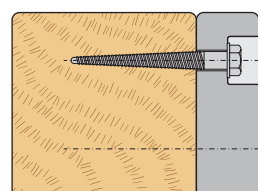
Concrete structure



Steel structure



Timber structure



Standard drilling diameters

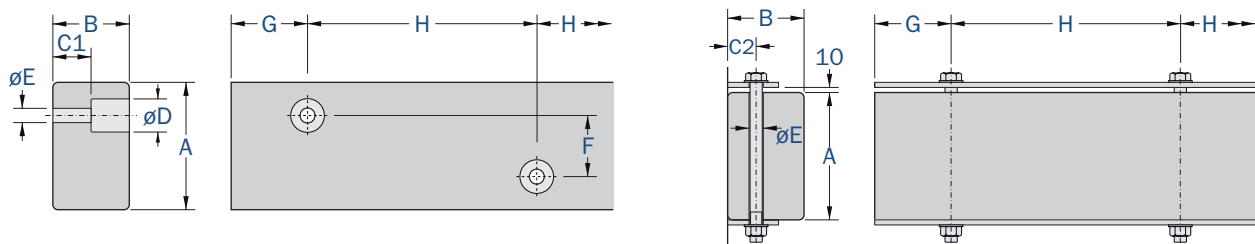
D	d	L
27	13	75
32	16	85
32	12	32
32	16	45
32	18	80
40	20	80
50	21	95
50	23	95
60	21	70
65	27	105
70	28	110
70	32	115
70	26	50

SLIDING FENDERS

A	B	L	C1	C2	D	E	F	G	H	Flat bar	Bolt size	Weight
50	50	5500	25	n/a	32	16	0	50-100	n/a	n/a	M12	2.4
60	60	5500	30	n/a	32	16	0	50-100	n/a	n/a	M12	3.4
70	50	2500	25	32	32	16	0	75-125	250-300	n/a	M12	3.3
70	70	6500	30	32	32	16	0	75-125	250-300	n/a	M12	4.6
80	60	5000	30	32	32	16	0	75-125	250-300	n/a	M12	4.5
100	50	5500	25	32	32	16	0	75-125	250-300	n/a	M12	4.7
100	65	5500	30	32	32	16	0	75-125	250-300	n/a	M12	6.1
100	100	6000	50	32	32	16	0	75-125	250-300	50 x 6	M12	9.3
120	80	5000	40	40	40	20	0	100-150	300-350	n/a	M16	8.9
120	120	6000	60	40	40	20	0	100-150	300-350	80 x 10	M16	13.4
140	70	5500	35	40	40	20	0-50	100-150	300-350	n/a	M16	9.1
160	70	5000	35	40	40	20	0-70	100-150	300-350	n/a	M16	10.4
160	160	6000	80	40	40	20	0-80	100-150	300-350	80 x 10	M16	24.1
170	120	5500	60	40	40	20	0-80	100-150	300-350	80 x 10	M16	19.0
180	70	5000	35	46	50	23	0-80	125-175	350-450	n/a	M20	11.7
180	180	6000	90	46	50	23	0-80	125-175	350-450	80 x 10	M20	30.2
190	110	5000	55	46	50	23	0-90	125-175	350-450	80 x 10	M20	19.4
200	75	5000	35	46	50	23	0-100	125-175	350-450	n/a	M20	14.0
200	100	6000	50	46	50	23	0-100	125-175	350-450	80 x 10	M20	18.6
200	150	5500	75	46	50	23	0-100	125-175	350-450	80 x 10	M20	27.9
200	200	6000	100	46	50	23	0-100	125-175	350-450	80 x 10	M20	37.6
250	150	6500	75	56	65	28	0-130	150-200	450-550	80 x 10	M24	34.8
250	160	5000	80	56	65	28	0-130	150-200	450-550	80 x 10	M24	37.2
250	250	5000	125	56	65	28	0-130	150-200	450-550	100 x 10	M24	58.1
300	100	5500	50	56	65	28	0-160	150-200	450-550	n/a	M24	27.9
300	210	5000	105	56	70	36	0-160	175-225	500-600	100 x 12	M30	58.6
300	300	5000	150	72	70	36	0-160	175-225	500-600	120 x 12	M30	84.6
440	160	2000	80	56	70	36	0-300	175-225	500-600	100 x 12	M30	66.8

Preferred sizes are in bold. Full or half lengths as standard.

[Units: mm, kg/m]



Property	Test method	Typical results	Unit
Density	ISO 1183-1	0.91-0.94	g/cm ³
Molecular weight	Light diffusion method	~200,000	g/mol
Dynamic friction	-	0.20-0.25	-
Yield strength	DIN 53504	10-15	MPa
Shore hardness	DIN 53505	48-50	Shore D
Abrasion index (sand slurry)	ISO/DIS 15527 (Draft) FQ1000-V = 100	~400	-
Operating temperature		-50 to +50	°C
Thermal expansion	DIN 53752	2 x 10 ⁻⁴	K ⁻¹

Property values are from tests on production materials. HD-PE is manufactured from a blend of virgin and recycled stock which can cause limited variations in test results.

SEAPILE® & SEATIMBER®

SeaPile and SeaTimber are advanced composite plastics with superior properties to timber, steel and concrete for many marine structures and applications.

They can withstand heavy impacts by absorption of energy through recoverable deflection. SeaPile and SeaTimber never rot, corrode or decay. They are impervious to marine borers, yet are totally non-polluting.

Manufactured from a recycled plastic matrix with unique glass fibre reinforcement bars, the stiffness of SeaPile and SeaTimber can be varied and controlled to suit each project. This makes the material the ideal choice for fenders, to build marine structures, and for coastal protection without damaging the environment.

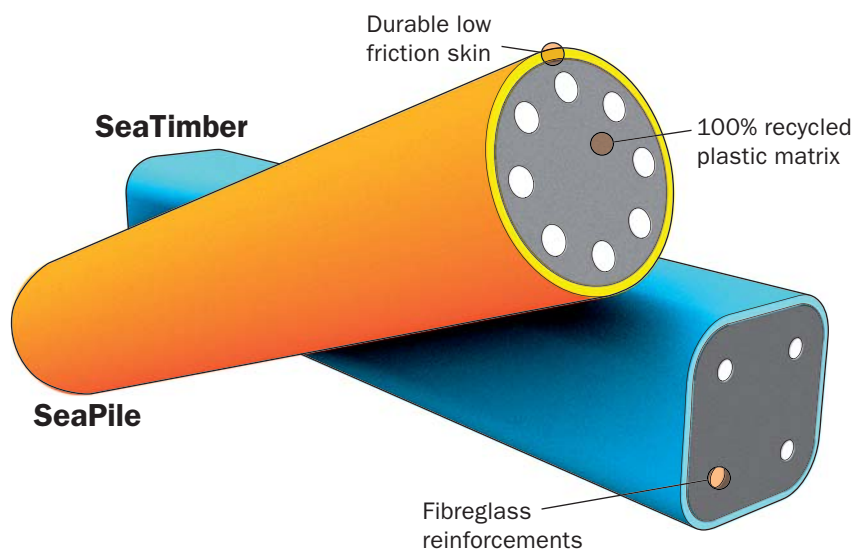
Features

- ▮ Low lifecycle cost
- ▮ Will not rot, corrode or decay
- ▮ Unaffected by marine borers
- ▮ Choice of modulus to suit different applications
- ▮ Can be pile driven, sawn and drilled
- ▮ Low friction coefficient
- ▮ Ultra low maintenance
- ▮ Custom colours available
- ▮ Unlimited lengths*

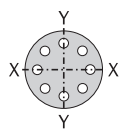
Applications

- ▮ Fender piles and systems
- ▮ Structural piles
- ▮ Bridge protection
- ▮ Guidewalls and locks
- ▮ Corner fenders
- ▮ Dolphins
- ▮ Navigation markers
- ▮ Walings and bullrails

* subject to transport restrictions



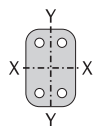
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SeaPile

SeaPile section	Diameter		Rebar quantity	Size		Yield		Weight	
	inch	mm		inch	mm	lb/in ²	MPa	lb/ft	kg/m
10 (6-1)	10	254	6	1	25	4300	29.65	24-29	36-43
10 (6-1.25)				1.25	32	5837	40.24	25-31	37-46
10 (6-1.375)				1.375	35	6766	46.65	26-32	39-48
10 (8-1)			8	1	25	5431	37.45	25-35	37-52
10 (8-1.25)				1.25	32	7482	51.59	26-32	39-48
10 (8-1.375)				1.375	35	8720	60.12	27-33	40-49
10 (8-1.5)				1.5	38	10036	69.20	28-35	42-52
10 (8-1.625)	1.625	41		11424	78.77	29-36	43-54		
13 (8-1)	13	330	8	1	25	3842	26.49	39-48	58-71
13 (8-1.25)				1.25	32	5207	35.90	41-50	61-74
13 (8-1.375)				1.375	35	6028	41.56	42-51	63-76
13 (12-1)			12	1	25	5365	36.99	41-50	61-74
13 (12-1.25)				1.25	32	7413	51.11	43-53	64-79
13 (12-1.375)				1.375	35	8643	59.59	45-55	67-82
13 (12-1.5)				1.5	38	9947	68.58	46-57	68-85
13 (12-1.625)	1.625	41	11315	78.01	48-59	71-88			
16 (16-1)	16	406	16	1	25	4928	33.98	61-74	91-110
16 (16-1.25)				1.25	32	6785	46.78	64-78	95-116
16 (16-1.375)				1.375	35	7899	54.46	66-81	98-121
16 (16-1.5)				1.5	38	9078	62.59	68-83	101-124
16 (16-1.625)				1.625	41	10313	71.11	70-86	104-128
16 (16-1.75)				1.75	44	11599	79.97	73-89	109-132

Modulus, stiffness and other material properties are available on request.



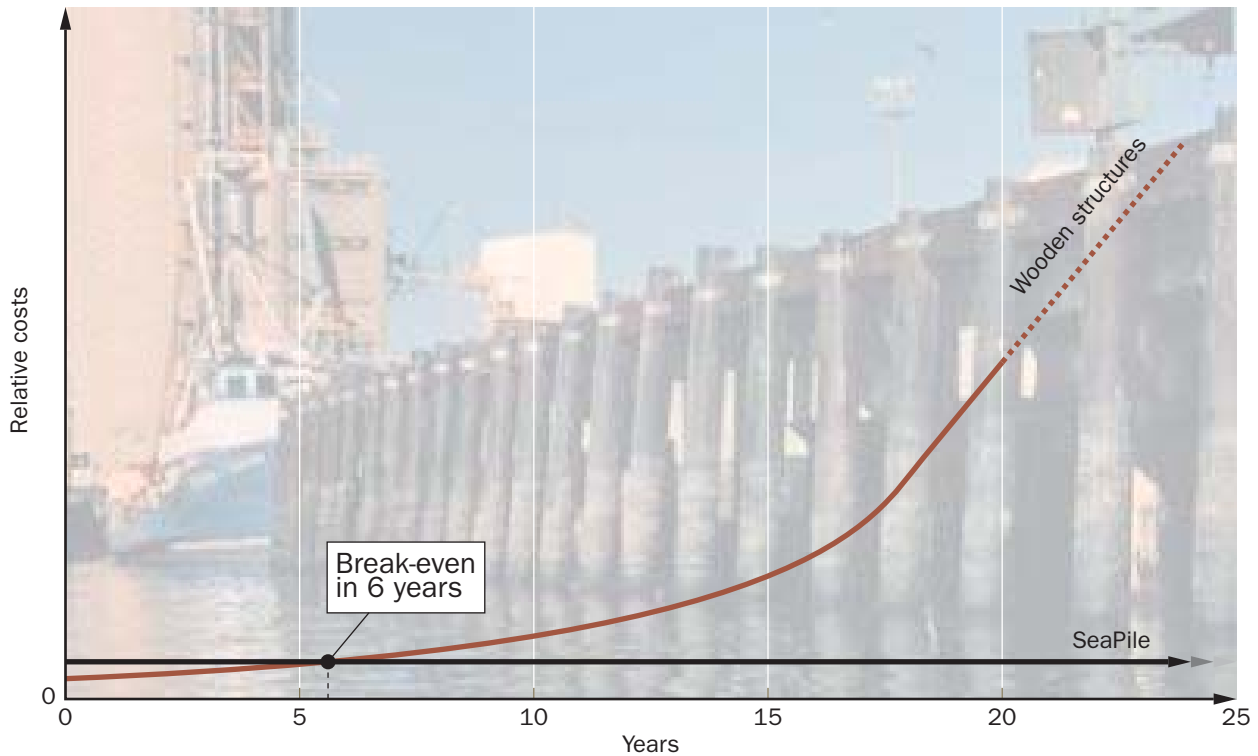
SeaTimber

SeaTimber section	Height		Width		Rebar qty	Size		Yield X-X		Yield Y-Y		Weight	
	inch	mm	inch	mm		inch	mm	lb/in ²	MPa	lb/in ²	MPa	lb/ft	kg/m
12 × 8 (No rebar)	12	305	8	203	–	–	–	860	5.93	860	5.93	25-31	37-46
12 × 8 (4-1)					1	25	3868	26.67	3421	23.59	26-32	39-48	
12 × 8 (4-1.25)					1.25	32	5155	35.54	4381	30.21	27-33	40-49	
12 × 8 (4-1.375)					1.375	35	5928	40.87	4964	34.23	28-34	42-51	
12 × 8 (4-1.5)					1.5	38	6746	46.51	5588	38.53	28-35	42-52	
12 × 8 (4-1.625)					1.625	41	7606	52.44	6250	43.09	29-35	43-52	
12 × 8 (4-1.75)					1.75	44	8501	58.61	6948	47.90	29-36	43-54	
10 × 10 (No rebar)	10	254	10	254	–	–	–	860	5.93	860	5.93	27-33	40-49
10 × 10 (4-1)					1	25	3443	23.74	3443	23.74	28-35	42-52	
10 × 10 (4-1.25)					1.25	32	4517	31.14	4517	31.14	29-36	43-54	
10 × 10 (4-1.375)					1.375	35	5163	35.6	5163	35.60	30-36	45-54	
10 × 10 (4-1.5)					1.5	38	5849	40.33	5849	40.33	30-37	45-55	
10 × 10 (4-1.625)					1.625	41	6571	45.31	6571	45.31	31-38	46-57	
10 × 10 (4-1.75)	1.75	44	7325	50.5	7325	50.5	31-38	46-57					
12 × 12 (No rebar)	12	305	12	305	–	–	–	860	5.93	860	5.93	39-47	58-70
12 × 12 (4-1)					1	25	2706	18.66	2706	18.66	40-49	60-73	
12 × 12 (4-1.25)					1.25	32	3466	23.90	3466	23.90	41-50	61-74	
12 × 12 (4-1.375)					1.375	35	3923	27.05	3923	27.05	41-51	61-76	
12 × 12 (4-1.5)					1.5	38	4406	30.38	4406	30.38	42-51	63-76	
12 × 12 (4-1.625)					1.625	41	4914	33.88	4914	33.88	42-52	63-77	

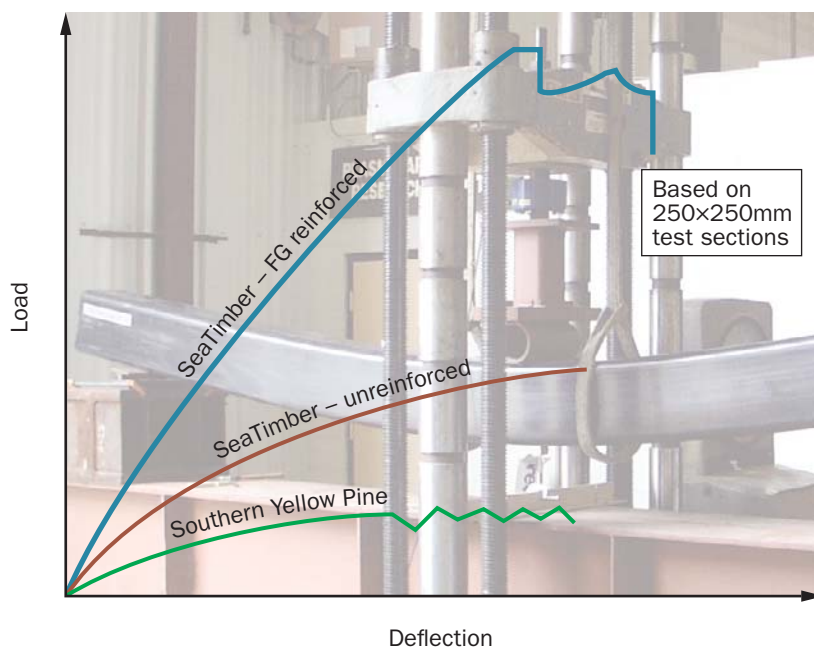
Modulus, stiffness and other material properties are available on request.

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Lifecycle cost



SeaPile and SeaTimber cost far less during the lifetime of a structure because they need little if any maintenance. Real comparisons with timber structures show the break-even point is just six years, sometimes far less.



SeaPile and SeaTimber can resist greater loads and deflections than wood, concrete and steel. When tested to ultimate load, SeaPile and SeaTimber absorb 15 times the energy of Southern Yellow Pine. In practical terms this means less damage, maintenance and downtime, leading to a lower lifecycle cost.

SEAPILE® & SEATIMBER®

Installation



Piling



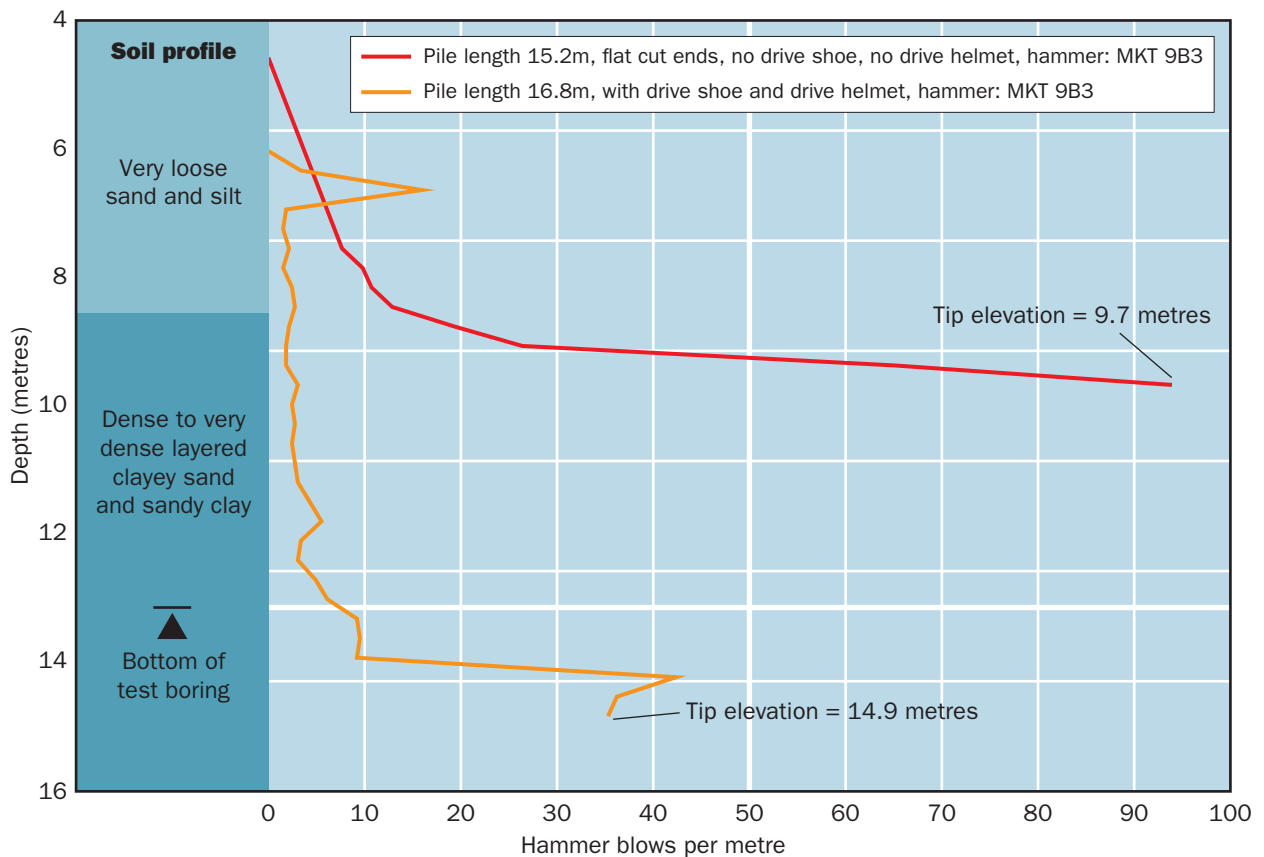
Cutting



Drilling

Various connecting methods are available to increase pile length. SeaPile and SeaTimber lengths can also be attached to steel pile extensions. A DVD explaining SeaPile and SeaTimber handling and installation methods is available.

Pile driving data

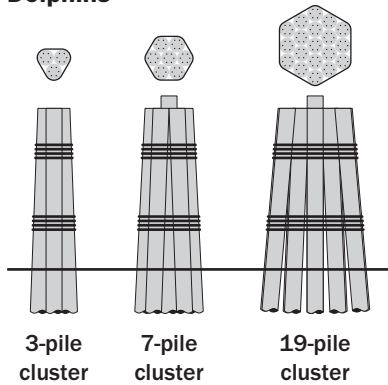


SEAPILE® & SEATIMBER®

Applications

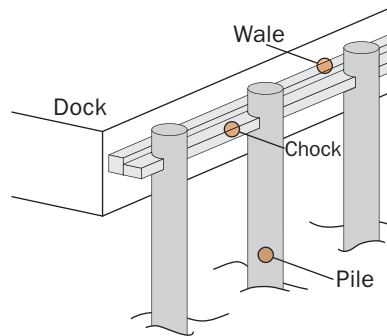
The SeaPile can generally be used in the same applications as traditional timber piling. Examples include:

Dolphins



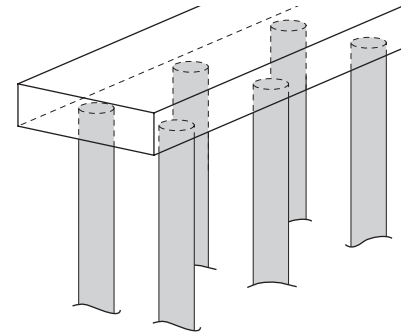
Dolphins, or groups of piles, are placed near piers and wharves to guide vessels into their moorings, to fend them away from structures, or to serve as mooring points. Compared with timber, considerably fewer SeaPiles are needed to absorb the same impact energy.

Fender piling



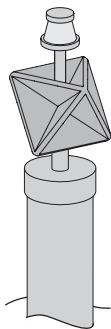
Piles are used extensively as vertical fenders set out in front of a marine structure. During the berthing of a ship, fender piles act as a buffer to absorb and dissipate the impact energy of the ship. They also provide a barrier to prevent vessels from going underneath the pier.

Light structural piling



Piles are used to support the loads of light-duty piers and wharves. Structural piling generally uses bracing between piles to increase the strength and stiffness of the foundation for the structure.

Navigational aids

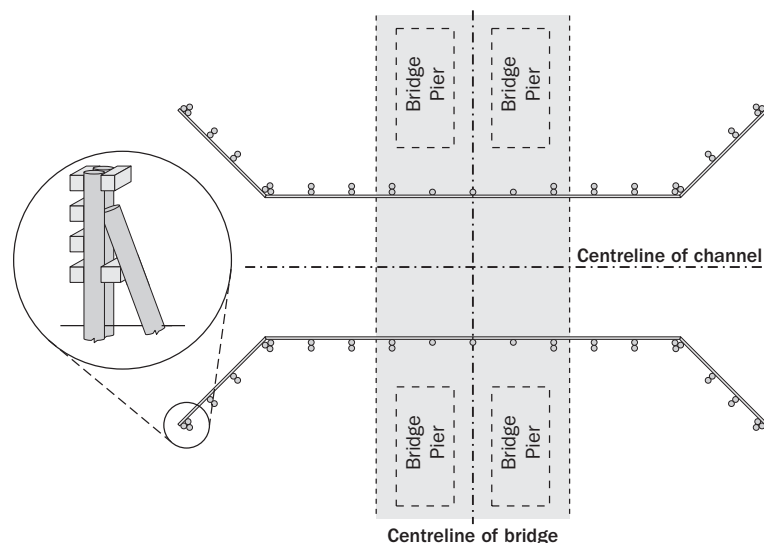


Single piles or dolphins are used to support lights, daybeacons, fog signals and radar beacons.

Refer to the SeaPile and SeaTimber Design Manual for more information and examples.

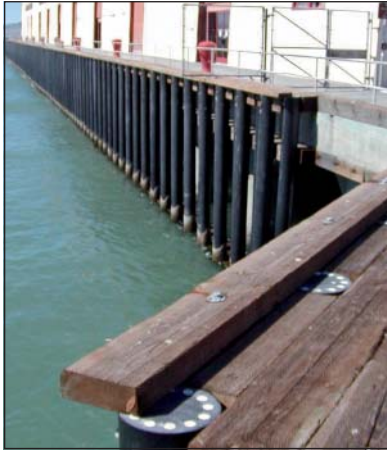
Bridge pier protection

Piles and dolphins are widely used to create protective structures for bridge piers, and to guide vessels into the channel and away from bridge supports. 3-pile clusters are used in impact zones, single piles in less vulnerable areas.



SEAPILE® & SEATIMBER®

Proven in practice

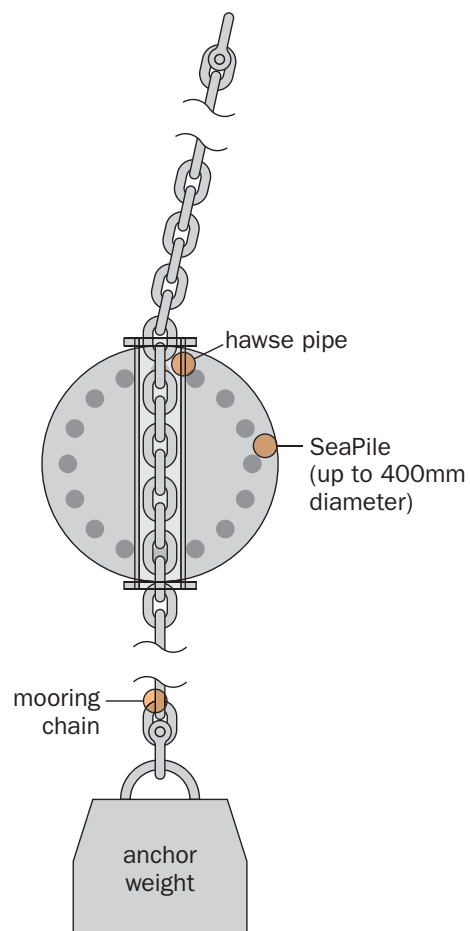
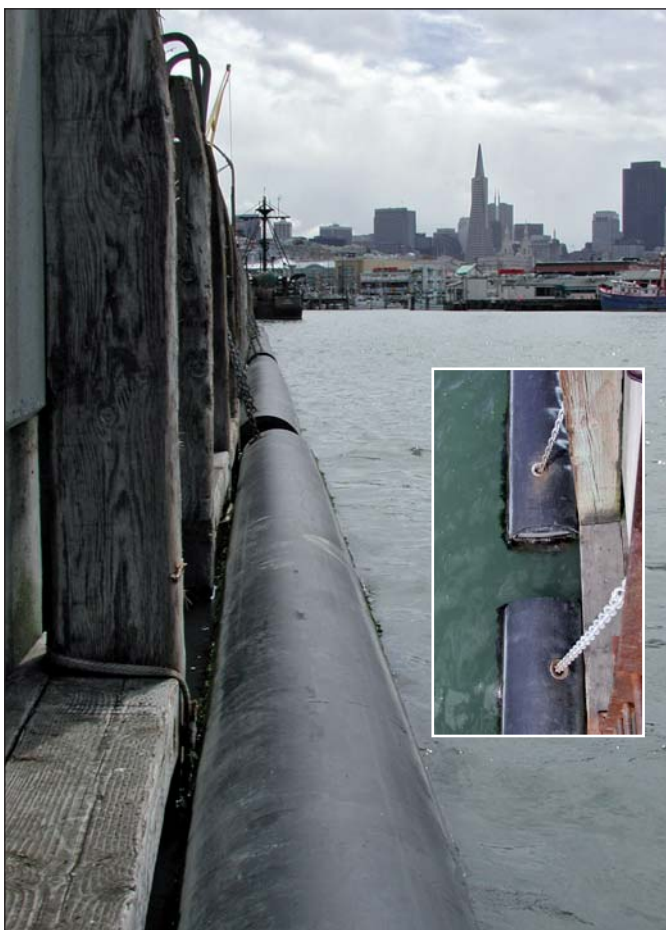


SEACAMEL®

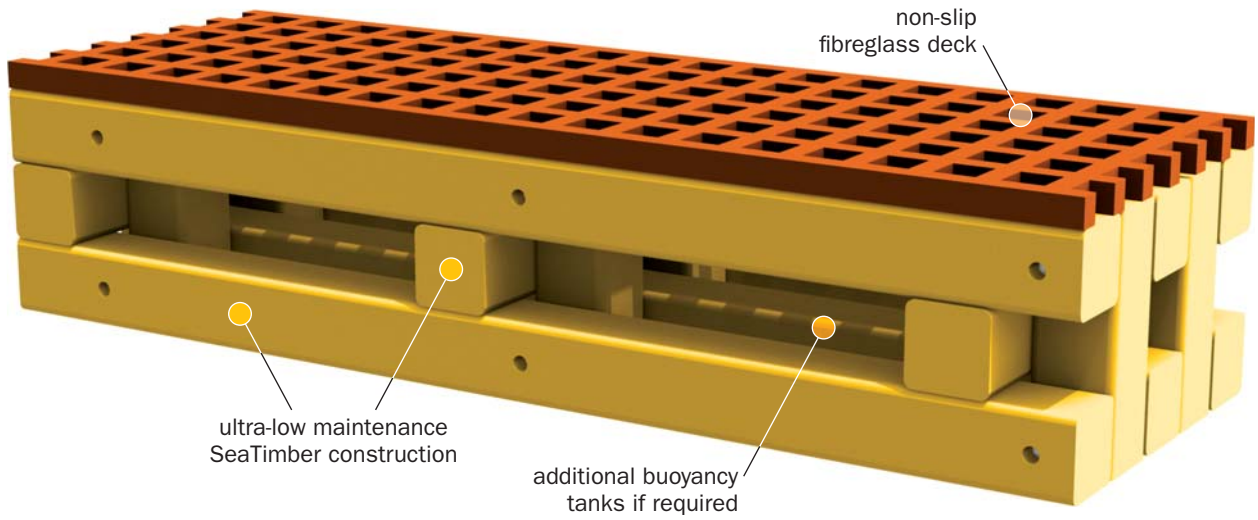
Floating camels are used in many military and commercial ports to maintain standoff between the vessel and pier face. They also transmit forces over a greater length of structure to avoid concentrated loads.

SeaCamels are constructed from SeaPile, SeaTimber or Ecoboard engineered plastics, which combine high strength with positive buoyancy and will not crush, split, corrode or decay.

SeaCamels are available in many configurations, either preassembled or in kit form. They can be fitted with access decks and face fenders as well as a variety of mooring options.



SEACAMEL®



Lengths up to 11.8m can be containerised for easy shipment.



ECOBOARD®

Ecoboard structures outlast any wood or 'wood flour' plastic composites, lowering your costs for years to come. Ecoboard is maintenance-free and needs zero care, and because Ecoboard doesn't deteriorate even in extreme environments, the ongoing cost of treating and repairing materials becomes a thing of the past.

Ecoboard is durable and versatile. The SR and SF grades are both based on the same 100% recycled and carefully graded polyethylene which is non-toxic and stable. Whether strengthened with chopped glass fibres (SF) or with high performance glass fibre rebars (SR), Ecoboard comes in many standard and custom sections to suit light, medium and heavy duty applications.

Ecoboard looks great too. With a choice of natural or textured finishes in popular UV-stabilised colours, designers can be confident that their Ecoboard structures will stay looking good for decades to come – no cracking or chipping, no warping or corrosion, no mould or decay. And if that still isn't enough to convince you to use Ecoboard for your next project then maybe Trelleborg's 50 year limited warranty will.



Materials



Ecoboard

Ecoboard is made from recycled polyethylene, reinforced with chopped glass fibre or GRP rebars. It doesn't rot, split or chip, and is ideal for long term immersion in water.



Timber composites

Timber composites are wood 'flour' in a plastic matrix. They overcome some disadvantages of natural timber but composites will still decay and rot over time, particularly when damp.



Wood

All wood suffers environmental attack, sometimes reduced by periodic chemical treatments. Wood can crack, split and splinter, is eaten by borers and suffers fungal and bacterial decay.

	Wood	Composite	Ecoboard®
50 year warranty			✓✓
Insect and borer resistant			✓✓
Rot and decay resistant	✓*	✓*	✓✓
Load bearing and structural	✓✓		✓✓
Non-splintering		✓	✓✓
Low friction			✓✓
Maintenance free			✓✓
Colour stability			✓✓
Non-leaching/toxin-free			✓✓
100% recycled feedstock			✓✓
Recyclable	✓	✓	✓✓
Long-term aesthetics			✓✓
Precurving and forming	✓	✓	✓✓

* Chemical treatments required.

ECOBOARD®

Joists & spans

Ecoboard's different grades give the right amounts of flexibility and strength just where they are needed.



Ecoboard SF

Chopped glass fibre reinforced polyethylene

Greater strength and modulus allows larger unsupported spans and fewer joists. Perfect for municipal structures and medium to heavy duty constructions.

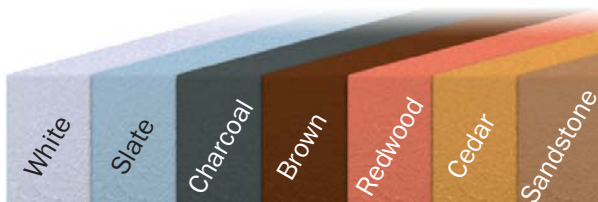


Ecoboard SR

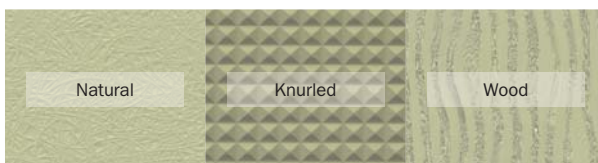
100% polyethylene with fibreglass reinforcement bars

Maximum structural strength for bearing piles and large freespan joists. The ultimate material for heavy duty, load-bearing structures.

Colours







Choose from our standard range, or ask about custom colours. Slight variations may occur during manufacture.



Ecoboard's natural finish is gently textured and pleasant to the touch. The wood grain texture blends in well, whilst the knurled texture provides a low-slip finish.

Sizes

Profile	Nominal (mm)	Finished (mm)	Max length (m)	Weight (kg/m)
Round 	76	76	3.0	4.0
	102	102	3.0	5.5
	127	127	4.6	11.3
	152	152	9.1	16.2
	216	216	9.1	32.7
	254	254	9.1	45.5
Square 	51 × 51	38 × 38	3.0	1.3
	102 × 102	89 × 89	3.7	6.4
	152 × 152	140 × 140	4.9	15.9
	203 × 203	191 × 191	6.1	32.7
Rectangular 	32 × 152	32 × 140	3.7	3.9
	32 × 254	32 × 241	3.7	6.8
	51 × 76	38 × 64	3.7	2.1
	51 × 102	38 × 89	4.9	3.1
	51 × 152	38 × 140	6.1	4.8
	51 × 203	38 × 191	4.9	6.4
	51 × 254	38 × 241	5.5	8.0
	51 × 305	38 × 292	3.7	9.8
	76 × 102	64 × 89	3.7	5.1
	76 × 152	64 × 140	3.7	7.9
	76 × 203	64 × 191	4.9	10.9
	76 × 254	64 × 267	5.5	13.7
	76 × 305	64 × 292	3.7	16.7
	102 × 152	89 × 140	3.7	11.0
	102 × 203	89 × 191	3.7	14.7
	102 × 254	89 × 241	3.7	19.0
102 × 305	89 × 292	5.5	23.2	
152 × 203	140 × 191	3.7	23.8	
152 × 254	140 × 241	4.9	30.4	
152 × 305	140 × 292	4.9	36.0	
203 × 254	191 × 241	4.9	41.4	
Tongue & groove 	51 × 254	38 × 230	5.5	8.0
	51 × 305	38 × 285	3.7	9.8
	76 × 254	64 × 230	5.5	13.7
	76 × 305	64 × 285	3.7	16.5
	102 × 305	89 × 285	5.5	23.2

- 1 Other sizes, sections and lengths are available. Please ask.
- 2 Nominal sizes relate to industry standard descriptions for lumber sections. Actual sizes should be used for design.
- 3 Thermal expansion must be allowed for in designs.
- 4 Weight may vary due to manufacturing methods and tolerances.

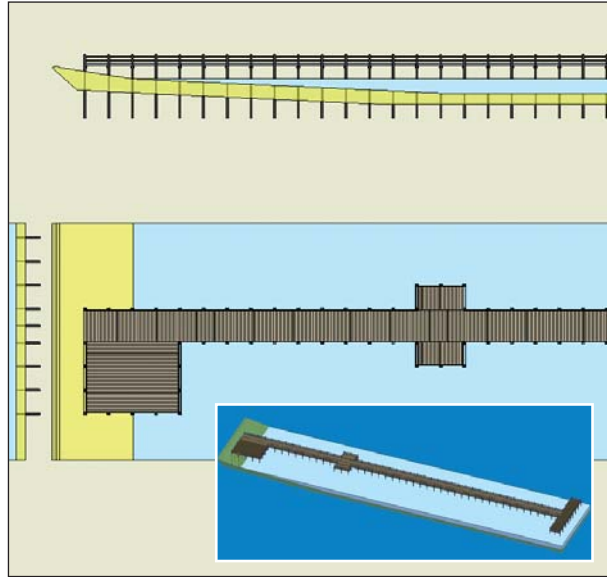
ECOBOARD®

Design fabrication

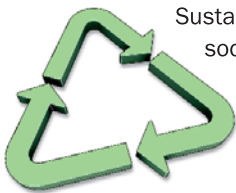
- | Chamfering
- | Drilling and counterboring
- | Shaping
- | Pre-curling*

Trelleborg can supply everything from plain lengths to a factory fabricated kit of parts, fully engineered and ready for rapid site assembly. Please ask for details

* SF grades only.



Sustainability



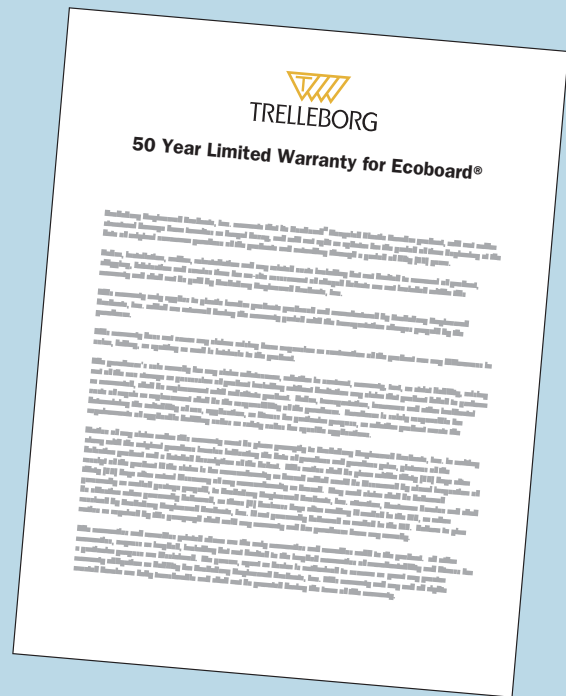
Sustainability is about economic growth, social development and a healthy environment. Within Trelleborg the ethos of sustainability involves everybody and everything we do or make, becoming a natural part of our daily business operations.

Ecoboard is a perfect example. Made from recycled raw materials in a clean and energy efficient factory. It is toxin-free, inert and non-polluting. Ecoboard is long lasting but even at the end of its useful service life it can be fully recycled and used again.

Visit www.trelleborg.com/sustainability to learn more about Trelleborg's efforts to build a sustainable environment within a commercial world.



50 Year Warranty



Please refer to your local office for full details of the EcoBoard 50 Year Limited Warranty backed by Trelleborg. Founded in 1905, Trelleborg now operates in 40 countries, employs over 22,000 people and has annual sales of \$4 billion.

ECOBOARD®

Proven in practice



Trelleborg Marine Systems is part of Trelleborg's Engineered Systems Business Area and specialises in the safe berthing and mooring of vessels within ports and harbours, on offshore structures and in waterways around the world.

We bring together the industry's best known and respected brands for fendering and mooring systems with the unrivalled

collective experience and knowledge of its sales and engineering staff. Our customers benefit from great choice and helpful support at every stage from initial concept and detailed design right through to supply, commissioning and after-sales service – all provided by our network of regional offices and local agents.



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