

## The Calculator :

This tool has been designed in order to carry out very preliminary calculations. It is based on the well known Hudson formula for breakwater armouring design.

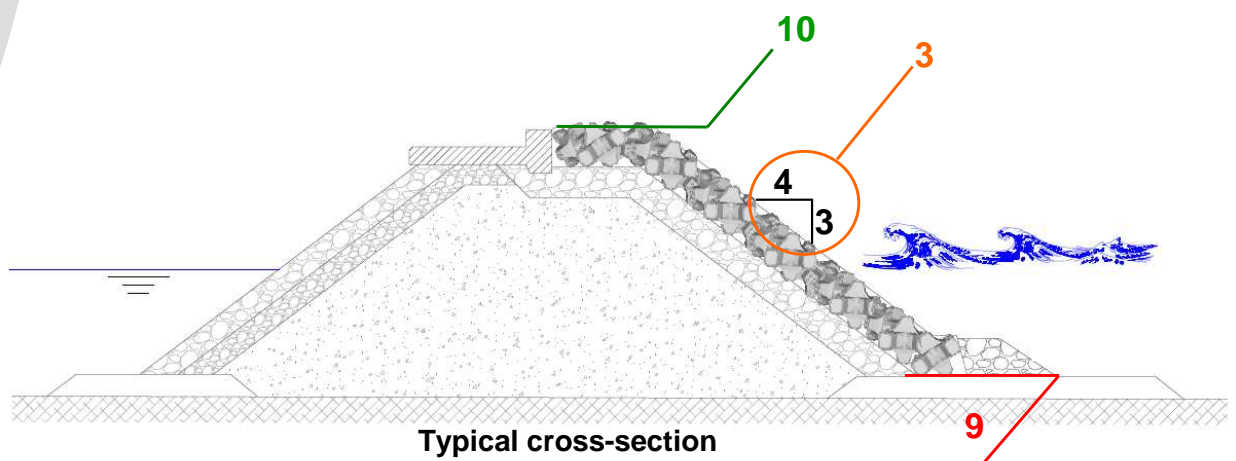
However, this version includes a variation in  $K_D$  varying with the seabed slope in front of the structure combined with wave breaking or non breaking (the  $K_D$  reduction according to the seabed slope is based on physical model results).

An option is also available by entering the parameters 9 and 10 (see table below). The calculator will automatically check the number of rows along the armour slope and will display the most suitable unit size.

### Input parameters list

Parameters N°	Description	Unit	Limit values
1	Structure type	-	-
2	Unit type	-	-
3	Armour slope	-	-
4	Concrete density	kg/m <sup>3</sup>	2250 - 2500
5	Water density	kg/m <sup>3</sup>	1000 - 1040
6	Project significant wave height (Hs)	m	3 - 10
7	Breaking waves	-	-
8	Seabed slope	%	0 - 10
9	Bottom level of the armour	m	Total height of the structure must be less than 35m
10	Upper level of the armour	m	

In the event your parameter are outside the limits shown here above, you are invited to seek specific advice directly from CLI: [cli@concretelayer.com](mailto:cli@concretelayer.com).



## Input parameters description :

- 1) The calculation can be applied on two types of structure stretches : a **trunk section** or a **non-linear section** (sharp curve or bend).
- 2) The Calculator gives the choice between the four CLI units which are specified as follows:
  - The **ACCROPODE™** unit is the first single layer unit developed by SOGREAH. The ACCROPODE™ unit has been used on more than 150 projects around the world.
  - The **ACCROPODE™ II** unit is the last evolution of the ACCROPODE™ unit. This new shape allows to preserve the robustness of the first generation, as well as to improve the stability and the placement output.
  - The rock appearance of the **ECOPODE™** unit allows a better integration in the natural environment as well as keeping the ACCROPODE™ II hydraulics characteristics.
  - The **CORE-LOC™** unit developed by the US Corps of Engineers is a cost-effective unit for sites exposed to moderate waves.

For further information concerning the CLI single layer units, CLI recommends you to browse through CLI website as well as the brochures and tables available in the download section of CLI web site.
- 3) Two armour slopes can be use for the CLI single layer: **4/3** and **3/2**. However, for the calculation with the Hudson formula, the calculator considers an armour slope of 4/3. The slope chosen by the Designer will however be integrated for geometrical considerations (number of rows). (see sketch on the previous page[3]).
- 4) The **concrete density** should not be overestimated in order to be lower than the minimum measured density on site.
- 5) The **sea water density**.
- 6) The **significant wave height (Hs)** is  $H_{1/3}$  (average of the highest 1/3 of all wave heights). Attention should be given on the difference between  $H_{1/3}$  and  $H_{mo}$  (spectral significant wave height) in shallow waters.
- 7) The **wave breaking** can influence the breakwater armour stability.
- 8) The **seabed slope** is estimated taking into consideration the mean seabed slope in front of the structure. In case of non-breaking waves, the seabed slope does not influenced the calculation results.
- 9) The **bottom level of the armour** is the level where the first row of units is placed (see sketch on the previous page [9]).
- 10) The **upper level of the armour** (see sketch on the previous page[10]).



## Output parameters list :

Parameters N°	Description	Unit
1	Theoretical volume	m <sup>3</sup>
2	Standard volume	m <sup>3</sup>
3	Unit mass	kg
4	Unit height	m
5	Armour thickness	M
6	Rocks underlayer	kg
7	Underlayer thickness	m
8	Concrete consumption	m <sup>3</sup> /m <sup>2</sup>
9	Number of units	u/100m <sup>2</sup>
10	Number of rows	u

## Output parameters description :

- 1) The **theoretical volume** is the unit volume resulting from the calculation.
- 2) The **standard volume** is one of the family sizes appearing in CLI tables corresponding to the theoretical volume and taking into account the maximum number of rows along the armour slope.
- 3) The **unit mass** is calculated using the standard volume and the concrete density value provided by the Designer.
- 4) The **unit height** is calculated using the CLI unit standard shape .
- 5) The **armour thickness** is specified in the CLI standards.
- 6) The **rocks underlayer** is specified in the CLI standards.
- 7) The **underlayer thickness** is specified in the CLI standards.
- 8) The **concrete consumption** per m<sup>2</sup> is specified according to the CLI standards.
- 9) The **number of units** per 100 m<sup>2</sup> is specified according to the CLI standards.
- 10) The **number of rows** is specified according to the standard volume estimated by the Calculator, the bottom and upper armour levels and the armour slope provided by the Designer.

For further information concerning the input and output parameters, do not hesitate to contact CLI: [cli@concretelayer.com](mailto:cli@concretelayer.com).