



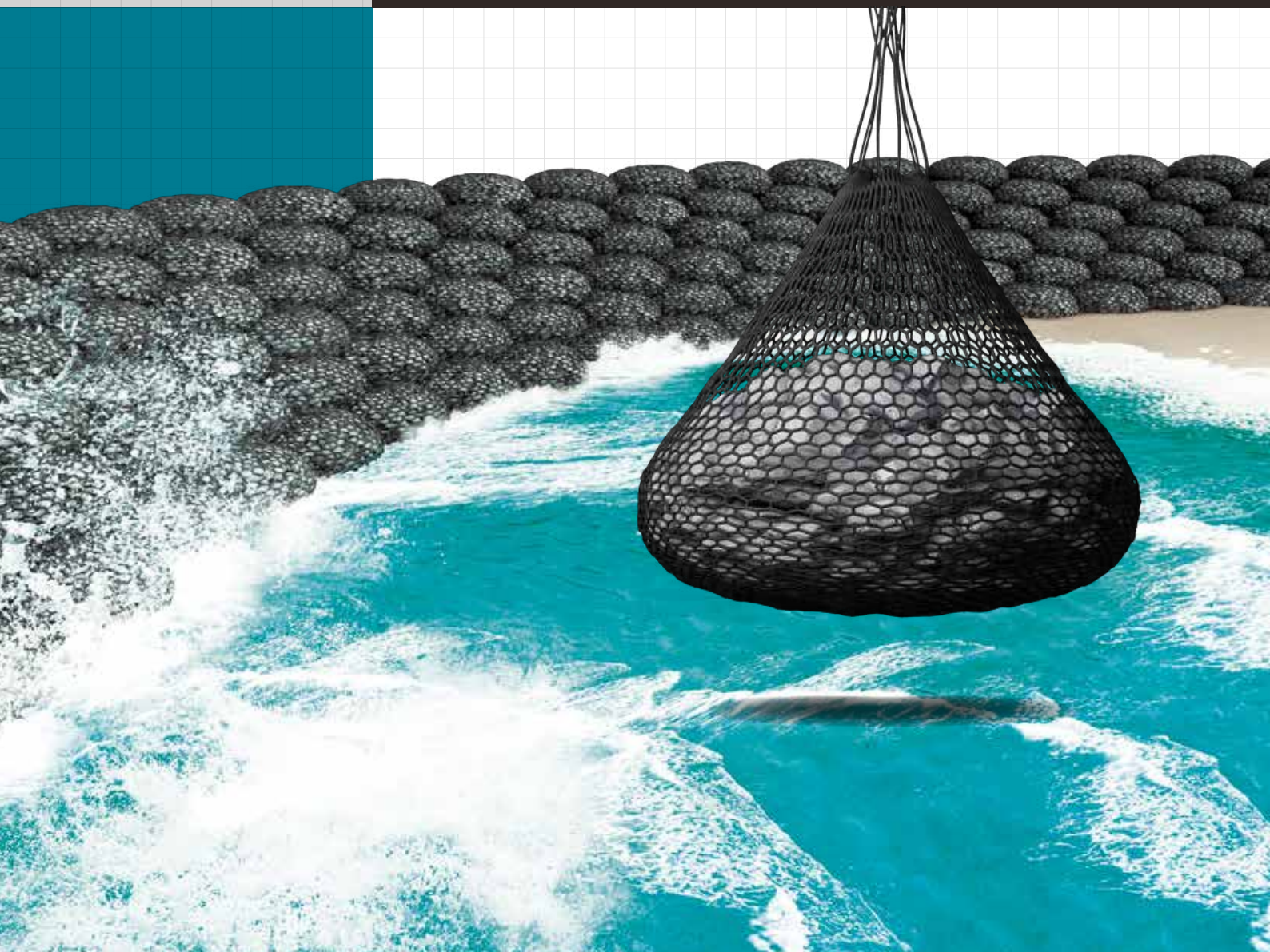
MAEDAKOSEN

Rock bag / Net bag  
for bag-type foot protection

# Powerful Unit

Examination confirmation of harbor-related commercial technology, and business evaluation technology assessment No. 18002

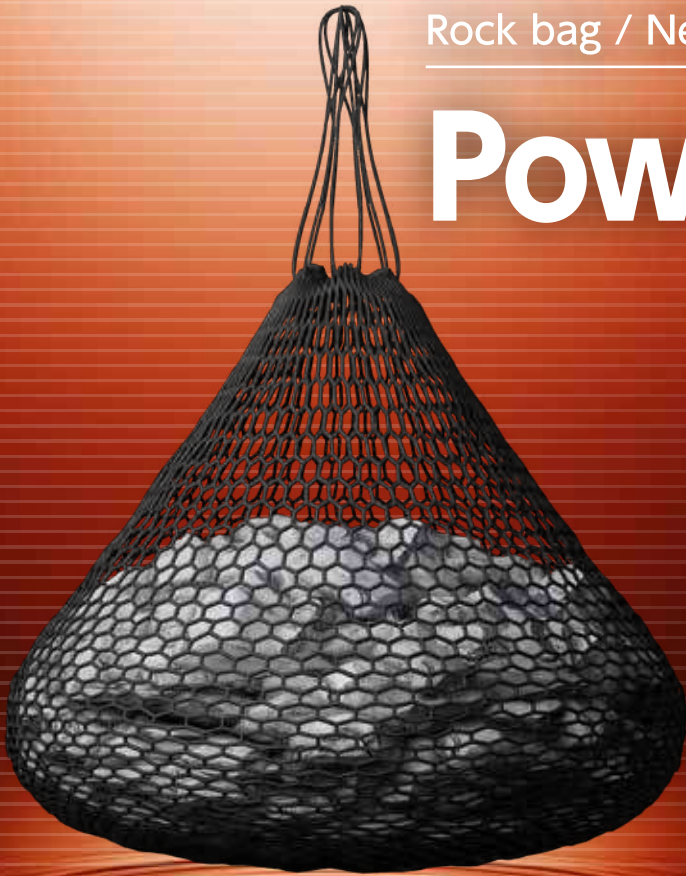
New Technology Information System (NETIS) Registration Number:CBK-120003-VE



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# Powerful Unit



Powerful Unit is a net bag material made by super-thick raschel netting utilizing polyester fibers. The product has outstanding durability due to thick raschel netting.

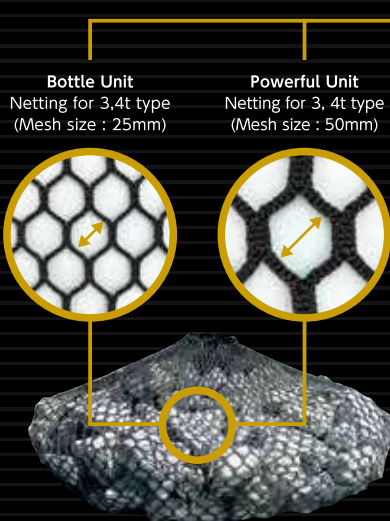
It is suitable for ocean revetment foot protection work and as a flood prevention material in emergencies such as coastal protection.

Also the product has high durability not only in coastal areas, but also in rivers where wear due to sand and gravel movement.

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## Characteristics of Powerful Unit



- Because of super-thick raschel netting, the bag material is resistant to rupture.
- All of the raw materials utilized are polyester fibers, there will be no degradation due to rusting.
- It has flexibility required for revetment foundation consolidation work, the bag shape is able to fit onto the landscape changes occurring in the bottom. In addition, the ability to fit into gaps is also maintained, which is necessary for filling work.
- During installation, since the mouth closing part (knot part) does not protrude, the bag has a shape that avoids caught up by driftwood.
- The netting mesh size is 50-75mm, which allows marine organisms easily pass in and out.
- For the filling materials, locally generated materials (such as boulders, broken stones and rag stones) and concrete chunks can be used.

## Procedure for filling



1 Setting the net on frame



2 Filling with filling material



3 Lifting off



4 Tying mouth binding rope

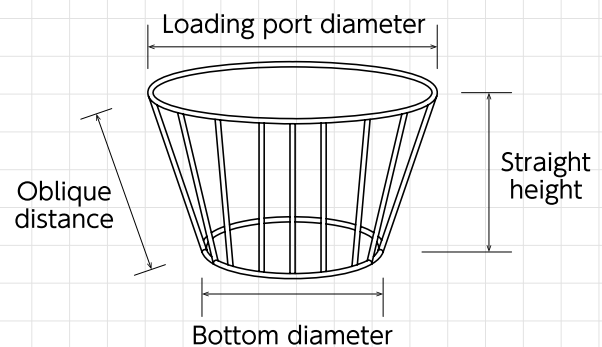


5 Lifting and moving to temporary storage



6 Placing at temporary storage

## Frame size and Powerful Unit size



| Frame type            | For 1t,2t           | For 3t,4t           | For 6t,8t           | For 12t             |
|-----------------------|---------------------|---------------------|---------------------|---------------------|
| Parts pieces          | 4                   | 4                   | 10                  | 8                   |
| Loading port diameter | 1.62 m              | 2.15 m              | 2.40 m              | 3.40 m              |
| Bottom diameter       | 1.07 m              | 1.63 m              | 1.60 m              | 2.80 m              |
| Straight height       | 0.90 m              | 0.90 m              | 1.50 m              | 1.00 m              |
| Oblique distance      | 0.94 m              | 0.94 m              | 1.55 m              | 1.04 m              |
| Weight                | 92 kg               | 140 kg              | 330 kg              | 360 kg              |
| Full capacity         | 1.33 m <sup>3</sup> | 2.57 m <sup>3</sup> | 4.90 m <sup>3</sup> | 7.62 m <sup>3</sup> |

## Product No. and standard specification

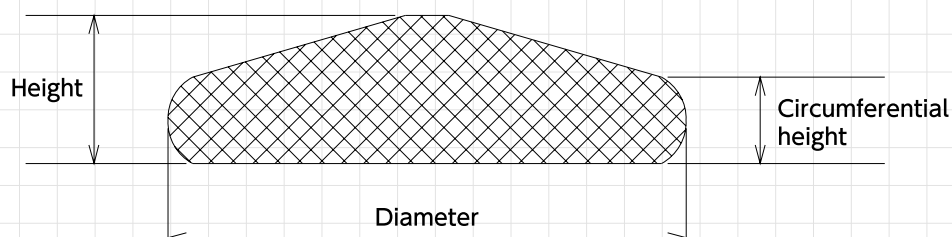
| Product No.<br>(Mass) |                             | FPU-10<br>(For 1t)   | FPU-20<br>(For 2t) | FPU-30<br>(For 3t) | FPU-40<br>(For 4t) | FPU-60<br>(For 6t) | FPU-80<br>(For 8t) | FPU-120<br>(For 12t) |                            |
|-----------------------|-----------------------------|--|--------------------|--------------------|--------------------|--------------------|--------------------|----------------------|----------------------------|
| Approximate capacity  | (m <sup>3</sup> )           | 0.5 to 0.62  | 1.0 to 1.25        | 1.5 to 1.9         | 2.0 to 2.5         | 3.0 to 3.75        | 4.0 to 5.0         | 6.0 to 7.5           |                            |
| Dimensions            | W (mm)                      | 1,800  | 2,250              | 2,600              | 2,850              | 4,000              | 4,000              | 4,500                |                            |
|                       | H (mm)                      | 1,600  | 2,150              | 2,400              | 2,650              | 2,700              | 3,000              | 3,300                |                            |
| Shape                 |                             | Single Net Bag   |                    |                    |                    |                    |                    |                      |                            |
| Netting               | Material                    | Polyester raschel net (Black spun-dyed)  |                    |                    |                    |                    |                    |                      |                            |
|                       | Composition (dtex)          | 1,670×80strands  |                    |                    |                    | 1,670×128strands   |                    | 1,670×230strands     |                            |
|                       | Mesh spacing (mm)           | 75   |                    | 50                 |                    | 50                 |                    | 70                   |                            |
|                       | Tensile strength (N/strand) | 2,700 or more  |                    |                    |                    | 4,000 or more      |                    | 7500 or more         |                            |
|                       | Tensile strain (%)          | 30 or more, and 50 or less   |                    |                    |                    |                    |                    |                      | 20 or more, and 50 or less |
| Lifting rope※1        | Tensile strength (kN)       | 12 or more   |                    | 22 or more         |                    | 46.7 or more       |                    |                      |                            |
|                       | Tensile strain (%)          | 40 or less   |                    |                    |                    |                    |                    |                      |                            |
| Mouth binding rope    | Tensile strength (kN)       | 3.5 or more  |                    |                    |                    | 12 or more         |                    |                      |                            |
|                       | Tensile strain (%)          | 40 or less   |                    |                    |                    |                    |                    |                      |                            |
| Bottom binding rope   | Tensile strength (kN)       | 12 or more   |                    |                    |                    | 22 or more         |                    |                      |                            |
|                       | Tensile strain (%)          | 40 or less   |                    |                    |                    |                    |                    |                      |                            |
| Filling material      |                             | Boulders, gravels, rubbles, concrete lumps(Sizes from 100mm up to human head size), etc. |                    |                    |                    |                    |                    |                      |                            |

\*Lifting point of FPU-10 to 80 shall be 6 points and for FPU-120 shall be 8 points.  
Binding types are also available.

## Completed shape reference table

| Product No.<br>(Mass)  |      | FPU-10<br>(For 1t) | FPU-20<br>(For 2t) | FPU-30<br>(For 3t) | FPU-40<br>(For 4t) | FPU-60<br>(For 6t) | FPU-80<br>(For 8t) | FPU-120<br>(For 12t) |
|------------------------|------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|----------------------|
| Diameter               | (mm) | 1,700              | 2,100              | 2,400              | 2,700              | 3,300              | 3,600              | 3,950                |
| Height                 | (mm) | 550                | 700                | 750                | 900                | 950                | 950                | 1,250                |
| Circumferential height | (mm) | 300                | 400                | 500                | 500                | 500                | 500                | 550                  |

The completed shape dimensions described above are reference values in the case where the filling materials used are broken stones between 150 to 250mm in size. Because the stone size, specific gravity, and grain size will differ according to the site, the diameter and height will also change. Additionally, in the case where the bags are placed in layers, because it can be expected that the heights in the table will become lower due to the weight and the method of placing the bags in layers, adjustments will be required at each site.



## Calculation of required mass

The required mass of Powerful Unit is calculated using the formulas shown in (1) to (3) below. The constants (KD value, NS value, Isbash value) required for calculation are obtained by hydraulic model experiments in Kyoto University Disaster Prevention Research Institute.

\*Natural Disaster Science *J.JSNDS 32-P91-102* (2013)  
 JSCE Proceedings B3 (Ocean Development) Vol.70, No.2, 1\_247-1\_252, 2014.

### ① Required mass of slope covering material : Hudson method

$$M = \frac{\rho\gamma H^3}{K_D(S\gamma - 1)^3 \cot\alpha}$$

M : Required mass of structure (t)

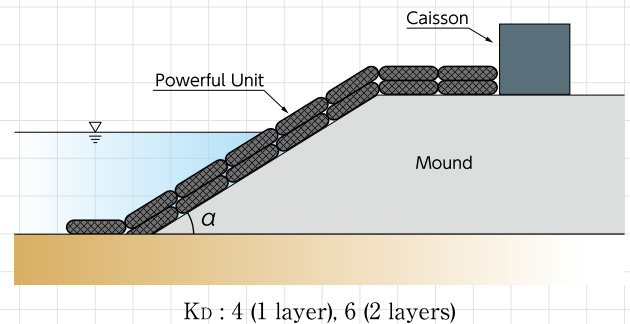
$\rho\gamma$  : Density of structure (t/m<sup>3</sup>)

H : Wave height (m) used for stability calculation

S $\gamma$  : Specific gravity of the structure with respect to water

$\alpha$  : Angle (°) that the slope forms with the horizontal plane

K<sub>D</sub> : The constant value obtained from the shape of structure and the damage rate.



### ② Required mass of slope covering material : Hudson method by stability number Ns

$$M = \frac{\rho\gamma H^3}{N_s^3(S\gamma - 1)^3}$$

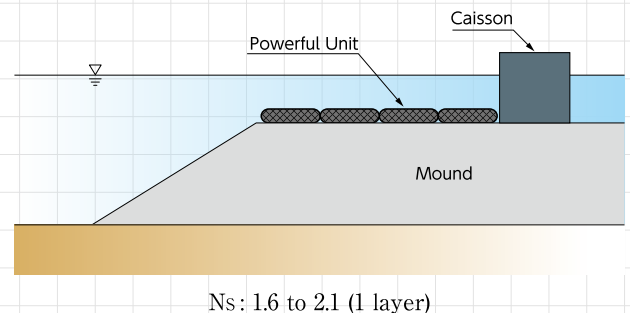
M : Required mass of structure (t)

$\rho\gamma$  : Density of structure (t/m<sup>3</sup>)

H : Wave height (m) used for stability calculation

S $\gamma$  : Specific gravity of the structure with respect to water

N<sub>s</sub> : Constant determined mainly by the shape of the structure and the damage rate, etc.



### ③ Required mass of slope covering material : Isbash value

$$M = \frac{\pi \rho\gamma U^6}{48g^3 y^6 (S\gamma - 1)^3 (\cos\theta - \sin\theta)^3}$$

M : Required mass of structure (t)

$\rho\gamma$  : Density of structure (t/m<sup>3</sup>)

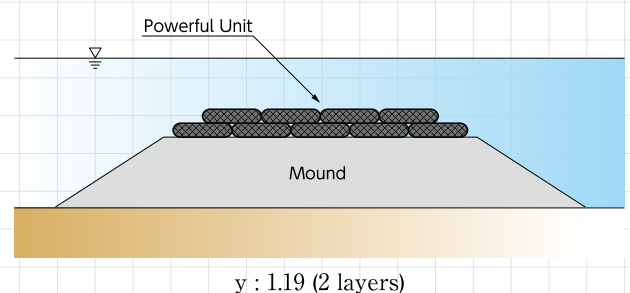
U : Water flow Speed (m/s) on the upper surface of riprap

g : Gravity acceleration(m/s<sup>2</sup>)

y : Isbash value

S $\gamma$  : Specific gravity of the structure with respect to water

$\theta$  : Slope gradient in the axial direction of the bottom of channel (°)



# Disaster recovery (Temporary recovery)

Can be used for emergency recovery in the event of a disaster.

Coastal erosion measures



Niigata Prefecture

Temporary restoration of the damaged revetment



Fukui Prefecture

Powerful Unit  
Construction  
examples

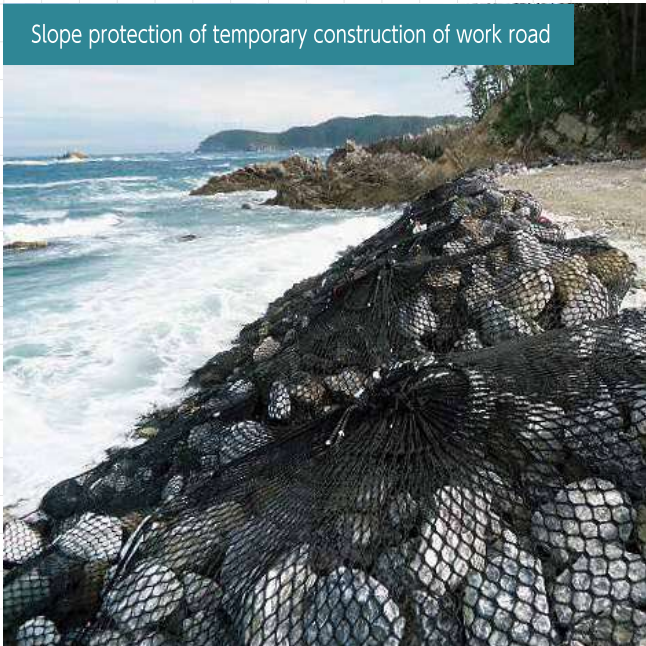
# Temporary works

Can be used for temporary construction associated with coastal construction.



Slope protection of temporary construction of work road

Ibaraki Prefecture



Slope protection of temporary construction of work road

Iwate Prefecture



Okinawa Prefecture

Construction yard protection



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