

# Advantages of the CLI single layer system ACCROPODE™ in comparison with the TETRAPODE double layers system.

## History:

In 1950's the TETRAPOD unit was introduced by SOGREAH in the field of breakwater armour protection. The TETRAPOD is the first interlocking armour unit. SOGREAH, based on the TETRAPOD experience, developed the ACCROPODE™ armour unit. The ACCROPODE™ unit is the pioneer of the single layer technique. The ACCROPODE™ armour unit was placed on more than 150 projects around the world and is currently placed on several projects. A new generation of the ACCROPODE™ unit (ACCROPODE™ II) is now available.

## Robustness:

The ACCROPODE™ shape demonstrated over the years good structural resistance by finite element and confirmed by site experience.

The SOGREAH/CLI experience on site showed a very low rate of breakage in service.

## Hydraulic stability:

A large number of research and project physical model tests using ACCROPODE™ unit have been performed in the most of laboratories in the world. The last rock manual indicates the stability numbers appearing in the table on the right hand side for the TETRAPOD and ACCROPODE™ units.

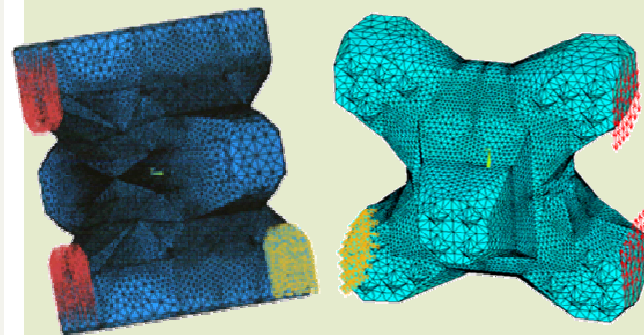
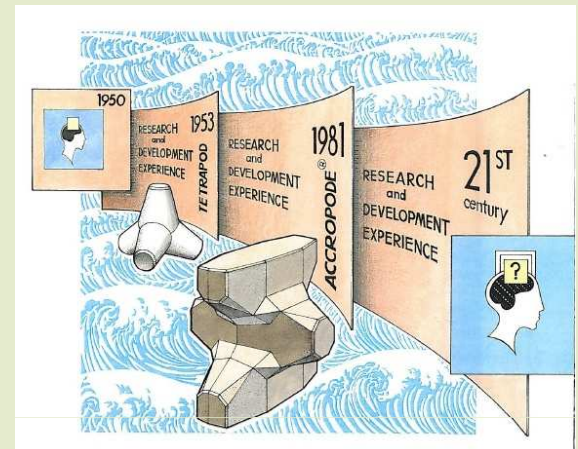
The design of a single-layer armour involves a compromise in which safety is systematically increased in comparison with an equivalent two-layer armour simply because part of economy gained by saving one layer is used to adopt a greater unit weight than would otherwise be necessary.

## Construction aspects:

As implied above, the ACCROPODE™ unit offers improvement on robustness over the TETRAPOD unit. In addition, the fact that less materials and less units are required translates into construction time saving.

**Casting :** Compared with TETRAPOD where the bottom of the mould cannot be totally re-used upon striking, the ACCROPODE™ mould can be entirely re-used immediately.

Much less storage space is required for ACCROPODE™ units than TETRAPOD units which can be stored on several levels.



Armour unit Type	Trunk	Head
TETRAPOD	2.3	2.1
ACCROPODE™	2.7	2.5
ACCROPODE™ II	2.8	2.6

Stability number of Van der Meer



Easy to store

**Handling:** ACCROPODE™ unit is easy to handle with simple slinging by crane.

**Placing:** TETRAPODE have a precise position and orientation to be respected during placing to allow the correct keying between the two layers, thus making the placing operation much more delicate. The ACCROPODE™ units are precisely positioned but with random orientation.

TETRAPOD are more susceptible to damage and breakage during placing than the most robust ACCROPODE™ units.

## Maintenance

Over the years, TETRAPOD armoured breakwaters have demonstrated a requirement for regular maintenance through breakage of units during the service life. This is partly due to the fact that the top layer of the Tetrapod armour gets loose (more freedom of movement of the armour units) further to storms, leading to more rocking of the units with time. On the contrary, single layer armours consolidate with time (less freedom of movement as wave action tend to increase interlocking effect of the single layer). For this reason, experience has shown that for ACCROPODE™ armours, maintenance has been negligible.

## Cost-effective system

The ACCROPODE™ unit is a cost-effective technique allowing to save, material and equipment as well as construction time at different stage of the construction, offering in addition a stability safety margin increasing in comparison with the TETRAPOD.

Taking into account the theoretical formula, we obtain the following difference between the ACCROPODE™ and TETRAPOD armour unit for 1m<sup>2</sup> of slope protection:

- Armour unit volume : -38%
- Concrete volume: -45%
- Armour unit number: -11%

-38% on the armour unit volume allow to reduce the crane reach capacity;

-45% on the concrete thus direct reduction of the global material cost;

-11 % on the number of unit to be cast, stored and placed.

## ACCROPODE™ II

The last ACCROPODE™ unit generation, ACCROPODE™ II unit, allows to improve, robustness, stability and placement rate compared to the first generation.



Harbour protected by ACCROPODE™ units



New ACCROPODE™ generation

## Reference

- Brochures CLI edited on September 2004.
- The Rock Manual - the use of rock in engineering (2<sup>nd</sup> edition) - CIRIA 2007



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