SuperWale™ Technical Data Sheet

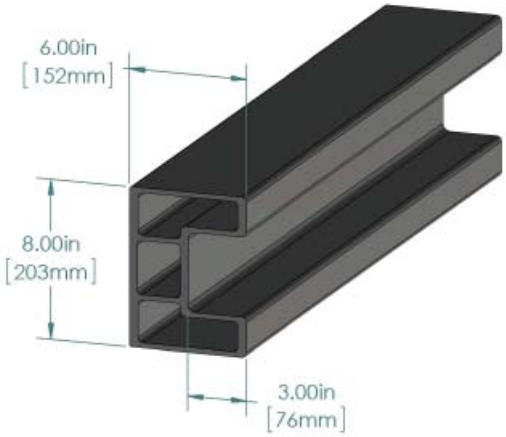
Part Number SS810

*Wale & Retaining Wall System
(US Patent #6,893,191 B2/May 17, 2005)

WHY SUPERWALE™?

- Environmentally friendly - low carbon footprint, will not leach dangerous chemicals or preservatives
- Will not rot, rust, or corrode
- Available in 24' and custom lengths
- Dimensionally stable
- Ease of field assembly
- Light weight
- Unique design allows for the tie rod to remain concealed, protecting humans and boats from potential hazard
- Superior strength and reliability
- Aesthetically pleasing
- Available in an array of colors
- Inert to marine borers and termites
- Field drillable and fabricated with ease

Rotted wale bringing down your asset protection bulkhead?
SuperWale™ composite wale is the solution, call today for details 888-(CPI-PULL).



SuperWale™ is stronger than wood, steel and concrete and has been independently tested in full section bending. SuperWale™ is manufactured of state of the art thermo-set resins and high strength glass, via the pultrusion process, making SuperWale™ the product of choice for the test of time. Engineers, architects, home owner associations, and government agencies continue to specify SuperWale™ where low maintenance, aesthetics, and a superior design life are crucial to their projects.

SuperWale™ load charts have been developed for both polyester and vinyl ester resin systems. Vinyl ester resins are based on bisphenol-A epoxy. Vinyl ester resins exhibit excellent toughness and fatigue resistance and they exhibit 20% to 30% higher mechanical properties than a polyester resin pultrusion. Polyester resins exhibit good structural strength, however they will lose approximately 50% of their compression strength over a 30 plus year design life. Vinyl ester resin pultrusions will lose approximately 15% to 20% of their compression strength over a design life of 30 plus years. This information was generated through accelerated aging studies developed by the Army Corps of Engineers.

The load charts are set up based on the allowable loads permitted to be induced on the wale section per foot of wale directly related to the tie-rod spacing. The permitted load on the wale may be based on either the tie-rod spacing, flexural strength, shear strength, deflection, or washer pull through capacity. In most cases the point load being induced on the SuperWale™, through the tie-rod, governs the tie-rod spacing and wale capacity. Particular attention should focused on the Allowable Tie-rod Force on SuperWale™ with Specified Steel Washers chart. The permitted tie-rod force is dependent on the resin selected for the wale section and the dimensions of the washer specified.

Wale splices are made with a galvanized 50 ksi steel section known as the SuperWale W-splice section. Tie-rods should be used in conjunction with the steel w-splice.

Corners are fabricated with a 316 stainless steel fabricated section that is cut and fabricated to fit the angle of the corner. 316 stainless steel is utilized to allow for welding the fabricated section.

Oversize steel washers must be utilized with every tie-rod in order for the SuperWale™ to perform to its optimal structural capacity.

Physical Properties of SuperWale™

Minor Section Modulus	14.40 in^3/ft. (1.97E+07 mm^3)
Minor Moment of Inertia	49.22 in^4 (2.05E+07 mm^4)
Depth of Section	6.0 in. (152.4 mm)
Width of Section	8.0 in.(203.2 mm)
Weight	9.70 lb/ft. (14.44 kg/m)
Area of Web	6.0 in^2 (3,870.96 mm^2)
Standard Color	Graphite Gray

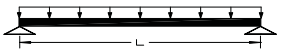
Mechanical Properties of SuperWale™

Mechanical Properties	Test Method	Average Values Imperial	Average Values Metric
Full Section Modulus of Elasticity	Lab	3.80E+06 psi	26,200 MPa
Full Section Shear Modulus	Lab	450,000 psi	3,103 MPa
Ultimate Shear Capacity	Lab/Calculated	42,000 lbs.	19,051 kg.
Ultimate Moment Capacity	Lab/Calculated	48,000 ft.-lbs.	65,079 N-m
EI value	Calculated	1.87E8 lbs-in^2	5.37E5 N-m^2
Compression Strength LW	ASTM D695	40,000 psi	276 MPa
Compression Strength CW	ASTM D695	13,000 psi	90 MPa
In-Plane Shear	Mod. D23441	7,000 psi[1]	48 MPa

Condo Installation

Marina Installation

Polyester Load Tables

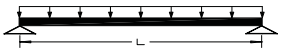


Design Charts for SuperWale™ Specified with Polyester Resin -Simply Supported, Simple Span Load Condition, Imperial Units

Tierod Spacing (ft.)	Load on the wale that produces 0.25" deflection (lbs./ft)	Load on the wale that produces 0.375" deflection (lbs./ft)	Load on the wale that produces 0.5" deflection (lbs./ft)	Allowable Load per foot of wale (Flexural) (lbs/ft.)	Allowable Load per foot of wale (Shear) (lbs/ft.)	Tie-rod Pull Force Allowable Load per foot of wale (lbs/ft.) utilizing a 3.25"x6.0"x.50" steel washer	Tie-rod Pull Force Allowable Load per foot of wale (lbs/ft.) utilizing a 3.25"x12"x.75" steel washer
3	23,128	34,692	46,256	17,067	9,333	4,000	5,000
4	7,318	10,977	14,636	9,600	7,000	3,000	3,750
5	2,997	4,496	5,995	6,144	5,600	2,400	3,000
6	1,445	2,168	2,891	4,267	4,667	2,000	2,500
7	780	1,170	1,560	3,135	4,000	1,714	2,143
8	457	686	915	2,400	3,500	1,500	1,875
9	286	428	571	1,896	3,111	1,333	1,667
10	187	281	375	1,536	2,800	1,200	1,500

Note: Safety Factors Include: 3 in Shear and 3 in the washer pull through strength.

Note: Safety Factors Include: 2.5 in flexure

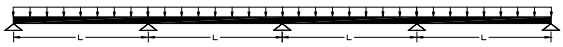


Design Charts for SuperWale™ Specified with Polyester Resin -Simply Supported, Simple Span Load Condition, Metric Units

Tierod Spacing (m)	Load on the wale that produces 6.35 mm deflection (kN/m)	Load on the wale that produces 9.52 mm deflection (kN/m)	Load on the wale that produces 12.70 mm deflection (kN/m)	Allowable Load per foot of wale (Flexural) (kN/m)	Allowable Load per foot of wale (Shear) (kN/m)	Tie-rod Pull Force Allowable Load per meter of wale (kN/m) utilizing a 82x152x12.7 mm steel washer	Tie-rod Pull Force Allowable Load per meter of wale (kN/m) utilizing a 82x305x19 mm steel washer
0.91	338	506	675	249	136	58	73
1.22	107	160	214	140	102	44	55
1.52	44	66	87	90	82	35	44
1.83	21	32	42	62	68	29	36
2.13	11	17	23	46	58	25	31
2.44	7	10	13	35	51	22	27
2.74	4	6	8	28	45	19	24
3.05	3	4	5	22	41	18	22

Note: Safety Factors Include: 3 in Shear and 3 in the washer pull through strength.

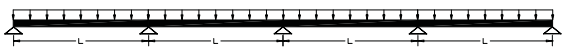
Note: Safety Factors Include: 2.5 in flexure



Design Charts for SuperWale™ Specified with Polyester Resin -Simply Supported, Continuous Span Load Condition, Imperial Units

Tierod Spacing (ft.)	Load on the wale that produces 0.25" deflection (lbs./ft)	Load on the wale that produces 0.375" deflection (lbs./ft)	Load on the wale that produces 0.5" deflection (lbs./ft)	Allowable Load per foot of wale (Shear) (lbs/ft.)	Tie-rod Pull Force Allowable Load per foot of wale (lbs/ft.) utilizing a 3.25"x6.0"x.50" steel washer	Tie-rod Pull Force Allowable Load per foot of wale (lbs/ft.) utilizing a 3.25"x12"x.75" steel washer
3	46,256	69,384	92,511	7,688	4,000	5,000
4	14,636	21,953	29,271	5,766	3,000	3,750
5	5,995	8,992	11,989	4,613	2,400	3,000
6	2,891	4,336	5,782	3,844	2,000	2,500
7	1,560	2,341	3,121	3,295	1,714	2,143
8	915	1,372	1,829	2,883	1,500	1,875
9	571	857	1,142	2,563	1,333	1,667
10	375	562	749	2,306	1,200	1,500

Note: Safety Factors Include: 3 in Shear and 3 in the washer pull through strength.



Design Charts for SuperWale™ Specified with Polyester Resin -Simply Supported, Continuous Span Load Condition, Metric Units

Tierod Spacing (m)	Load on the wale that produces 6.35 mm deflection (kN/m)	Load on the wale that produces 9.52 mm deflection (kN/m)	Load on the wale that produces 12.70 mm deflection (kN/m)	Allowable Load per foot of wale (Shear) (kN/m)	Tie-rod Pull Force Allowable Load per meter of wale (kN/m) utilizing a 82x152x12.7 mm steel washer	Tie-rod Pull Force Allowable Load per meter of wale (kN/m) utilizing a 82x305x19 mm steel washer
0.91	675	1,013	1,350	112	58	73
1.22	214	320	427	84	44	55
1.52	87	131	175	67	35	44
1.83	42	63	84	56	29	36
2.13	23	34	46	48	25	31
2.44	13	20	27	42	22	27
2.74	8	13	17	37	19	24
3.05	5	8	11	34	18	22

Note: Safety Factors Include: 3 in Shear and 3 in the washer pull through strength.

Vinyl Ester Load Tables

Design Charts for SuperWale™ Specified with Vinyl Ester Resin -Simply Supported, Simple Span Load Condition, Imperial Units

Tierod Spacing (L) (ft.)	*Load on the wale that produces 0.25" deflection (lbs./ft)*	*Load on the wale that produces 0.375" deflection (lbs./ft)*	*Load on the wale that produces 0.5" deflection (lbs./ft)*	*Allowable Load per foot of wale (Flexural) (lbs/ft.)*	*Allowable Load per foot of wale (Shear) (lbs/ft.)*	*Tie-rod Pull Force Allowable Load per foot of wale (lbs/ft.) utilizing a 3.25"x6.0"x.50" steel washer*	*Tie-rod Pull Force Allowable Load per foot of wale (lbs/ft.) utilizing a 3.25"x12"x.75" steel washer*
3	9,333	9,333	9,333	17,067	9,333	5,000	6,667
4	6,505	7,000	7,000	9,600	7,000	3,750	5,000
5	2,664	3,996	5,329	6,144	5,600	3,000	4,000
6	1,285	1,927	2,570	4,267	4,667	2,500	3,333
7	694	1,040	1,387	3,135	4,000	2,143	2,857
8	407	610	813	2,400	3,500	1,875	2,500
9	286	428	571	1,896	3,111	1,667	2,222
10	187	281	375	1,536	2,800	1,500	2,000

Note: Safety Factors Include: 3 in Shear and 3 in the washer pull through strength.
Note: Safety Factors Include: 2.5 in flexure

Design Charts for SuperWale™ Specified with Vinyl Ester Resin -Simply Supported, Simple Span Load Condition, Metric Units

Tierod Spacing (L) (m)	*Load on the wale that produces 6.35 mm deflection (kN/m)*	*Load on the wale that produces 9.52 mm deflection (kN/m)*	*Load on the wale that produces 12.70 mm deflection (kN/m)*	*Allowable Load per meter of wale (Flexural) (kN/m)*	*Allowable Load per meter of wale (Shear) (kN/m)*	*Tie-rod Pull Force Allowable Load per meter of wale (kN/m) utilizing a 82x152x12.7 mm steel washer*	*Tie-rod Pull Force Allowable Load per meter of wale (kN/m) utilizing a 82x305x19 mm steel washer*
0.91	136.2	136.2	136.2	249.1	136.2	73.0	97.3
1.22	94.9	102.2	102.2	140.1	102.2	54.7	73.0
1.52	38.9	58.3	77.8	89.7	81.7	43.8	58.4
1.83	18.8	28.1	37.5	62.3	68.1	36.5	48.6
2.13	10.1	15.2	20.2	45.7	58.4	31.3	41.7
2.44	5.9	8.9	11.9	35.0	51.1	27.4	36.5
2.74	4.2	6.3	8.3	27.7	45.4	24.3	32.4
3.05	2.7	4.1	5.5	22.4	40.9	21.9	29.2

Note: Safety Factors Include: 3 in Shear and 3 in the washer pull through strength.
Note: Safety Factors Include: 2.5 in flexure

Design Charts for SuperWale™ Specified with Vinyl Ester Resin -Simply Supported, Continuous Span Load Condition, Imperial Units

Tierod Spacing (ft.)	*Load on the wale that produces 0.25" deflection (lbs./ft)*	*Load on the wale that produces 0.375" deflection (lbs./ft)*	*Load on the wale that produces 0.5" deflection (lbs./ft)*	*Allowable Load per foot of wale (Shear) (lbs/ft.)*	*Tie-rod Pull Force Allowable Load per foot of wale (lbs/ft.) utilizing a 3.25"x6.0"x.50" steel washer*	*Tie-rod Pull Force Allowable Load per foot of wale (lbs/ft.) utilizing a 3.25"x12"x.75" steel washer*
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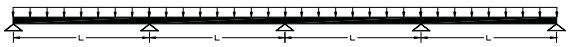

Design Charts for SuperWale™ Specified with Vinyl Ester Resin -Simply Supported, Continuous Span Load Condition, Metric Units

Tierod Spacing (m)	*Load on the wale that produces 6.35 mm deflection (kN/m)*	*Load on the wale that produces 9.52 mm deflection (kN/m)*	*Load on the wale that produces 12.70 mm deflection (kN/m)*	*Allowable Load per foot of wale (Shear) (kN/m)*	*Tie-rod Pull Force Allowable Load per meter of wale (kN/m) utilizing a 82x152x12.7 mm steel washer*	*Tie-rod Pull Force Allowable Load per meter of wale (kN/m) utilizing a 82x305x19 mm steel washer*
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1.22	214	320	427	84	55	73
1.52	87	131	175	67	44	58
1.83	42	63	84	56	36	49
2.13	23	34	46	48	31	42
2.44	13	20	27	42	27	36
2.74	8	13	17	37	24	32
3.66	3	4	6	25	18	24

Note: Safety Factors Include: 3 in Shear and 3 in the washer pull through strength.

Design and Testing Information

The SuperWale™ was tested in a full section scenario, in independent labs, to determine the full section modulus of elasticity, moment capacity, shear capacity and tie rod punch through strength.

Moment Capacity

The ultimate moment capacity of the wale was determined by calculating the moment at a maximum flexural stress of 40,000 psi. The moment capacity was then verified by several full section tests configured in a three-point bend scenario.

The calculated ultimate moment capacity was determined to be 48,000 ft-lbs. The allowable moment is the ultimate moment divided by a 2.5 safety factor. Therefore, the allowable moment is 19,200 ft-lbs.

The 48,000 ft-lb. calculated ultimate moment was verified through full section testing. Several wale sections were loaded in a 3-point bend at a span of 11'-6" until failure. The average failure load was 26,025 lbs. The corresponding moment was determined to be 74,821 ft-lbs. The actual safety factor, when comparing the ultimate moment capacity to the allowable design moment capacity was determined to be 3.89.

Shear Capacity of the SuperWale™

The ultimate shear capacity was determined by the utilization of the following shear equation:

$$\tau_{xy} = \frac{3}{2}\frac{V}{A_w}$$

Where,

τ_{xy} = 9,000 psi, Shear Stress (psi)

V = Shear Load (lbs.)

A_w = 6.0 in^2, Area of the web (in^2)

The ultimate shear load V was calculated to be 36,000 lbs. A safety factor of 3 was applied to the shear load. Therefore, the allowable shear load is 12,000 lbs.

Several full section tests were performed on the SuperWale™ to verify the shear capacity. The tests conducted concluded that punch through occurred prior to the wale failing in shear.

Tie-Rod Capacity

The tie-rod capacity is subject to the tie-rod connection detail. The washer size greatly influences the capacity of the Superwale system. Punch through tests have been conducted on the Superwale section with various washer configurations.

The test involved drilling a 1.25" diameter hole in the middle of the wale section and inserting an FRP nut and stud through the hole in the washer as depicted in Figure 1. Various washer sizes were tested to determine the appropriate washer dimensions.

Figure 1. Photo of the Tie-rod push through test conducted in CPI Lab.

A load was then induced onto the nut utilizing an INSTRON testing machine. The load and deflection was recorded until a failure occurred. Failure was defined as perminant distortion or when audible/visual cracking was detected.

The following chart reflects the allowable tie-rod force with various washers. CPI only recommends the washer dimensions specified below. Alternative washer dimensions are only to be used at the discretion of the practicing engineer.

Allowable Tie-rod Force on SuperWale™ with Specificied Steel Washers		
Allowable Tie-rod Force with Vinyl Ester Resin Specified in SuperWale™ lbs (kg)	**Allowable Tie-rod Force with Polyester Ester Resin Specified in SuperWale™ lbs (kg)**	**Steel Washer Dimensions inches (mm)**
15,000 (6,803)	12,000 (5,443)	3.25x6x.5 (82x152x12.7)
20,000 (9,072)	15,000 (6,803)	3.25x12x.75 (82x152x19)

Fabrication

The Superwale can be cut and drilled with standard construction tools. Specifically, a concrete saw should be utilized to field cut the wale section. A standard carbide steel drill bit should be used to drill holes in the Superwale. A wood bit is not recommended!

General Safety

It is recommended to wear a dust mask and safety glasses when cutting the composite materials. Fiberglass dust can be irritating to the eyes and the skin. The dust and drops are inert and can be land filled. For a complete MSDS please consult Creative Pultrusions, Inc.

SuperWale™ Accessories

SuperWale™ W-Splice

Part No.: FAB095
Material: 50 ksi structural steel galvanized per ASTM A123
Dimension: 12L x 8.4W (305x213) in(mm), Hole Diameter 1.125 (29)
Weight: 11 lbs. (5 kg)

Engineering Notes
1. Tie-rod must be backed with a 3.25x3.25x.25 (83x83x6) in(mm) steel washer.
2. A tie rod should be utilized with each splice.
3. The working load capacity of the wale splice is 20,000 lbs., which includes a service factor.

SuperWale™ W-Corner Connector

Part No.: 90° Connector FAB093
45° Connector FAB094
Note: Special angles are available upon request; however, a 2-week lead time applies.
Material: 316 Stainless Steel; Therefore, parts can be factory or field welded.
Dimension: Both sides 12L x 8.4W (304.8x 213.4) in(mm), Hole Diameter drilled at 13/16" (20.64) for a .75x4.5 (19.05x114.3) in(mm) bolt.
Weight: 23 lbs. (10 kg)

SuperWale™ Steel Washers

Part No.: FAB384 3.25x6x.5 (82x152x12.7) in(mm)
FAB385 3.25x12x.75 (82x152x19) in(mm)
Material: 50 ksi steel, galvanized per ASTM A123
Dimension: Hole diameter 1.125 (28.58) in(mm)
Weight: FAB384 2.75 lbs each
FAB385 8.35 lbs each

FOR MORE DETAILS ON THE SUPERLOC™ SHEET PILE SYSTEM AND SUPERWALE™ CONTACT:

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