COMPARATIVE STUDY OF THE PLACEMENT OF ACCROPODE™ ET ACCROPODE™ II

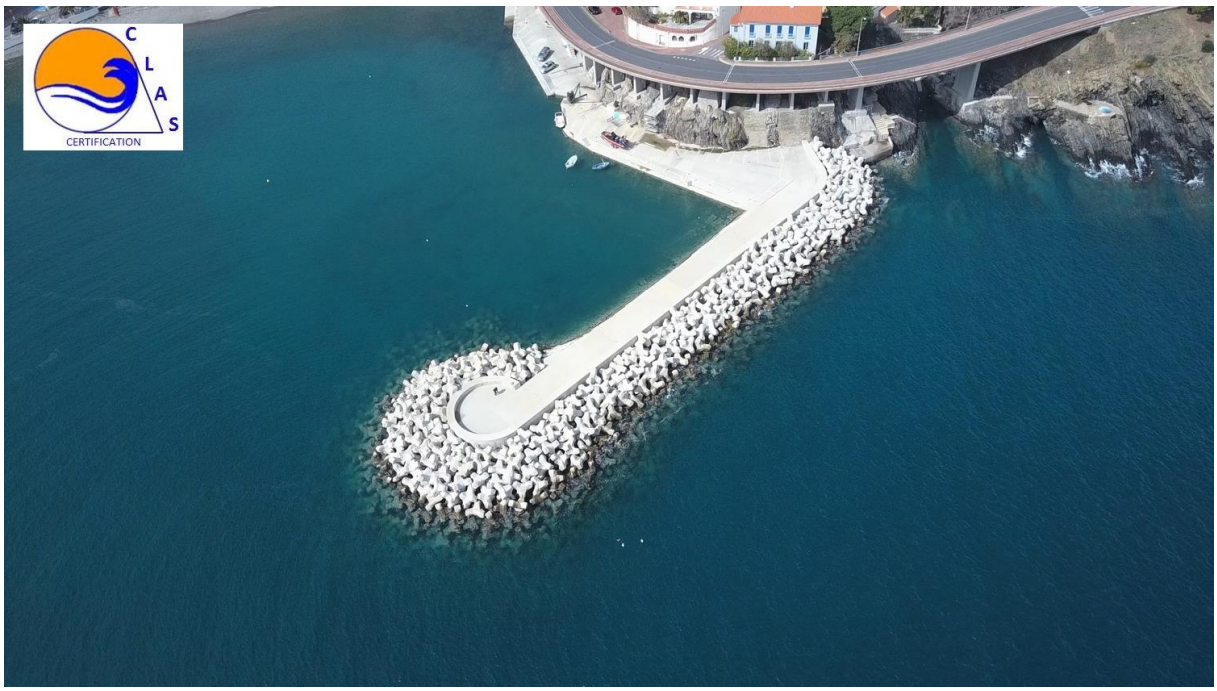
Comparison between ACCROPODE™ and ACCROPODE™II techniques

April 2015

1 Framework of the study

The ACCROPODE™II technique is competing with other single-layer blocks: the ACCROPODE™ block from SOGREAH still in use, the CORELOC™ and the X-bloc® from DMC. We pass in silence the ECOPODE™ block and other blocks which knows a marginal use.

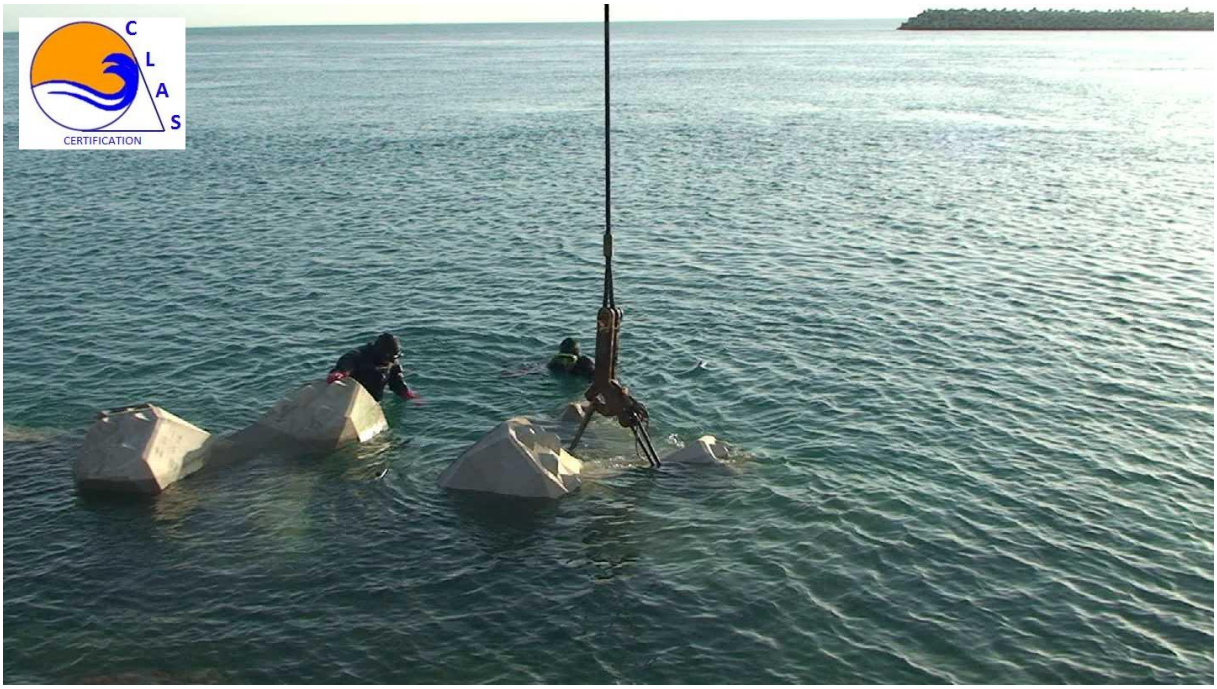
We conducted a first in Europe by placing 9m^3 ACCROPODE™II blocks at Cerbère (France), a project for which a strict intervention window was imposed due to tourism constraints and weather risk.



Control of installation times was therefore a priority. We noticed some differences with the installation in the same conditions of ACCROPODE™ blocks of the same size that our experts used in Vietnam on the DUNG QUAT project.

It also seemed interesting to compare the data collected on the KHALIFA project at ABU DHABI

which was executed with ACCROPODE™ blocks and to compare them with the data collected on the MARCHICA project in MOROCCO where ACCROPODE™II were implemented.



We chose these two sites because they were ACCROPODE ™ and ACCROPODE ™ II of the same size that were used.

ACCROPODE ™ and ACCROPODE ™ II are an invention of SOGREAH and are marketed by its subsidiary Concrete Layer Innovation.

The data was collected by the company IDMer. It was independent company that intervened with contractors to develop a quality assurance plan adapted to diving, training and control of production and quality, which allowed the optimization of the means of implementation of the ACCROPODE™ and ACCROPODE™II blocks with the personnel and equipment of the contractors. IDMer has become CLAS, an international company specializing in single layer technologies for the construction of breakwaters.

ACCROPODE ™

ACCROPODE ™ II

2 Conditions of the study

Our objective being to highlight the qualities and the defects of these blocks for the placement in order to compare them, we collected precise enough information to leave the action of installation of all the constraints of the construction site and to compare as well as the intrinsic qualities of each block. The information was collected in both cases with an on-site stock that allowed uninterrupted supply. Stops for reasons unrelated to the movements of the ACCROPODE ™ blocks themselves have not been recorded: mechanical breakdowns or GPS, staff in prayer etc...

Placement team: Experienced divers with ACCROPODE ™ and ACCROPODE ™ II blocks and an efficient crane operator with the GPS system.

Means of laying: Cable crane and excavator without rotating head.

Placing tools: No placing tool has been implemented on these sites.

Visibility conditions: We made a comparison in the following two cases:

- Good visibility: The diver could see more than three ACCROPODE ™ or ACCROPODE ™ II blocks simultaneously.

- Poor visibility: The diver did not see the entire ACCROPODE ™ or ACCROPODE ™ II block to place.

Quality criteria: The study is based on quality conforming to the acceptance criteria of a breakwater armour as defined by the technical standards published by CLI. Occasional defects that occur at the time of installation such as the extraction of a block when the cable comes out, an out of profiles or a breakage of block, give place systematically to an immediate repair which is not counted of the average time deposit.

3 Numerical results.

The time taken into consideration is composed of the following operations:

1 Elingage of the ACCROPODE™ or ACCROPODE™II block.

2 Movement of the crane on the target point.

3 Installation of the ACCROPODE™ or ACCROPODE™II block with coordination of the installation by the diver.

4 Adjustment possible in case of movement of the ACCROPODE™ or ACCROPODE™II block after installation.

These values were established on a placement in linear current section.

Underwater placement by wire crane – Result 1

ACCROPODE™		ACCROPODE™ II	
Bonne visibilité			
Average per hour	8	Average per hour	12
Highest production	14	Highest production	22
Mauvaise visibilité			
Average per hour	6	Average per hour	10
Highest production	10	Highest production	16

Placement by excavator without rotating head – Result 2

ACCROPODE™		ACCROPODE™ II	
Bonne visibilité			
Average per hour Moyenne par heure	8	Average per hour	16
Pointe de production	14	Average per hour	22
Mauvaise visibilité			
Average per hour	6	Average per hour	10
Highest production	10	Highest production	15

Out of water placement with a wire crane – Result 3

ACCROPODE™		ACCROPODE™ II	
Average per hour	12	Average per hour	16
Highest production	16	Highest production	18

Out of water placement with an excavator without rotating head – Result 4

ACCROPODE™		ACCROPODE™II	
Average per hour	14	Average per hour	28
Highest production	18	Highest production	34

4 Comments

The results show a superiority of the ACCROPODE ™ II technology over the ACCROPODE™ technology.

The production values under optimum conditions of placement: placement over water at the excavator, result 4 show a difference of the single to double. We also noted a smaller gap between average production and peak production with ACCROPODE ™ II.

This difference with the ACCROPODE ™ is explained by the geometric shape ACCROPODE ™ II which facilitates the natural placement of the block while obtaining a performing interlocking.

The natural pose, that is to say the pose which does not require that the block is guided and oriented, but on the contrary that it is positioned alone, is improved with the ACCROPODE ™ II block compared to the ACCROPODE ™ block because the angles of the anvils on ACCROPODE ™ have been removed, even for anvils which resulted in unsatisfactory relative interlocking.

The movements of the ACCROPODE ™ II block are also faster when the block is released and delivered to its natural movement.

We noted the following particularities:

The ACCROPODE ™ II block is positioned mainly nose in the slope and this movement must be compensated at the time of placement otherwise unacceptable defects appear. This problem is easy to circumvent for specialists of the placement of these blocks and does not entail a loss of time.

During the removal of the sling, it happens that it remains stuck between two blocks or between the block and the underlayer, the only solution is to withdraw the sling by

an additional traction on the cable, which can cause a rotation of the laid block. Both ACCROPODE ™ and ACCROPODE ™ II systems have the same risk of block movement. Although very rare, the extraction of the block with the cable, its out of profile, or its displacement in the neighboring free space must be controlled after withdrawal of the sling. From this point of view, the ACCROPODE ™ II block provides no improvement over the ACCROPODE ™ block since the problem is generated by the sling and not by the block itself.

5 Conclusion

We found that the ACCROPODE ™ II technology retains a number of requirements that we may have encountered when placing the ACCROPODE ™ block, for example, this block does not allow blind placement. These requirements are specific to work with artificial blocks with strong interlocking and requires specially trained personnel for this work both in terms of safety and technique.

Nevertheless, it undoubtedly constitutes an important technical advance because it allows a construction rate of the works much higher than that observed with the ACCROPODE ™ technology. The order of magnitude of this improvement, with regard only to the intrinsic qualities of each ACCROPODE ™ geometric shape, is between 30% and 100% depending on the conditions of use.

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