

**Planner's guide**

**LedroSteel EcoBox Gabions**

**Instruction and information about technical specifications and performances of the gabion and the filling material.**

**European Technical Assessment ETA 17/0059**

### 1. LedroSteel Ecobox gabion description:

The gabion have the shape of a cube or a parallelepiped, according to the format. It is composed by 6 panels: the bottom panel, the covering panel, and 4 verticals panels.

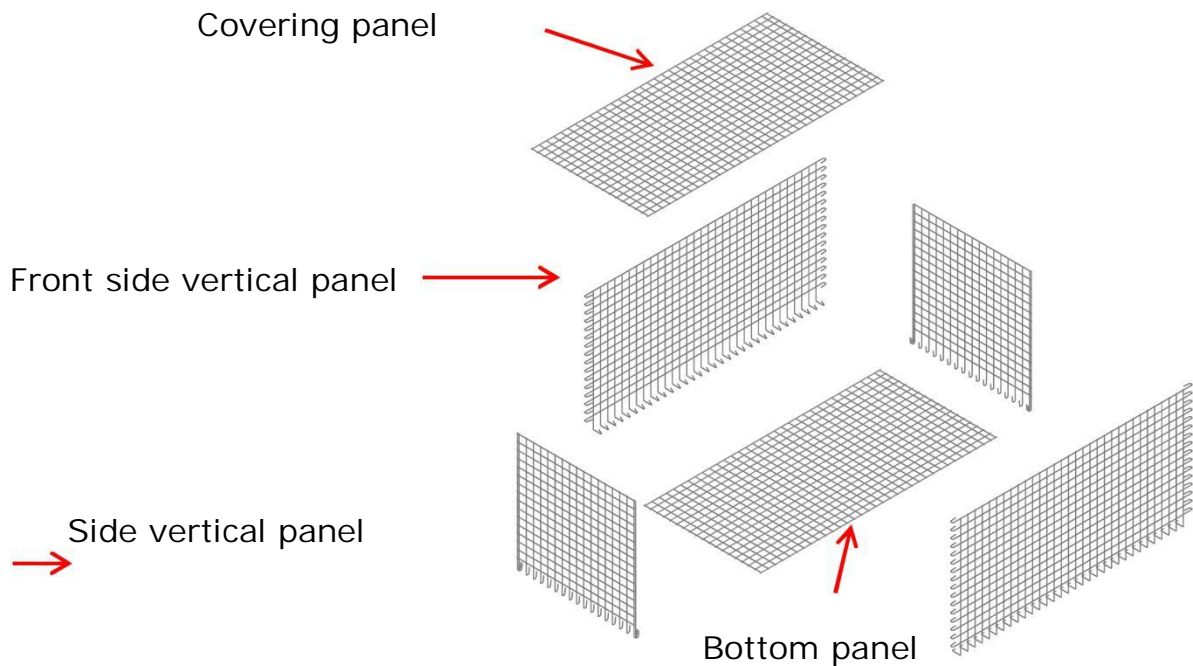


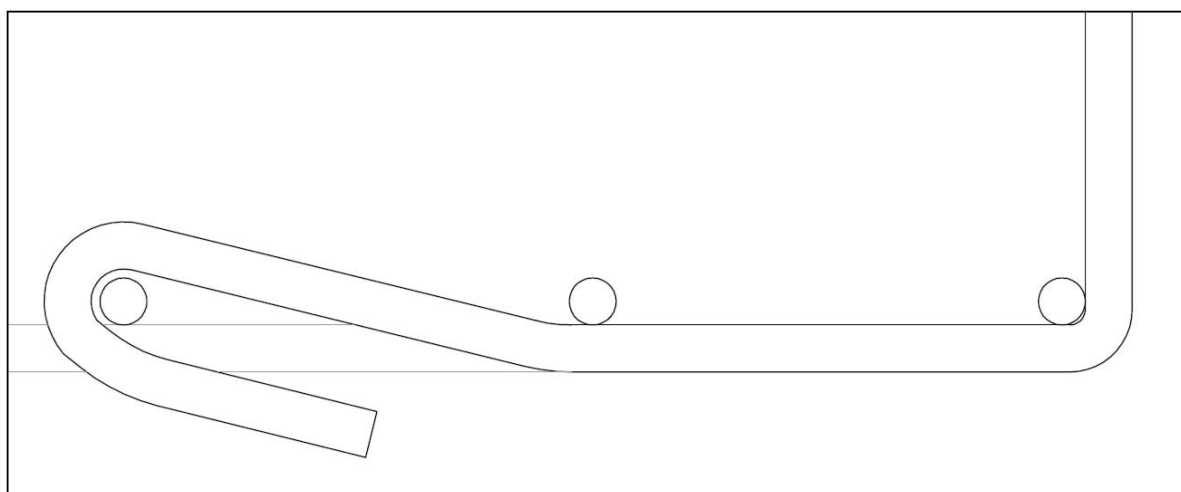
Fig.1 - scheme of the elements that compound the gabion -

The internal rods (6 mm) and panels of the LedroSteel Ecobox gabion are made of C4D steel wires, compliant with EN ISO 16120-2, with a diameter of 4 mm; in particular, the wires that make up the panels are single horizontal and vertical, welded together to create a 60 x 60 mm mesh

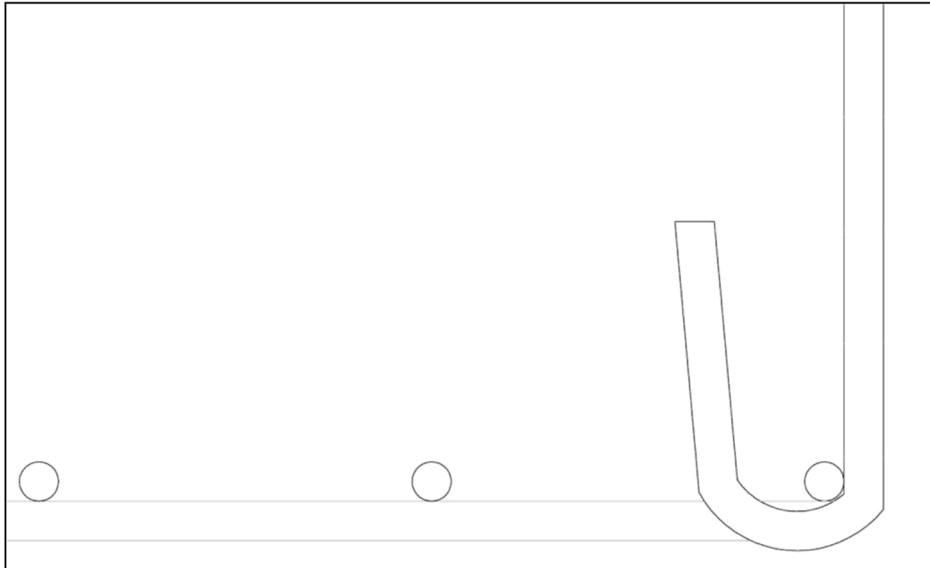


*Fig.2 – Ecobox gabion –*

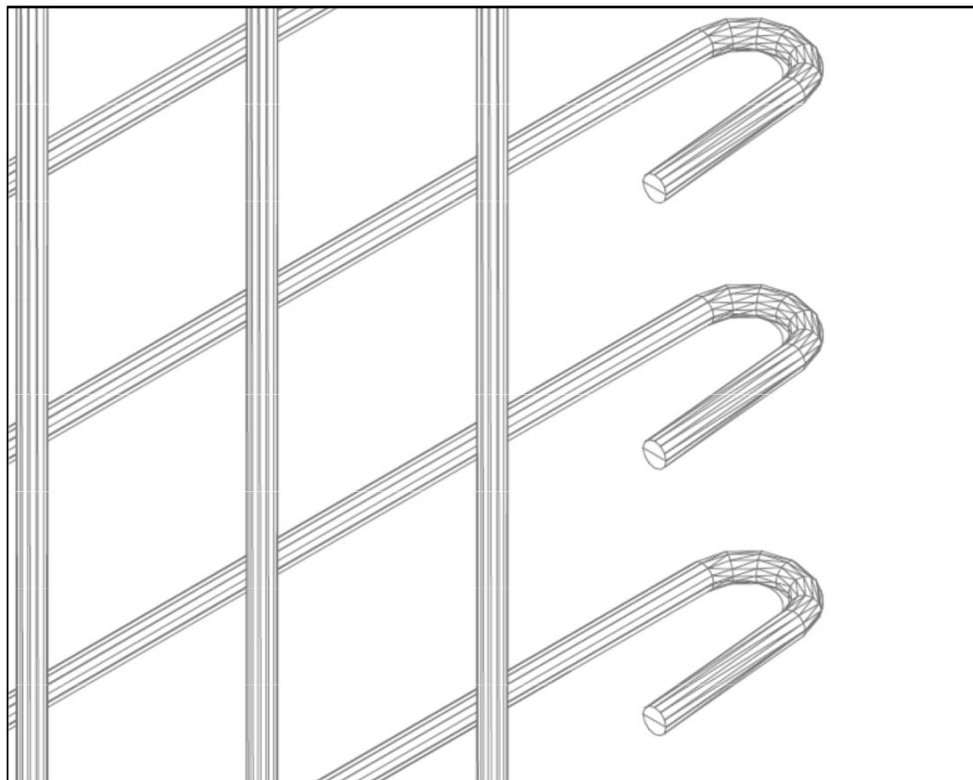
All the steel wires are covered by a zinc alloy,  $\approx 93\%$ , aluminium  $\approx 7\%$ , called Galfan alloy. Panels have to be assembled using the J-shaped and U-shaped hooks they feature, as pointed out in the assembly instruction. Hooks are able to provide structural stability and stress strength.



*Fig.3 – particular of a J shaped hook –*

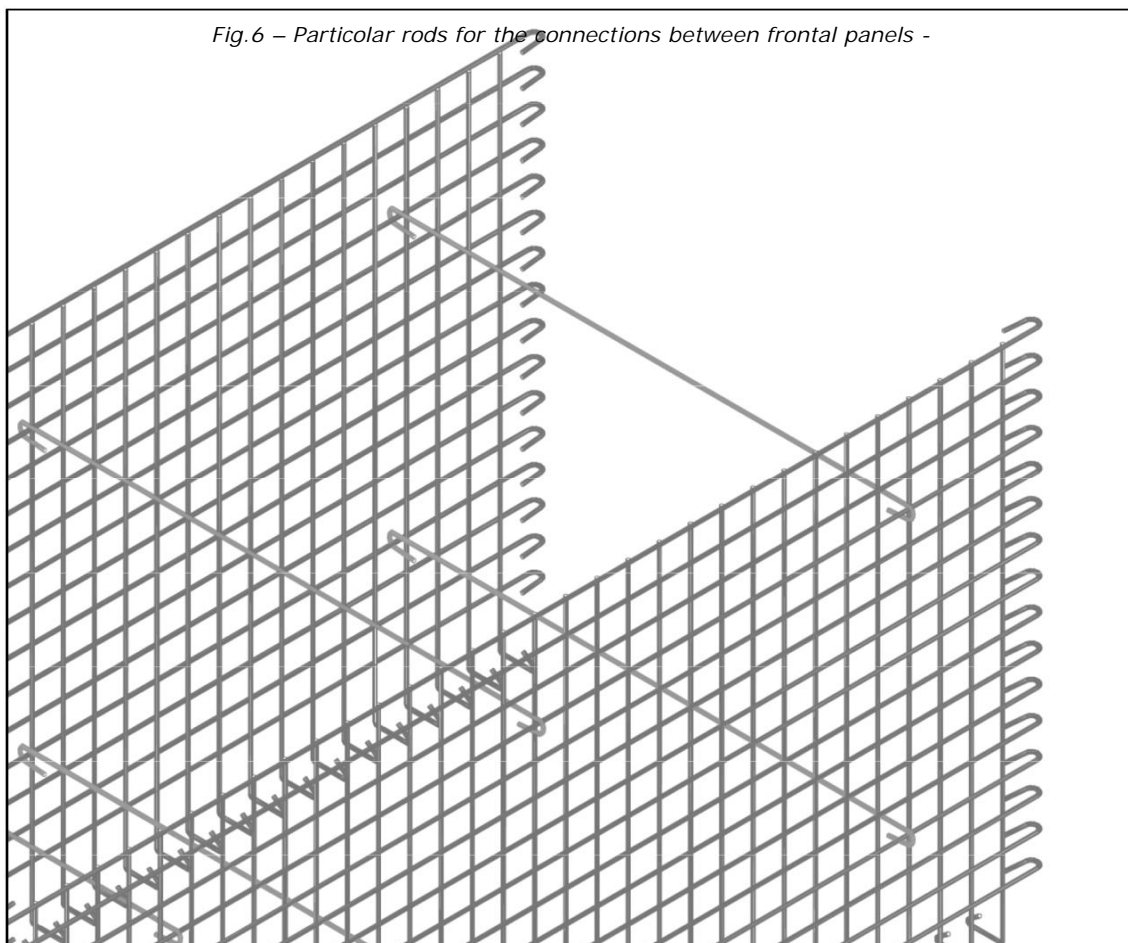


*Fig.4 – particular of a U shaped hook –*



*Fig.5 – Particular U shaped hook for the connection between side panels –*

Panels, both on the long side and the short side, are connected in pairs with many horizontal rods curved at the end to form two U-shaped hook



The covering panel gets connected with the underlying vertical panels with metal rings using a stapler.



*Fig.7 – Particular metal rings for the connection between covering panel and side panels –*

The LedroSteel EcoBox gabion have to be built and filled on the place of usage. The filling can be done using operating machines such as excavators.

The CE marking, gained through ETA 17/0059, is referred exclusively to the metal gabion.



## **2. Specifications of the filling material for the LedroSteel Ecobox gabion and instruction for its packing:**

- Specifications of the filling material

The filling material have to comply with the norm EN 13383-1: 2002/AC: 2004 – “aggregates for the protection works, armourstone – particulars” that will point out the properties the “aggregates obtained through the treatment of natural materials, artificial or laundered and mixes of them, for the usage as aggregates for structures for protection” need to have. The usage planned by the norm is for “ hydraulic works for protection and adjustment”  
the CE marking, as a building product, is required since 01/06/2004.

The decree of the Minister of Infrastructures of april the 11<sup>th</sup> 2007<sup>1</sup>,  
*“Application of the directive n. 89/106/CEE about the building products, acknowledged with D.P.R. of april the 21<sup>st</sup> 1993, n. 246<sup>2</sup>, about the identification of the products and the related checking methods of the compliance of the aggregates”, in the Annex 2, for the products under this norm, which uses are for “mantles of protection”, requires an evaluation and checking system of the constancy of the service 2+<sup>3</sup>.*

The minimum specifications to be declared in the CE<sup>4</sup> marking for the use of the product in Italy are specified in the same Annex.

The minimum performances of the filling material, that have to be used to consider valid the result of the experimental test campaign for the project conditions, performed by the University of Trento, are stated below.

<sup>1</sup> Pubblicato sulla Gazzetta ufficiale 19/04/2007 n. 91

<sup>2</sup> Il Regolamento UE N. 305/2011 del Parlamento Europeo e del Consiglio del 9 marzo 2011, entrato in vigore il 01.07.2013, abroga e sostituisce la direttiva 89/106/CEE

<sup>3</sup> Si veda l'allegato V del Regolamento UE 305/2011

<sup>4</sup> Marcatura CE accompagnatoria il prodotto e Dichiarazione di Prestazione – DoP

- Shattered filling material specifications EN 13383-1  
"aggregates for the protection works, armourstone"

Essential specifications	Material's performances, testing ground admissible		Reference	Restrains, comments and minimum performances required from EN 13383-1
	CP <sub>90/180</sub>	CP <sub>90/180</sub>		
Granulometry	CP <sub>90/180</sub>	CP <sub>90/180</sub>	Paragraph 4.2.1, statement 1	the 90/180 granulometry is a narrow granulometry for special applications such as gabions
Shape	6%	20%	Paragraph 4.3.2, statement 6	L <sub>T</sub> the aggregate's percentage with the relation length-thickness higher than 3 have to be ≤ 20%;
Shattered or broken surface's proportion	0%	≤5%	Paragraph 4.4, statement 7	R <sub>O</sub> s proportion of aggregation pieces with less than 50% of shattered or broken surfaces ≤ 5%
Granular density	≥ 2,77 Mg/mc	≥ 2,50 Mg/mc	Paragraph 5.2, statement 8	≥ 2,30 Mg/mc
Granular heap density	1,44 Mg/mc	1,30 Mg/mc	UNI EN 1097-3	unexpected specifications
Packed granular heap density	1,60 Mg/mc	max porosity 44%	University of Trento testing field	unexpected specifications
Breaking resistance of the aggregates	215 MPa	160 MPa	Paragraph 5.3, statement 9	CS <sub>80</sub> higher than 80 MPa
Wear resistance of the aggregates	11	choice bound to the point of use	Paragraph 5.4, statement 10	M <sub>DE10</sub> coefficient micro Deval ≤ 10 M <sub>DE20</sub> coefficient micro Deval ≤ 20 M <sub>DE30</sub> coefficient micro Deval ≤ 30
Dicalcium silicate disintegration	NPD	NPD		Only for blast furnace slag. Not included in the project.
Steel disintegration	NPD	NPD		Only for blast furnace slag. Not included in the project.
Iron slag disintegration	NPD	NPD		Only for blast furnace slag. Not included in the project.
Release of dangerous chemicals	complying	complying	D.M. 05/04/2006 n. 186	the product should be accompanied by documentation that lists eventual legislations about dangerous chemicals, and also possible information required by the legislation itself.
Water absorption	0,4%	choice bound to the point of use	Paragraph 7.3, statement 12	WA <sub>1</sub> WA1 medium water absorption ≤ 0,5% to ensure the appropriate durability, mass percentage
Frost and thaw strength	0,1%	choice bound to the point of use	Paragraph 7.4, statement. 13	FT <sub>A</sub> mass loss inferior to 0,5% or formation of open fractures
Salt crystallization strength	24%	choice bound to the point of use	Paragraph 7.5, statement 14	MS <sub>25</sub> mass loss ≤ 25%
Petrographic research				rock type classification. A petrographic research and a classification of the type of the rock can often provide a clear indication of high resistance to
Basalt sonnenbrand	NPD	NPD	Paragraph 7.6, statement.15	only for basalt

- Table 1, shattered filling material specifications



- Alluvial round filling material specifications EN 13383-1 “ aggregates for the protection works, armourstone”

Essential specifications	Material's performances, testing ground admissible		Reference	Restrains, comments and minimum performances required from EN 13383-1
Granulometry	CP <sub>90/180</sub>	CP <sub>90/180</sub>	Paragraph 4.2.1, statement 1	the 90/180 granulometry is a narrow granulometry for special applications such as gabions
Shape	6%	20%	Paragraph 4.3.2, statement 6	LT <sub>A</sub> the aggregate' s percentage with the relation length-thickness higher than 3 have to be ≤ 20%;
Shattered or broken surface's proportion	87%	90%	Paragraph 4.4, statement 7	RO <sub>90</sub> proportion of aggregation pieces with less than 50% of shattered or broken surfaces ≤ 90%
Granular density	≥ 2,70 Mg/mc	≥ 2,55 Mg/mc	Paragraph 5.2, statement 8	≥ 2,30 Mg/mc
Granular heap density	1,57 Mg/mc	1,48 Mg/mc	UNI EN 1097-3	unexpected specifications
Packed granular heap density	1,75 Mg/mc	max porosity 39%	University of Trento testing field	unexpected specifications
Breaking resistance of the aggregates	169 MPa	160 MPa	Paragraph 5.3, statement 9	CS <sub>80</sub> higher than 80 MPa
Wear resistance of the aggregates	11	choice bound to the point of use	Paragraph 5.4, statement 10	M <sub>DE10</sub> coefficient micro Deval ≤ 10 M <sub>DE20</sub> coefficient micro Deval ≤ 20 M <sub>DE30</sub> coefficient micro Deval ≤ 30
Dicalcium silicate disintegration	NPD	NPD		Only for blast furnace slag. Not included in the project.
Steel disintegration	NPD	NPD		Only for blast furnace slag. Not included in the project.
Iron slag disintegration	NPD	NPD		Only for blast furnace slag. Not included in the project.
Release of dangerous chemicals	complying	complying	D.M. 05/04/2006 n. 186	the product should be accompanied by documentation that lists eventual legislations about dangerous chemicals, and also possible information required by the legislation itself.
Water absorption	0,4%	choice bound to the point of use	Paragraph 7.3, statement 12	WA <sub>1</sub> WA <sub>1</sub> medium water absorption ≤ 0,5% to ensure the appropriate durability, mass percentage.
Frost and thaw strength	0,1%	choice bound to the point of use	Paragraph 7.4, statement 13	FT <sub>A</sub> mass loss inferior to 0,5% or formation of open fractures
Salt crystallization strength	24%	choice bound to the point of use	Paragraph 7.5, statement 14	MS <sub>25</sub> mass loss ≤ 25%
Petrographic research	sediment. 62% magmat. 18% metamorf. 20%			rock type classification. A petrographic research and a classification of the type of the rock can often provide a clear indication of high resistance to
Basalt sonnenbrand	NPD	NPD	Paragraph 7.6, statement 15	only for basalt

- Table 2. alluvial filling material specifications

### 3. Specifications of the material constituent the LedroSteelEcoBox

Essential specifications	legal reference	minimum legal performance	verified performance ETA 17/0059
Wire tensile and lengthening strength	EN 10223-6 "wire and product steel coated for fences and grids – gabions made by welded mesh- " paragraph 7.4	max tensile stress before breaking > 500 MPa	max load before breaking = 14567 N max stress before breaking = 554,12 MPa , max deformation = 6,47 %
Weld shear strength	EN 10223-6 "wire and product steel coated for fences and grids – gabions made by welded mesh- " paragraph 7.5	welding strength $\geq$ 75% of the max tensile stress before breaking	medium value = 14181,25 N > 11037 N medium value on the double wire = 16231 N
Measurement of the coating alloy of zinc and aluminum got with the gravimetric method	EN 10244-2 "wire and product steel coated – metal coating without iron on the steel wires – part 2: zinc or other zinc alloy coating"; paragraph 5.2.2.1/5.2.2.2 and table 2	Measurement of the coating alloy of zinc and aluminum got with the gravimetric method $\geq$ 290 g/mq for the A class	medium value on 5 coating mass test = 401,8 g/mq
Verification of the grip between the coating and the wire through winding test	EN ISO 7802 "metal material – winding test of the wire"	no detachment of the coating	no detachment of the coating
Corrosion tests in artificial atmospheres	EN ISO 9227 "Corrosion tests in artificial atmospheres – saline mist test"	surface affected by rust < 5% after 1000 hours of saline mist	surface affected by rust < 5%
Hooks strength test	unnecessary test performed by the University of Trento, industrial department	shape maintenance	opening strength value = 2000 N

- Table 3, Specifications of the material constituent the LedroSteel EcoBox gabion

	Opening load (N)	average (N)
1	1597	1596,33
2	1609	
3	1583	

Table 4 – result of the of the tests about the opening strength of the hooks –

## 1. Technical data for the calculation of the LedroSteel Ecobox gabion in work:

The gabion have to:

- Be assembled as written in the paragraph 1 of this manual or in the paragraph 8 of the “Instructions and information for the proper movement, storage, transportation, assembling and laying LedroSteel Ecobox”;
- Be filled by a material that satisfy the condition of the paragraph 2;

In this conditions the gabion can ensure the following admissible strength values:

Essential specifications	value reference	provision of exercising	Formulae
Gabion crushing strength	testing campaign and relative relation from the University of Trento, geotechnics department	$\sigma_y = 32 \text{ kN/mq}$	
Friction of the gabion on a lean concrete surface	test campaign and related report from the Trento University, geotechnical department	$\mu = 0,742$	$F_h[\text{kN}] = 0,742 \times F_v[\text{kN}]$ $\tau[\text{kPa}] = 0,742 \times \sigma_v[\text{kPa}]$
Friction between gabions	test campaign and related report from the Trento University, geotechnical department	$\mu = 0,502$	$F_h[\text{kN}] = 0,502 \times F_v[\text{kN}]$ $\tau[\text{kPa}] = 0,502 \times \sigma_v[\text{kPa}]$

- Table 5 – technical data for the calculations of the gabion with  $F_h$  horizontal strength and  $F_v$  vertical strength –

The report drafted by the prof. Stefano Rossi of the Industrial Engineering department of the University of Trento, by the prof. Lucia Simeoni of the Civil, Environmental and Mechanical Engineering department of the University of Trento and by the "Laboratorio Trentino" can be consulted at "Metallurgica Ledrense" office.