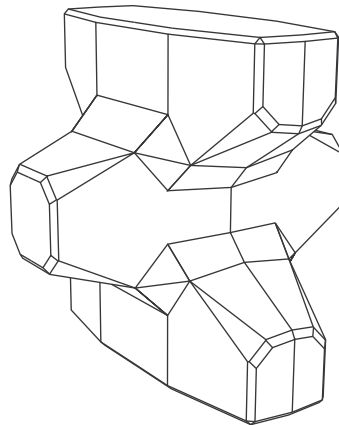




ACCROPODE™

"The benchmark in single-layer
armouring technology"



"Sharing skills and experience
to achieve successful projects"

ACCROPODE™

Single-layer system for breakwater armouring

Background

The ACCROPODE™ is the first single-layer artificial armour unit developed by Sogreah (ARTELIA). Widely used, this technology has proved to be successful on a great number of breakwater projects worldwide. Technical assistance is systematically provided on all ACCROPODE™ projects.

Hydraulic stability

Good hydraulic stability shown in extensive physical scale-model testing.

Specified stability coefficients at design stage:

- Hudson's design K_D values:
 - 15 on trunk sections
 - 11.5 on roundheads
- Van der Meer stability number

$$N_S = H_S / (\Delta D_{n50}) = 2.7$$

where

H_S = Significant wave height

Δ = Relative mass density

D_{n50} = Nominal diameter

These coefficients are valid for armour slopes from 3H/2V to 4H/3V. However for breaking waves and a seabed slope greater than 1%, lower values shall apply.

Proven structural robustness

During the development stage, finite-element methods and full-scale drop tests were conducted to check the sturdiness of the unit using ordinary mass concrete.

Experience on many projects has demonstrated the excellent behaviour of the ACCROPODE™.



2D tests



3D tests

Concrete strength specifications for placing the units

	Min. compressive strength Fc at 28 days	Min. tensile strength Ft at 28 days
Unit volume $\leq 4.0 \text{ m}^3$	25 MPa	2.5 MPa
Unit volume $> 4.0 \text{ m}^3$	30 MPa	3.0 MPa

Drop tests conducted at development stage



Practical formwork

- Quick stripping and assembly of the two shells



Assembled mould

Simple casting

- Min. area required to cast one unit of height H : $1.50H^2$
- Min. compressive concrete strength recommended at stripping:
6 MPa for units $\leq 4 \text{ m}^3$, 7 MPa for sizes between 5 m^3 and 15 m^3
and 10 MPa for sizes $> 15 \text{ m}^3$
- Typical daily standard production rate: one unit per mould

Storage and handling

- Forklifting is effective for handling small to medium size units
- Large units are handled by sling
- ACCROPODE™ units can be stored one on top of the other
- Min. area required to store 10 units on one level: $8H^2$
where H = ACCROPODE™ unit height
- Min. compressive concrete strength recommended for handling units:
15 MPa for units $\leq 4 \text{ m}^3$, 20 MPa for sizes between 5 m^3 and 15 m^3
and 25 MPa for sizes $> 15 \text{ m}^3$

Fast placement

Principle: each unit placed in a random attitude to obtain the specified packing density, using GPS.

Proper packing provides adequate coverage on breakwater slope: $\frac{Na}{A} = \phi V_{accr}^{-2/3}$

where

Na = Number of armour units

A = Unit area of breakwater slope

ϕ = Packing density

V_{accr} = ACCROPODE™ unit volume

Placement rates (using cable cranes)

	Average placing time per unit
$0.8 \text{ m}^3 \leq \text{Unit volume} \leq 3.0 \text{ m}^3$	5 to 8 mins
$4.0 \text{ m}^3 \leq \text{Unit volume} \leq 9.0 \text{ m}^3$	9 to 12 mins
Unit volume $\geq 12.0 \text{ m}^3$	12 to 20 mins

NB: higher rates can be obtained using hydraulic placing equipment with small size units.

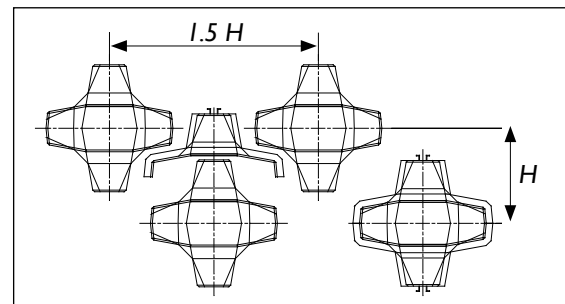


Side view of single layer under construction

Form ready for casting



Hauling large units with a low trailer



Plan layout of casting arrangement



Placement in progress

Armouring being completed





Successful applications
completed in 48 countries



CLI Head office

CS 30218
6, rue de Lorraine
38432 Echirolles
FRANCE
Tel. +33 (0)4 76 04 47 74
Fax +33 (0)4 76 04 47 75
Email: cli@concretelayer.com
Website: www.concretelayer.com

ACCROPODE™ is a registered trademark of ARTELIA Eau & Environnement
CLI is the licensee of ARTELIA Eau & Environnement

www.concretelayer.com