PlastiSpan™ Flotation Billets

Buoyancy Systems:
Selection, Application and Specification

Plasti-Fab PlastiSpan flotation billets are produced using expanded polystyrene with extra attention paid to water absorption and flexural strength properties. PlastiSpan flotation billets are produced in a standard size, with special sizes available for custom floating structures or boats.

Advantages of PlastiSpan flotation billets:

- PlastiSpan flotation billets are suitable for fresh or salt water and are unaffected by winter temperatures. Proper design methods for flotation devices exposed to winter weather should be employed to prevent or minimize mechanical damage caused by ice movement by extending skirt boards below water line.
- PlastiSpan flotation billets support 881 kg/m^3 (55 lb/ft^3) with a margin of safety, whereas wood, which is 20 to 40 times heavier depending on type, will support only one-third to one-half of this weight.
- PlastiSpan flotation billets provide low installation and maintenance costs, and is lightweight and easy to work with using conventional tools.
- PlastiSpan flotation billets provide no food value for marine animals. Growth of marine life on PlastiSpan flotation billets may occur in stagnant water, however, any topical growth will not impair the buoyancy of the billet and the growth can be removed with a wooden scraper. Where marine animals may chew out a space for a nest and cause settling, wrap the billets in 6 mm or 10 mm (1/4" or 3/8") non-corroding wire mesh or construct the floating structure so that billets are placed right against the boards or against each other.
- Floating structures utilizing properly placed flotation billets exhibit excellent rebound characteristics with minimum rocking. PlastiSpan billets provide less resistance to breaking waves and are quieter than other types of flotation devices (e.g. drum floats).
- Damage to a billet is confined to a specific area and is non-progressive; each of the foam cells which makeup the foam structure acts as separate flotation compartments.

Toughide Flotation Billets (Gasoline Resistant)

Toughide flotation billets consist of a PlastiSpan billet factory coated with 10 mm (3/8") thickness of a tough, hard polyurethane foam. Toughide billets are resistant to abrasion and intermittent exposure to gasoline. Take care not to crack the coating when tightening fasteners through the billets.

Other Finishes

On request Plasti-Fab can coat PlastiSpan flotation billets with a number of other elastomeric finishes which can provide gasoline resistance or other properties to the billet.

Caution

PlastiSpan flotation billets are subject to damage by gasoline or other petroleum solvents. Where gasoline spills are expected, cover PlastiSpan billets with galvanized iron, aluminum, plywood or other suitable cover to below the water line. Skirt boards properly installed to below the water line will protect the billet from random gasoline spills floating in the water. As an alternate, substitute Toughide flotation billets.

PlastiSpan flotation billets and Toughide flotation billets are combustible; this is not a concern in floating structures but during construction, normal fire precautions should be observed. Avoid open flames, welding torches and high intensity lamps. Fire extinguishers using water foam, carbon dioxide or dry chemicals are all effective.

Design Data

Billet Type	Size mm (in)	Weight kg (lb)	Volume m^3 (ft^3)	Buoyancy Force kg (lb)
PlastiSpan Flotation Billet	175 x 500 x 2400 (7 x 20 x 96)	3.5 (7.8)	0.22 (7.77)	195 (430)
	250 x 500 x 2400 (10 x 20 x 96)	5.0 (11.1)	0.32 (11.11)	285 (630)
	250 x 600 x 2400 (10 x 24 x 96)	6.0 (13.3)	0.38 (13.33)	335 (740)
	300 x 500 x 2400 (12 x 20 x 96)	6.0 (13.3)	0.38 (13.33)	335 (740)
	300 x 600 x 2400 (12 x 24 x 96)	7.3 (16.0)	0.45 (16.00)	395 (880)
	550 x 600 x 2400 (22 x 48 x 96)	26.6 (58.7)	1.66 (58.67)	1465 (3230)
PlastiSpan Toughide Flotation Billet	300 x 500 x 2400 (12 x 20 x 96)	6.0 (13.3)	0.38 (13.33)	335 (740)
	300 x 600 x 2400 (12 x 24 x 96)	7.3 (16.0)	0.45 (16.00)	395 (880)
	550 x 600 x 2400 (22 x 48 x 96)	29.02 (64.0)	1.81 (64.00)	1595 (3515)

Custom sizes are available in both types of billets.

Design Data

General

Use a minimum of two billets in free-floating structures for stability. Install billets flat with longer side horizontal and as close to outside edges as possible.

Leave wide spaces between billets to permit waves to roll through with minimum effect on the structure. When floating debris or gasoline on the surface of the water is to be expected, install a skirt board around the entire floating structure. The skirt board should extend into the water when there is no live load on the structure.

Buoyancy Calculations

Several pieces of information are required.

1. Live Load – The maximum weight expected on the structure calculated based upon the number of people – using an average of 80 kg (175 lbs) per person – plus estimate weights for any motors, equipment etc. expected on the structure. Use the total load in calculating raft requirements or the average load per lineal foot (perimeter) for docks.
2. Safety Factor – A percentage of the live load is added as a safety factor. A factor of 25% is often used. A high safety factor will cause the structure to ride high when not loaded. Unless the depth of skirt boards has been designed to take this into account, the boards may clear the water exposing the billet to erosion by ice, debris or floating gasoline.
3. Dead Load – The weight of the structure above the design waterline. The weights of the wood in the structure can be calculated from the table on page 3. In rafts the total load is calculated; in docks the load per lineal foot (meter) is used.
4. Buoyancy of Structure – The buoyancy of any lumber below the waterline can be calculated from the table on page 3.

When the above have been calculated the values obtained are used in the following formula:

Flotation Required = Live Load + Safety Factor + Dead Load – Buoyancy of Structure

For rafts the resulting figure will be the total flotation required. Choose an even number of billets to permit symmetrical placement on sides or in corners for maximum stability.

For docks the resulting figure will be the flotation required per lineal foot (meter) of dock. Choose two billets of the same size – one for each side of dock. Calculate the combined buoyancy of the two billets and use in the following formula:

$$\text{Dock Length supported by pair of billets} = \frac{\text{Buoyancy of pair of billets}}{\text{Flotation required per lineal foot (meter)}}$$

The result gives the centre to centre spacing of the billets down the length of the dock. If the distance calculated is less than 2.4 m (8 ft.), select a larger billet and re-calculate. Custom sized billets can be ordered.

Example

Live Load = 2 people per 1.5 metres of dock @ 80 kg per person	=	160 kg
Outboard motor at 95 kg per linear metre of dock	=	95 kg
Total Live Load		255 kg
Live Load per linear metre of dock	=	170.0 kg/m
Safety Factor = Use 25% (selected by designer) = 170 x 0.25	=	42.5
Dead Load: Dock constructed using Red Cedar Lumber (weight of lumber above water line using values from tables on page 3)	=	26.8 kg/m
Buoyancy of structure (buoyancy of lumber below water line)	=	13.4 kg/m
Flotation Required = 170.0 + 42.5 + 26.8 - 13.4	=	225.9 kg/m
Select two 300 x 500 x 2400 mm billets – combined buoyancy = 335 x 2	=	670 kg
Substituting in the above values into the above formula = 670 ÷ 225.9	=	2.96 m

Use 300 x 500 x 2400 mm PlastiSpan billets at 3 metres on centre along the whole length of the dock on each side. For example, for a 30 metre long dock, 20 billets (10 each side) will be required.

Boats

Calculate live and dead weights separately. Dead weight should include the boat, its gear, motor and battery.

For aluminum boats and motors divide 2/3 of the dead weight in kilograms by 881 to obtain cubic meters of foam required (or divide 2/3 of dead weight in pounds by 55 to obtain cubic feet of foam required).

For steel boats use 9/10 of total weight and for polyester-fibreglass use 1/2 of the total weight. Wood boats require only enough foam for the live load. The wood will support itself, motor and gear.

For live weight, allow 0.014 cubic metre (1/2 cubic foot) of foam for each person the boat is allowed to carry.

Wood Framing

Cedar lumber can be used without preservative treatment. All other types of lumber should be treated with pentachlorophenol preservative. Use commercially treated wood or apply treatment at the jobsite after all cutting but before assembly.

Make sure that lumber treated with preservative is cured before the lumber is in contact with PlastiSpan flotation billets.

Weight and Buoyancy Force of Lumber

Lumber Size mm (in)	Western Red Cedar		Douglas Fir	
	Weight kg/m (lb/ft)	Buoyancy kg/m (lb/ft)	Weight kg/m (lb/ft)	Buoyancy kg/m (lb/ft)
38 x 89 (2 x 4)	1.31 (0.88)	1.62 (1.09)	1.95 (1.31)	1.09 (0.73)
38 x 140 (2 x 6)	2.05 (1.38)	2.56 (1.72)	3.07 (2.06)	1.71 (1.15)
38 x 191 (2 x 8)	2.80 (1.88)	3.48 (2.34)	4.18 (2.81)	2.32 (1.56)
38 x 241 (2 x 10)	3.54 (2.38)	4.42 (2.97)	5.30 (3.56)	2.95 (1.98)
38 x 292 (2 x 12)	4.29 (2.88)	5.34 (3.59)	6.41 (4.31)	3.57 (2.40)
19 x 89 (1 x 4)	0.65 (0.44)	0.80 (0.54)	0.97 (0.65)	0.54 (0.36)
19 x 140 (1 x 6)	1.03 (0.69)	1.28 (0.86)	1.53 (1.03)	0.85 (0.57)
19 x 191 (1 x 8)	1.40 (0.94)	1.74 (1.17)	2.08 (1.40)	1.16 (0.78)
89 x 89 (4 x 4)	3.04 (2.04)	3.79 (2.55)	4.55 (3.06)	2.53 (1.70)
kg/m^3 lb/ft^3	385 24	481 30	577 36	321 20

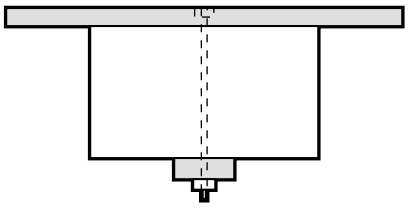
Design Data

General Installation Instructions

Billet Attachment

Fasten billets by one of the methods shown (listed in order of preference).

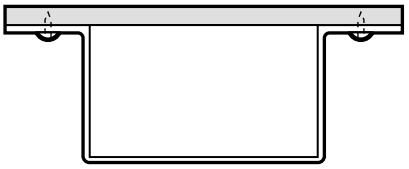
1. **Bolts** – Raise structure and block at a height that will permit flotation billets to be placed. Leave sufficient clearance for placing 38 mm x 140 mm (2" x 6") sleepers under billets and for tightening nuts on bolt fasteners. After placing a billet and a sleeper, drill a hole through the structure, the billet and the sleeper. Place 13 mm (1/2") or 15 mm (5/8") diameter galvanized bolt through the hole, assemble washer and nut and tighten. Use two bolts per 2400 mm (96") billet.



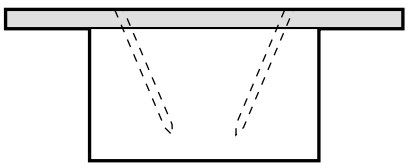
2. **Straps** – Fasten billets to structure with two non-corroding straps per billet. Note that it will be necessary to leave space between edge framing and billet to permit fastening of strapping.

   Use straps that are at least 38 mm (1-1/2") wide. Place strapping over billet and fasten securely into place with non-corroding fasteners.

   Plastic straps and plastic webbing have been used as satisfactory strapping materials, although stainless steel and brass are also used.



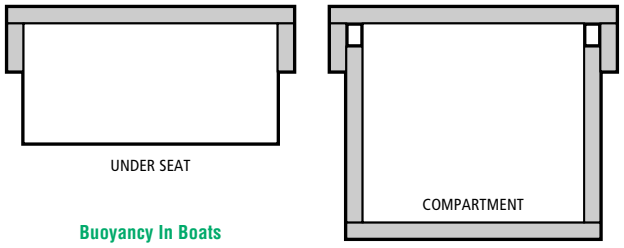
3. **Dowels** – Lay structure on billets in proper location. Drill 16 mm (5/8") diameter holes at angles through structure, then drive 16 mm x 300 mm (5/8" x 12") fir dowels through holes into billets at a 30° angle. Though this is the most economical fastening method, in rough water dowels can work loose. Use two dowels through each crosspiece at 600 mm (24") centres.



Boats

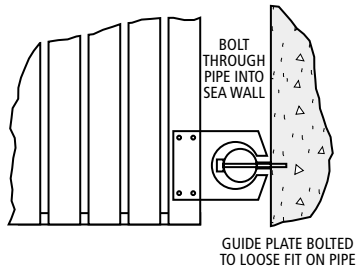
Place foam as high as possible in the boat to keep the boat upright if it is swamped and to keep it clear of oil or gasoline in the bilge water.

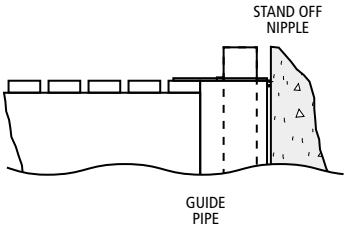
Mechanically fasten foam under seats and under the forward deck, as well as in the stern to balance the weight of the motor. In boats with rib construction, place foam upright between the ribs.



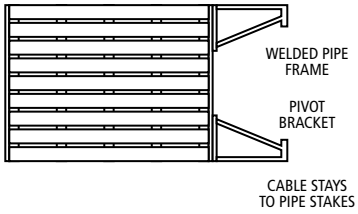
Buoyancy In Boats

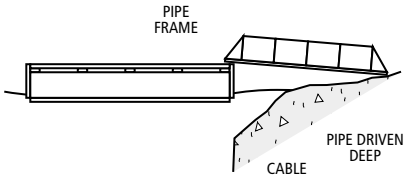
Anchoring Systems



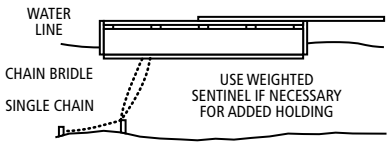


Tidal Float to Sea Wall



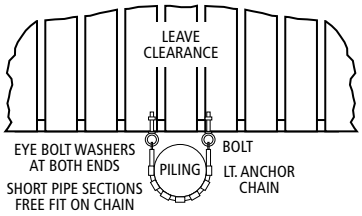


Float to Beach



Float to Bottom

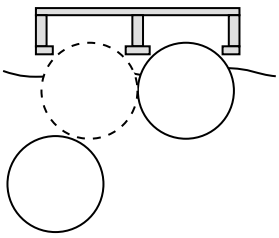
THIS TYPE OF ANCHORING CAN DRAG WITH WAVE ACTION. ITS LIMITED MOVEMENT MAKES IT UNSUITABLE FOR TIDAL WATERS.



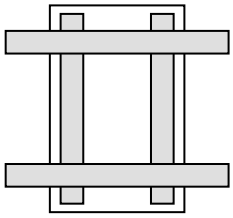
Tidal Float to Piling

THIS IS AN EXCELLENT METHOD FOR LONG DOCKS.

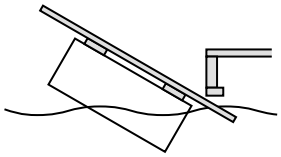
Replacement of Drum Floats



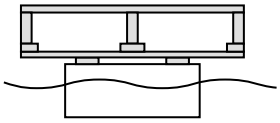
1. Puncture existing drums and allow them to sink for removal; remove two at a time.



2. Build a crib of 2" x 8" (38 mm x 190 mm) lumber and fasten it to the PlastiSpan billets. Cross members should be longer than width of wharf.



3. Tilt crib; push under wharf using the cross members as handles.



4. Centre under wharf and secure with 3–1/2" (90 mm) galvanized nails. Saw off protruding ends of cross members.

BSAS – 0406

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