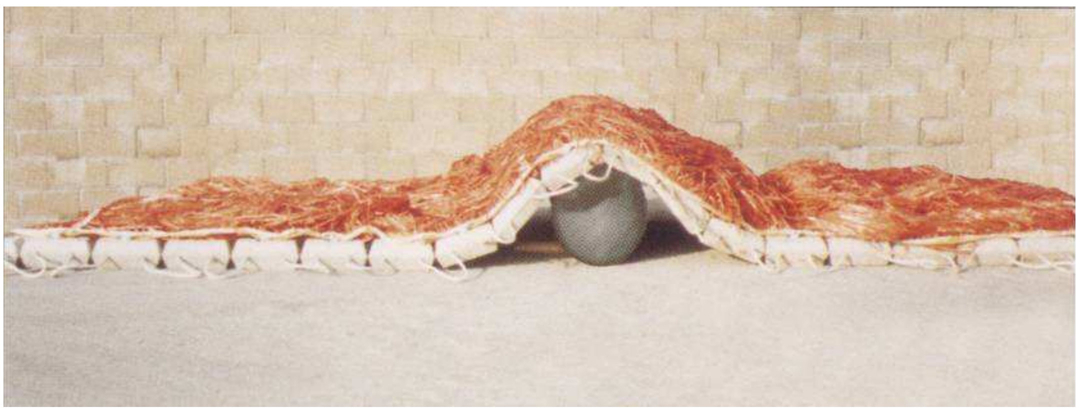
# FROND FLEXIFORM CONCRETE MATTRESS

The **"Frond Flexiform"** Mattress, is a combined buoyant frond scour mat and flexible concrete mattress available in several standard variants, all have the same continuous and significantly overlapping parallel lines of buoyant fibrillated polypropylene fronds attached to and aligned with, the lines of the concrete blocks.

No steel members (nor any other metals) are used in the blocks – this avoids dissimilar metal corrosion problems that have arisen in the offshore oil and gas industry from the use of slag in rock dumps. The Frond Line attachment points are moulded into the concrete base blocks.



**FROND FLEXIFORM CONCRETE MATTRESS**

The **"Frond Flexiform"** Mattress combines all the features of both a flexible concrete mattress and a buoyant frond scour control mat in one: and in particular it offers the following benefits:

- installation is simple and swift, and it provides both instant stabilisation / protection with immediate hold down;
- the creation of long term fibre reinforced, consolidated and vibration compacted sediment bank build up over the mattress substantially adds to the degree of protection afforded and provides an exceptional reduction in scour potential close to structures;
- it provides scour protection for an area somewhat greater than the actual area covered by the mattress:
- the individually profiled concrete segments provide a high degree of flexibility in two planes and allow for a complete stabilisation / protection of subsea structures and pipelines and offer a linked flexible foundation to ensure that load is spread evenly over an area; and
- the fronds prevent edge scour and also halt internecine block (or rock) scour, this eliminates any requirement for the use of geotextile filter screens under a Frond Flexiform mattress.

The submerged weight of the mattress on first installation will increase as the scour control system creates a fibre-reinforced bank over the base mattress. The rate of build up and size of such bank varies from site to site.

The build up of the material bank within the Frond Flexiform mattress is non-linear. The 1.25m high fronds create the greatest viscous drag when first deployed and the initial 200mm to 300mm of mat/mattress infill occurs quickly in normal tidal conditions given the sort of sediment sizes at most offshore sites. As the material bank forms, the exposed frond length is reduced, the mat creates less viscous drag and the rate of formation of the material bank slows until a steady state is reached.

The sediment bank created is considerably more stable and more dense than the natural surrounding seabed: many surveys have confirmed that it is considerably consolidated by the vibratory movement of fronds during the sedimentary period and once in place it is permanently reinforced by the frond material.

Any sediment bank so formed extends out from the frond area to cover the sides of the base mattress extending out in descending curve to seabed level for a distance slightly greater that the height of the formed bank – the final shape of such a "curve" depends upon the coefficient of friction of the seabed particles.

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**SEDIMENT BANK PROJECTION**

For offshore sites after some 20 to 45 days a significant, compacted and solid sediment bed will be in place and a height of not less than 450mm is normal; the final height of bank with a frond height of 1,250mm should should safely exceed 900mm in height after some 40 to 75 days. The formation of such a sediment bank over the Mattress provides submerged weigh or “hold down”. A typical submerged weight of sand particles is 819.5kg/m$^3$, but the range is large thus the submerged weight of the fibre reinforced material bank can vary. For a 5.0m x 3.0m Frond area this should be:

- after 20 days: in the range 6.67 tonnes to 5.5 tonnes – this is additional to the base mattress' concrete block weight (with 150mm base blocks = 2.28t submerged weight and with 300mm base blocks =4.18t submerged weight).
- after 40 to 75 days: in the range 15.0 tonnes 11.08 tonnes + base mattress' concrete block submerged weight.

**BUOYANT FROND MATERIAL**

UV stabilised Polypropylene. Fully tested “ Chemically Resistant”. Specific gravity 0.908 and 0.92. Full fibrillated and with profiled film.

**FROND LENGTH & ATTACHMENT**

Buoyant Fronds are attached to Mattress in successive continuous rows providing substantial and unbroken overlap of fronds to those in the neighbouring rows. Frond clumps are NEVER used. Frond Length (height when deployed) of the lines of buoyant frond material is 1250mm. In riverine (and other special situations) lesser frond heights allied to a proportionate increase in frond density (spacing) in the frond rows may be used. A “Safe Net” frond release is provided for diver and ROV safety.

**STANDARD BLOCK THICKNESS**

150mm, 300mm, and 450mm.

**STANDARD BLOCK DENSITY**

2.4 Tonnes / Cubic Metre. Lightweight and Heavy Density options are also available from

1.8 - 3.6 Tonnes / m$^3$.

**WEIGHTS (STANDARD DENSITY)**

| Approximately Weight / m$^2$ - at Installation | | |
|---|---|---|
| Thickness (Tonnes) | In Air (Tonnes) | Submerged (Tonnes) |
| 150mm block | 0.275 | 0.152 |
| 300mm block | 0.510 | 0.279 |
| 450mm block | 0.770 | 0.430 |

## FROND FLEXIFORM CONCRETE MATTRESS

## TECHNICAL DATA

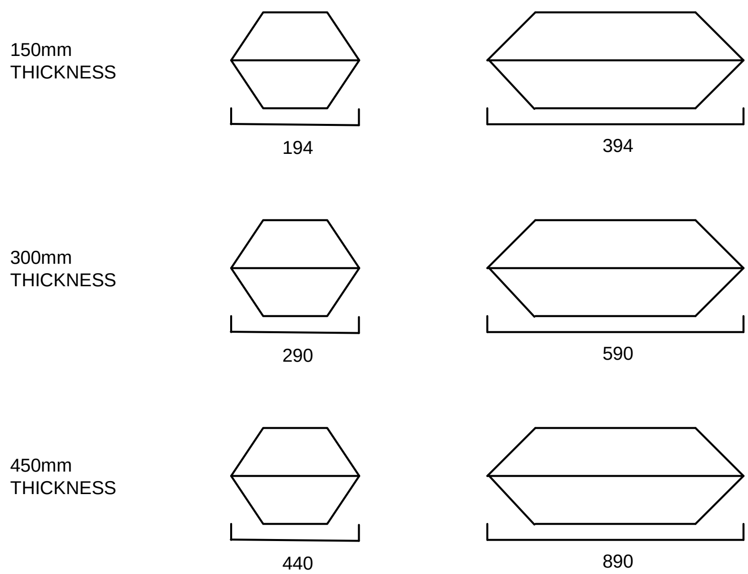
**TOTAL SUBMERGED WEIGHT**

The submerged weight will increase due to the material bank formed by the fronds: the weight of the bank varies according to the seabed composition. A typical submerged weight of sand particles is 819.5kg / m$^3$, but the range is large thus the submerged weight of the fibre reinforced material bank can vary. For a 6m x 4m mattress this should be in the range is large thus the submerged weight of the fibre reinforced material bank can vary. For a 6m x 4m mattress this should be in the range 23.9 tonnes to 19.9 tonnes - this is additional to the concrete weight which with a 150mm thick mattress at standard density would be 3.7 tonnes giving a total submerged hold down of 27.6 to 23.6 tonnes.

**STANDARD MATTRESS SIZES**

Standard mould sizes are 10m x 3m in plan area. Mattress may be manufactured in any size within mould dimensions subject to standard block sizes. For pipeline overlay either 4m or 5m width by 2, 3, 4, 6 or 10m length is preferred to provide cover 2 to 2½m either side of the pipeline as well as over & along the line in a single installation. Mattresses in excess of standard mould sizes may be manufactured to order.

**STANDARD BLOCK SIZES (N.T.S.)** MEASUREMENT IN MM




**CONCRETE DESIGN SPECIFICATION**

C40 / C50 - N / mm$^2$ @ 28 days. Conforms to the requirements of BS8110: The Structural Use of Concrete

**ADDITIONAL GROUND ANCHORS**

Additional 1 tonne ground anchors certified by ABS and Lloyd’s may be attached at corners or edges to provide the additional edge hold down to increase stability / protection capability (e.g. against trawling).

**LIFTING ARRANGEMENT**

Integral lifting loops connected to quick release frame.

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