TECHNICAL DOCUMENT

DolceVita

Above ground pool "Dolcevita"

- *OVERVIEW*
- *GRAPHIC DIAGRAMS*
- *VERIFICATION OF STRUCTURAL ELEMENTS*
- *GROUND LOADS AND SUPPORT REACTIONS ANCHORS*

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INTRODUCTION

This TECHNICAL DOCUMENT is intended solely for:

- a description of **the geometry** and **assembly methods** of the elements that make up the SUPPORTING STRUCTURE of the pool;
- a description of the model (geometry, loads, constraints) subject to structural verification;
- an illustration of the results of the verification
- the indication of loads on the ground and support reactions at the attachment points.

Items not relevant to the purposes listed above will not be taken into account. For the aesthetic and/or functional description of the pool, please refer to the other documents supplied (technical data sheet/assembly instructions/user manual).

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OVERVIEW

DOLCEVITA ® is a ***modular structure*** swimming pool made with prefabricated elements, produced at the Laghetto Pools plant and conveniently assembled on site.
The product is modular because the final product takes shape by combining and assembling individual structural **modules**, which can be of two types: (A) **Lateral** and (B) **Angular**.

(A)-The single **lateral module** consists of the following main parts:

1. VERTICAL SUPPORTS
2. THE UPPER LONGITUDINAL JOINTS

The walls of the swimming pool are created by combining various lateral modules.

(B)-The perimeter, having in any case A RECTANGULAR shape, is then "closed" thanks to four **angular modules** which, in addition to the elements listed above, provide:

3. the CORNER POLES

Once the perimeter is "closed", the modules, connected as described above, accommodate **the tensile-structural and water containment membrane**: thanks to the presence of a special groove along the upper internal profiles, it is constrained along the entire perimeter of the pool. The various "main pieces" and the individual elements that compose them will be illustrated in detail below.

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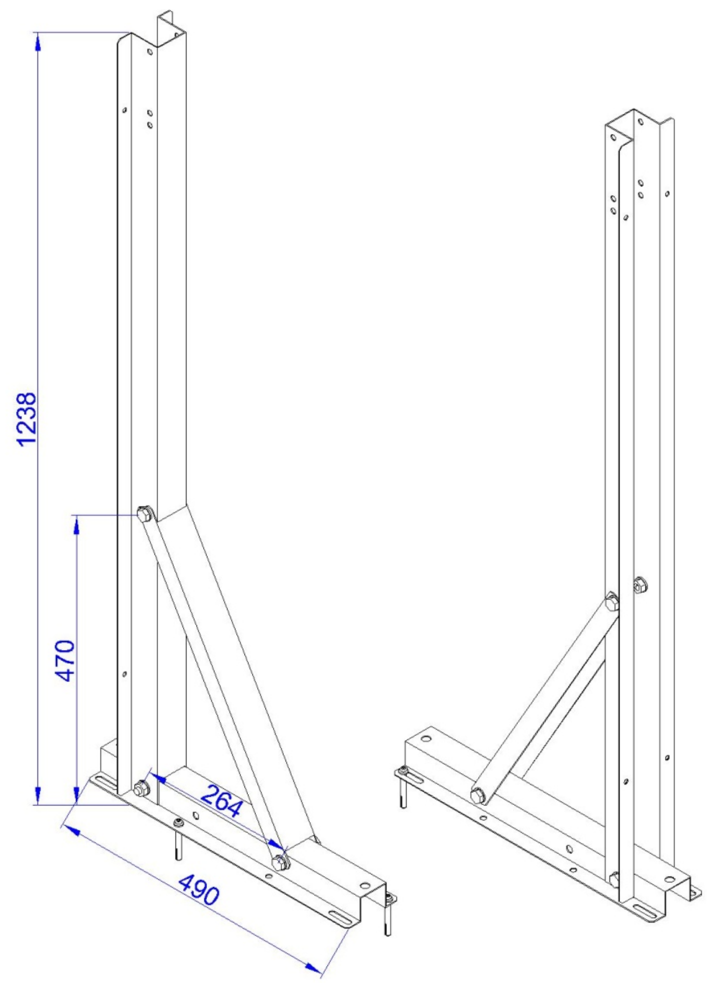
LATERAL MODULES

The LATERAL modules of the models intended for ABOVE GROUND mounting consist of the following pieces (in S250GD ZM310 steel):
VERTICAL SUPPORTS – These are "composite" pieces, with main vertical development, consisting of the assembly of the following elements:

- One BASE CROSSBAR, FOOT/ in omega profile 48x38.5x25mm thickness=1.5mm in cold formed AISI304 stainless steel
- A VERTICAL POLE in Omega profile 53x49.5x25mm, 2 mm thick, in cold formed steel S250GD ZM310, protected against corrosion with "Magnelis" coating and finished with powder painting.
- A DIAGONAL REINFORCEMENT BRACING in U profile 30x58 mm, 2 mm thick, in S250GD ZM310 steel, cold formed, corrosion protected with "Magnelis" coating and powder painting

Fig. 1 – FOOT



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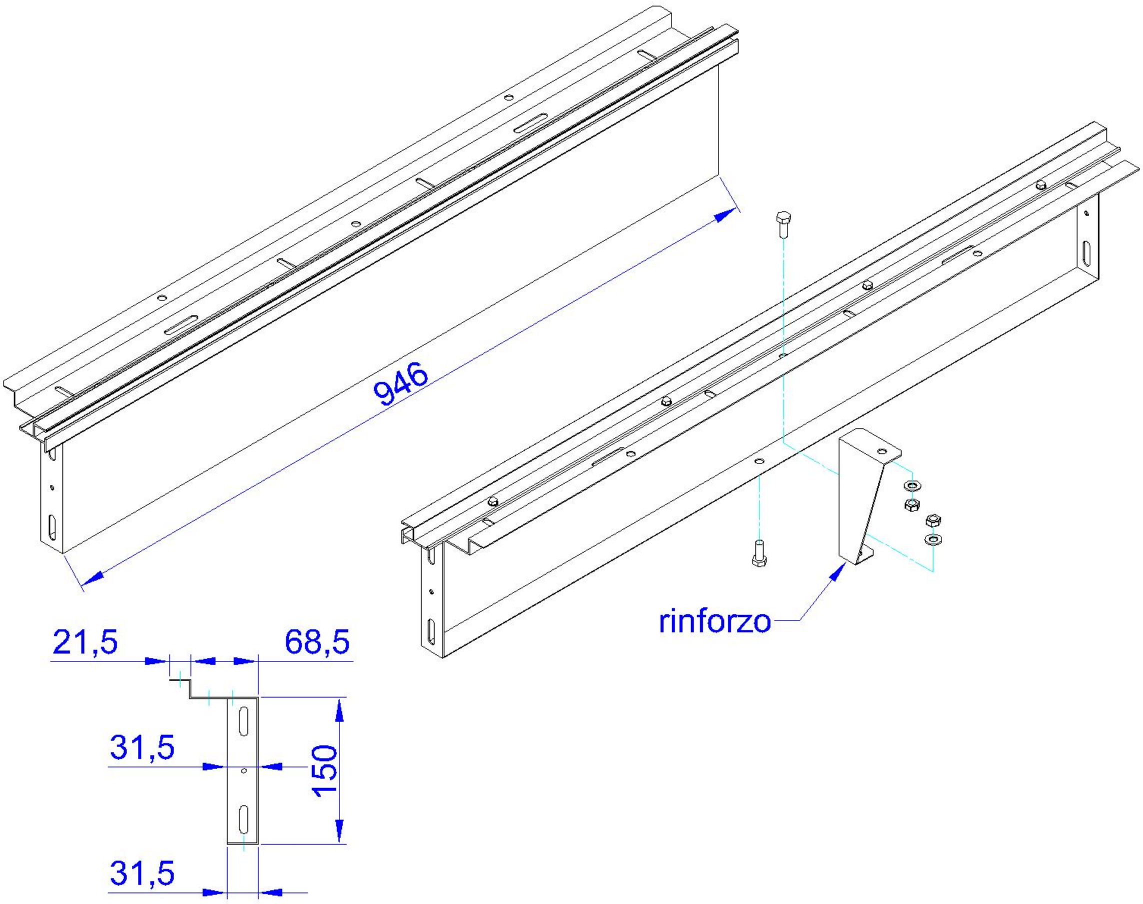
THE UPPER CONNECTION SHEETS – The vertical supports are connected together through an upper connection, made using a bent sheet having a thickness of 1.5 mm in S250GD ZM310 sheet, powder painted with a central reinforcement inserted.

Fig. 2 – Foot connection plate



The single lateral module is composed by connecting two vertical supports through the upper sheets – with standard width equal to 1m.

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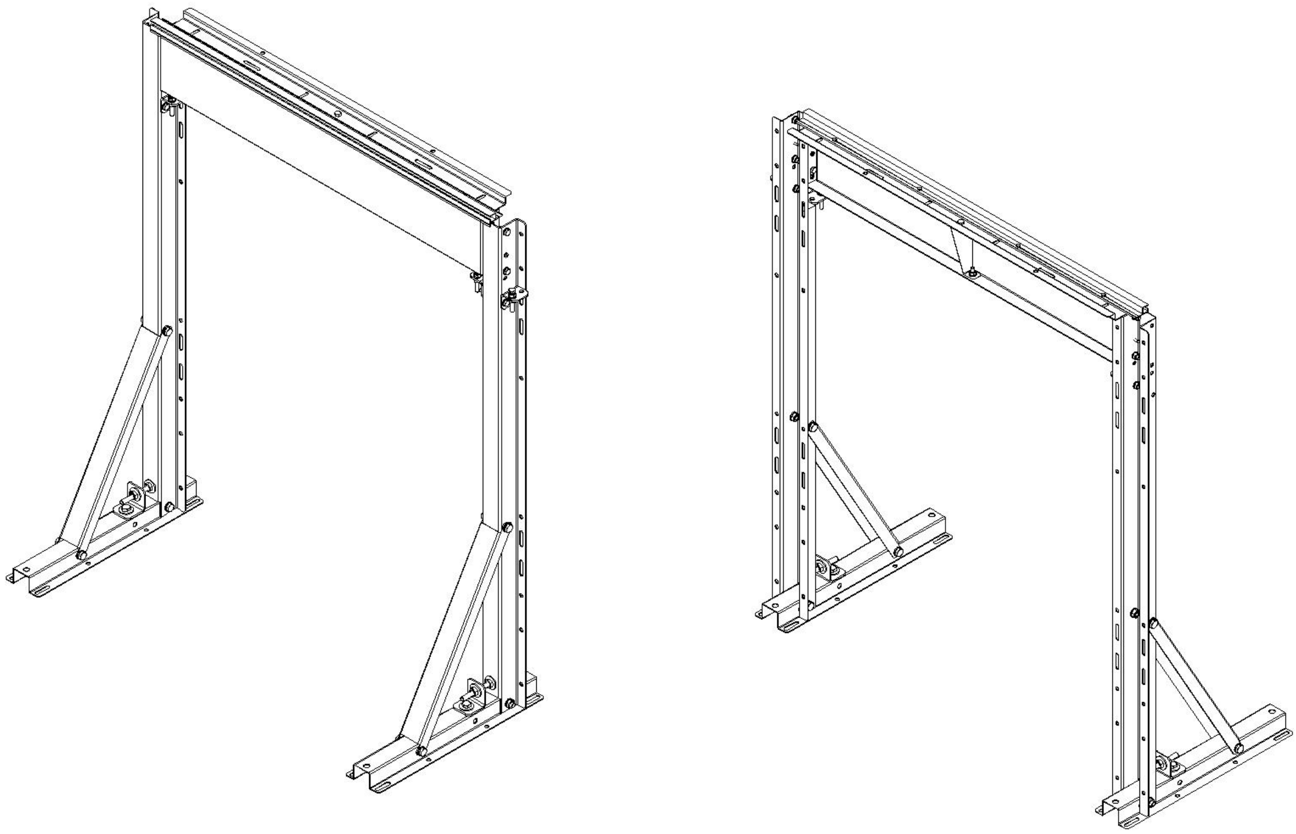
Fig. 3 - ASSEMBLED ABOVE GROUND LATERAL MODULE



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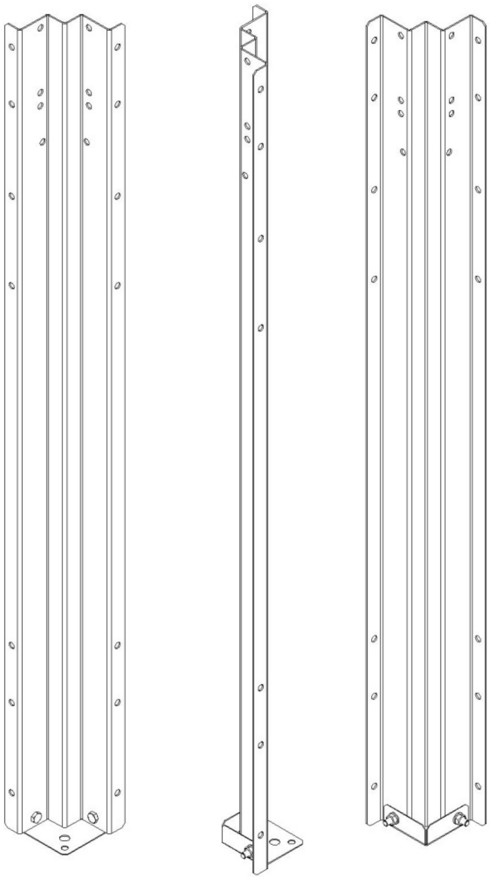
ANGULAR MODULES

The ANGULAR modules of the models intended for ABOVE GROUND mounting consist of a corner foot.

Fig. 4 – ANGULAR MODULE: corner foot



Therefore, by connecting two upper connection plates to the corner foot at 90°, the standard angular module length of 1 m is obtained.

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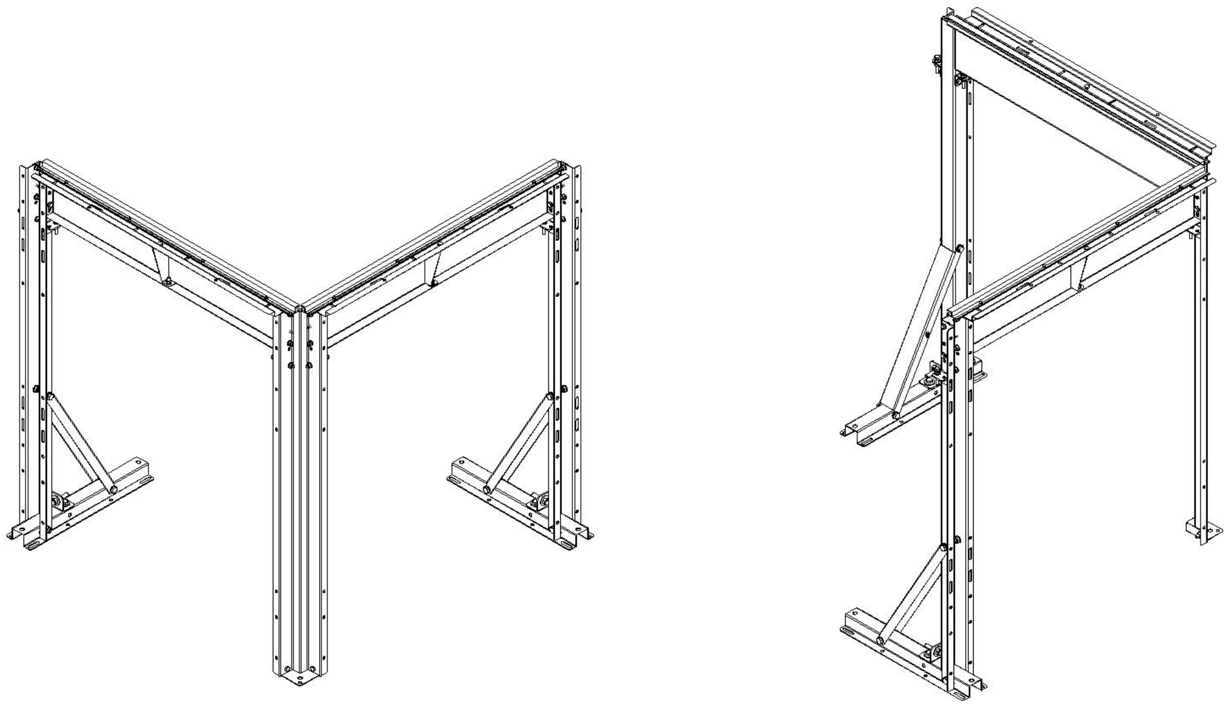
Fig. 5 – DOLCEVITA ®: ASSEMBLED CORNER MODULE



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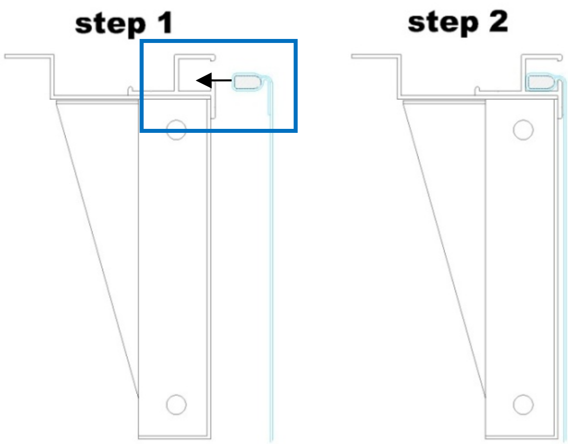
TENSILE-STRUCTURAL AND WATER-CONTAINING MEMBRANE

The water containment fabric is made with a weft and warp fabric of polyester fibres coated with PVC on both sides. The material, suitably treated for UV resistance thanks to the use of additives that limit ageing, is tested and certified as resistant to **a tensile load equal to N = 3.50 kN / 5 cm "strip" - according to DIN 53354 standards.**
The edge of the sheet, suitably shaped, is inserted into the groove of the upper connection plate, as shown in the following figure (steps 1 and 2):

Fig. 6 – DOLCEVITA ® – INSERTION OF WATER CONTAINMENT SHEET



Finally, the sheet is fixed in place using an appropriate *plastic extruded PVC profile* that blocks the release of the edge of the sheet from the groove (steps 3 and 4):

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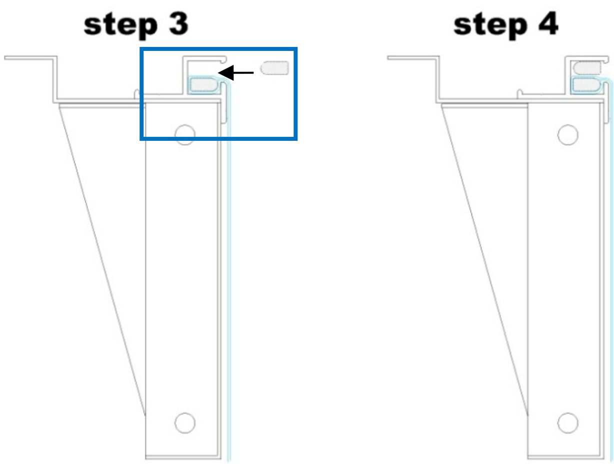
Fig. 7 – DOLCEVITA ® – FASTENING OF WATER CONTAINMENT SHEET



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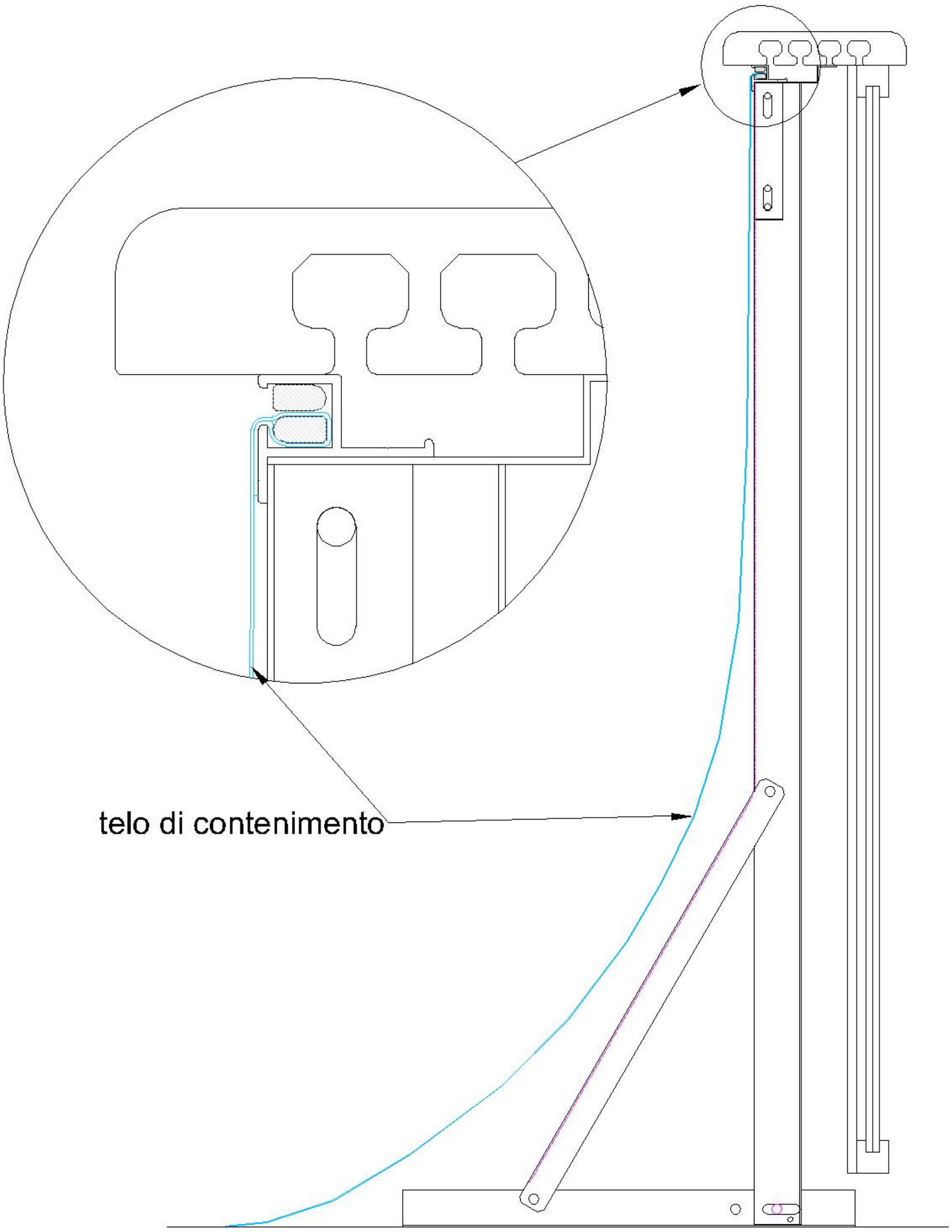
The following figure shows, in section, an overview of the sheet and the fixing point with respect to the lateral module.

Fig. 8 – DOLCEVITA ® - WATER CONTAINMENT SHEET AND LATERAL MODULE



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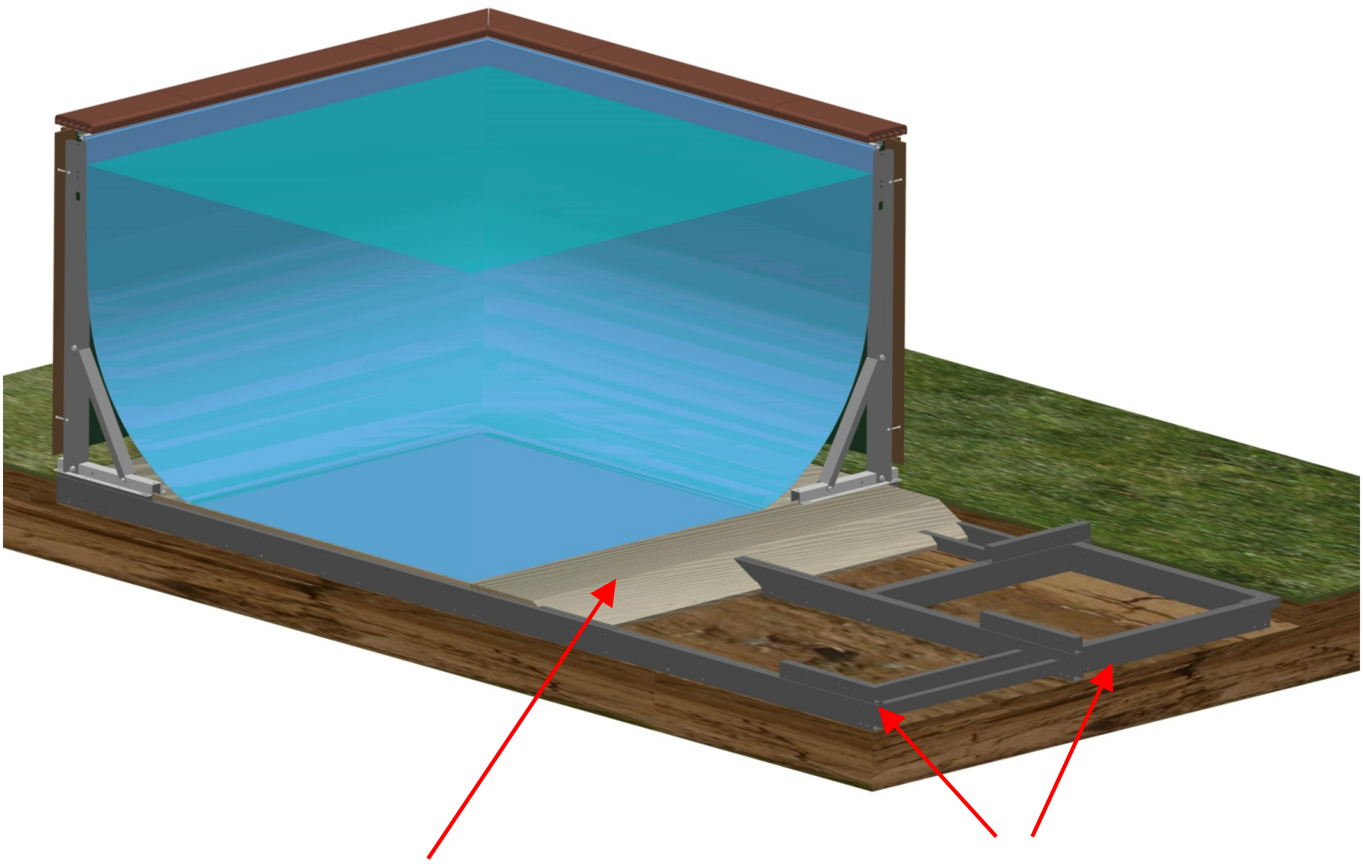
POSITIONING ON THE GROUND

DOLCEVITA ®, regardless of the version, must be positioned above a **support surface** suitable for supporting the weight of the water and the structure of the pool itself.

- In the presence of a reinforced concrete base (existing or new), the main modules can be fixed using suitable mechanical anchors – or chemical fixings, depending on the characteristics of the support itself.
- In the absence of a reinforced concrete base, it is not appropriate to create a "direct support" on the ground.
  Between the bottom of the pool and the ground there will then be **a frame of metal profiles** (arranged in a "grating"), between which a sand filling bed must then be laid. The function of the grating is to keep the containment sheet raised with respect to the "virgin" soil. It will be the filling in sand that will ensure the presence of an adequate distribution surface for the above load.

Fig. 9 – EXAMPLE OF LAYING ON THE LOWER GRATING



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Below are, by way of example, the plan view and the section of a structure on a base with metal profiles, corresponding to a water surface of **3 x 7 meters**.

Fig. 10 – EXAMPLE OF PLAN VIEW / water surface of 3 x 7 m

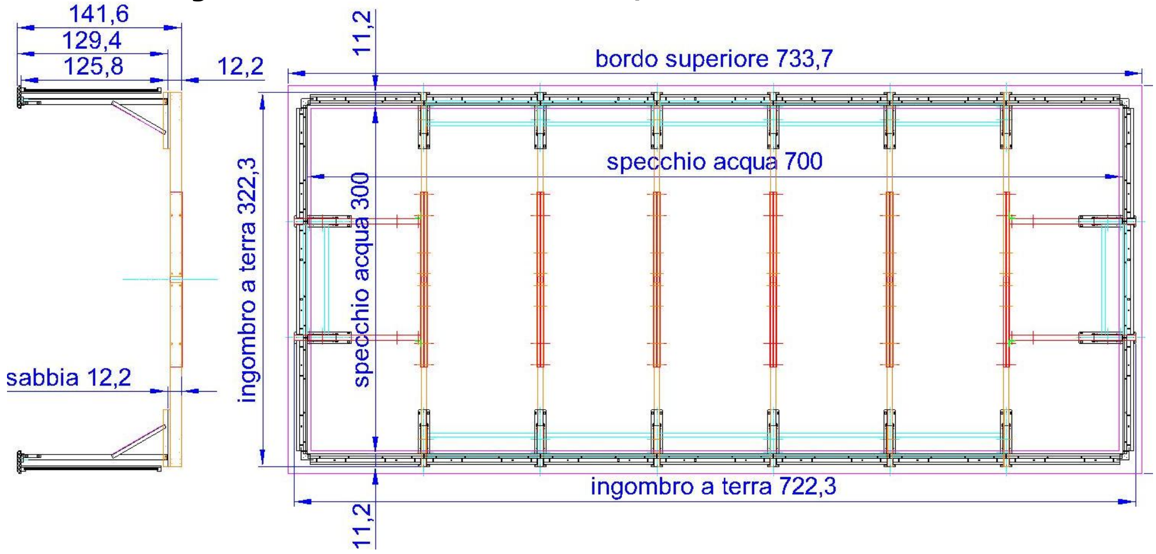
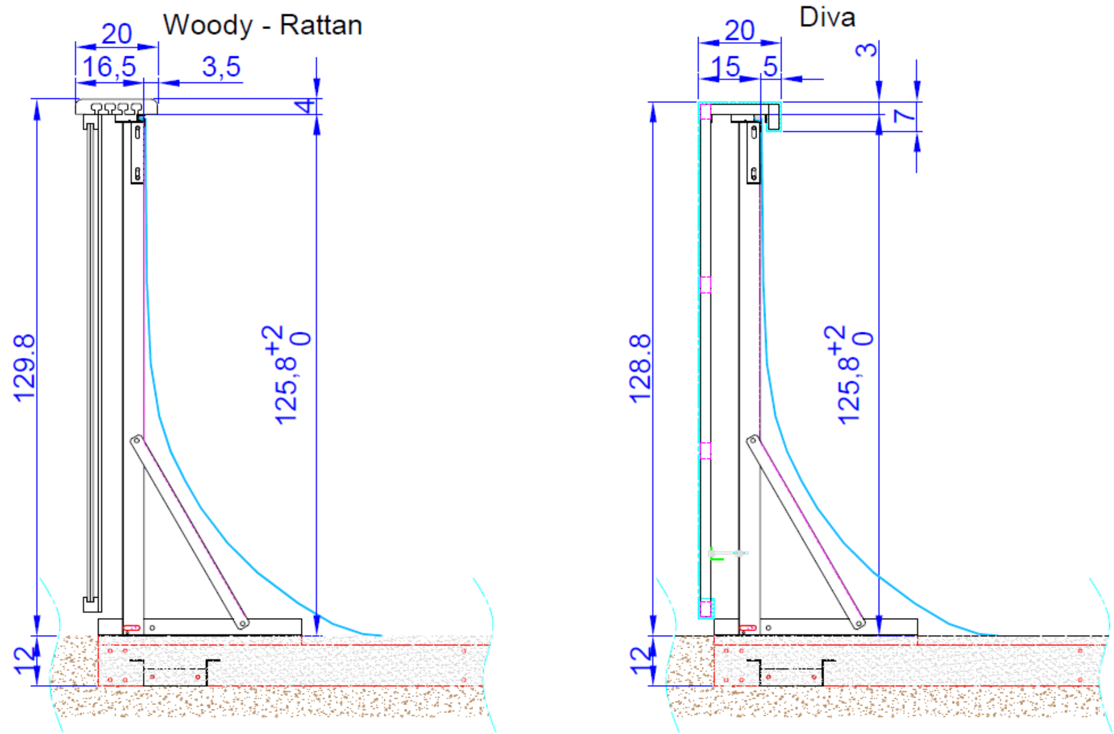


Fig. 11 -SAMPLE SECTION



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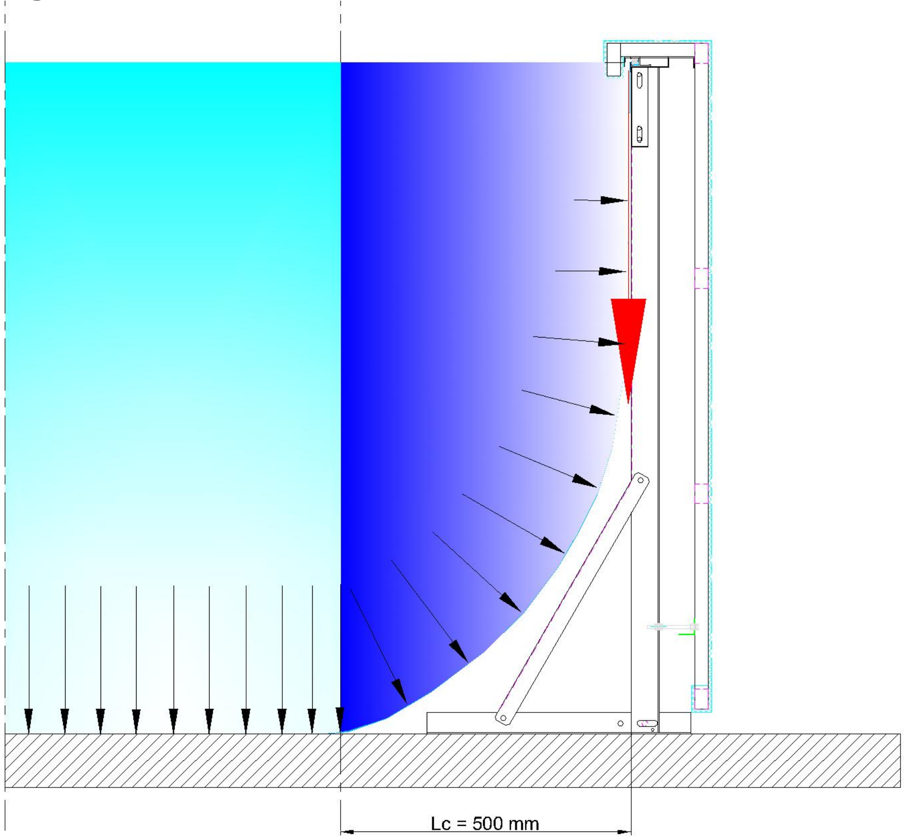
SCHEME AIMED AT STRUCTURAL VERIFICATION

From the section shown in Fig.12, it can be seen that the hydrostatic pressure force is always perpendicular to the surface of the membrane. The sum of the pressure forces acting on the membrane results in a force (load) applied to the point of attachment of the sheet in a direction that we can consider vertical.

Fig. 12 – Portion of a standard SECTION/Load volumes and rates



With a pool water fill height of 1250 mm, the vertical load exerted by the sheet on the structure is:

Qp= 1.25^2x9810/2 = 7,664 kN/m Load exerted by the sheet expressed per linear m of structure

Since the structural module is repeated at a distance of 1 m, this load "per meter" is in absolute value the load supported by each vertical element.

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STRUCTURAL CHECK/INPUT DATA

General structure design criteria, Applied Standards

Eurocode 1 - Loads on structures

- EN 1991 -1 Loads in general

Eurocode 3 – Design of steel structures

- EN 1993-1-1 - General rules and rules for buildings
- EN 1993-1-3 - General rules - Additional rules for the use of profiles and thin sheets

  cold bent

- EN 1993-1-4 - General rules - Additional rules for stainless steels
- EN 1993-1-8 - Design of joints
- EN 1993-1-10 - Design of structures with tensioned elements

Loads acting on the structure:

Max pool water fill height: **Hw = 1.250 mm**

Vertical tensile load exerted by the sheet per metre of structure:

Qp = 1.25^2x9810/2 = **7665 N/m = 7,665 kN/m**

In Fig. 13 is the simplified "iron wire" model of a module used for verification.

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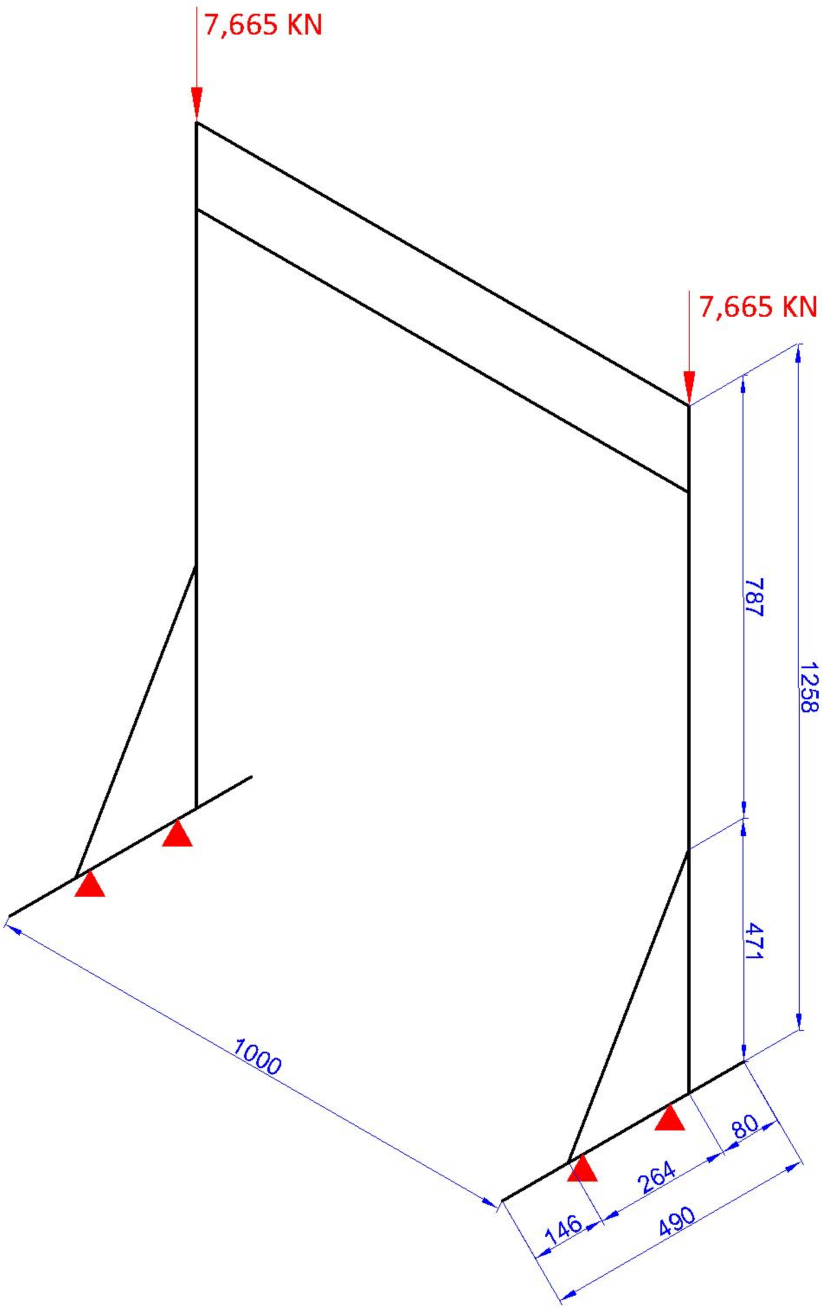
Fig. 13 - Display of the simplified "iron wire" model of a module



The present load can be defined as a permanent non-structural load, therefore a combination coefficient of 1.5 is used in the SLU calculation.

7,665 x 1.5 = **11.5 kN/m**

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Static characteristics, section properties and resulting stresses:

OMEGA FOOT 25X40X48X1.5mm, cold formed, in AISI 304 STAINLESS steel:

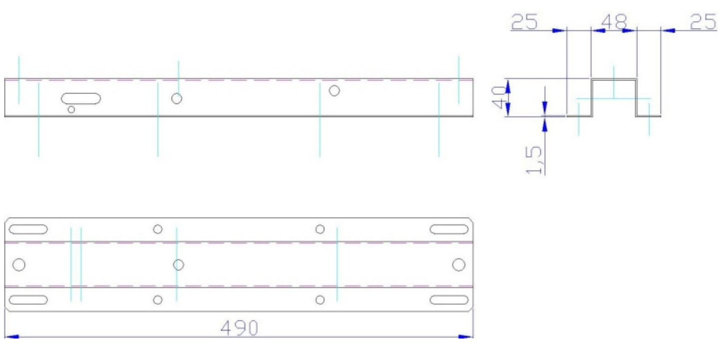
- J = 6.716 cm4 Moment of inertia
- Wx=3.358 cm3 Resistance module
- Area = 258 mm_2
- i = 16.13 mm Radius of inertia
- Material used for profile: AISI 304 STAINLESS STEEL:
  - Yield stress f_y: 210 N/mm_2
  - Rupture stress f_u: 515 N/mm_2
  - **Design values:**

    Design Yield stress $\mathbf{f_{yd}} = f_{yk}/\gamma_M$: 210/1.05 = **200 N/$mm_2$**

    where $\gamma_M = 1.05$

    M_{ed} / Wx < f_{yk}/γ_M = 600/3.35=**178 N/mm_2**< 210/1.05= 200 N/mm2

    Ratio = 0.89 Verified



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OMEGA VERTICAL POLE 25X51X53X2mm, cold formed, in structural steel S250GD ZM310:

- J = 16.19 cm4 Moment of inertia
- Wx=6.29 cm3 Resistance module
- Area = 399 mm_2
- i = 20.2247 mm Radius of inertia
- Free bending length = 840 mm
- Material used for profile: structural steel **S2G50D ZM310**
  - Yield stress f_y: 250 N/mm_2
  - Rupture stress f_u: 330 N/mm_2
  - **Design values**

    Design Yield stress $\mathbf{f_{yd}} = f_{yk}/\gamma_M$: 250/1.05 = **238 N/mm2**

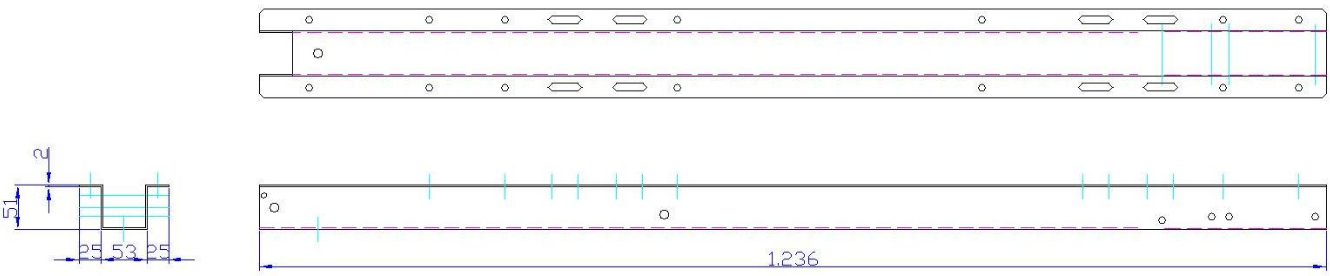
    where γ_M = 1.05

    M_{ed} / Wx < f_{yk}/γ_M = 422/6.29= **67 N/mm2**< 250/1.05= 238 N/mm2

    Ratio = 0.3 Verified

Peak load verification

Slenderness ratio of the pole $\boldsymbol{\lambda = l_c/i = 42}$ < 150, for the verification of stability at peak load the slenderness ratio in the structural membranes in presence of significant efforts must be less than 150.



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TIRANTE U 30X58X2mm, formato a freddo, in acciaio strutturale S250GD ZM310:

- J = 12.03 cm4 Momento d'inerzia
- Wx= 4.15 cm3 Modulo di resistenza
- A = 228 mm^2
- i = 22.97 mm Raggio d'inerzia
- Lunghezza libera di inflessione = 536 mm
- Materiale usato per il profilo: acciaio strutturale **S250GD ZM310**
  - Tensione di snervamento f_y: 250 N/mm^2
  - Tensione di rottura f_u: 330 N/mm^2
  - **Valori di progetto**

    Design Yield stress $\mathbf{f_{yd}} = f_{yk}/\gamma_M$: 250/1.05 = **238 N/$\mathbf{mm^2}$**

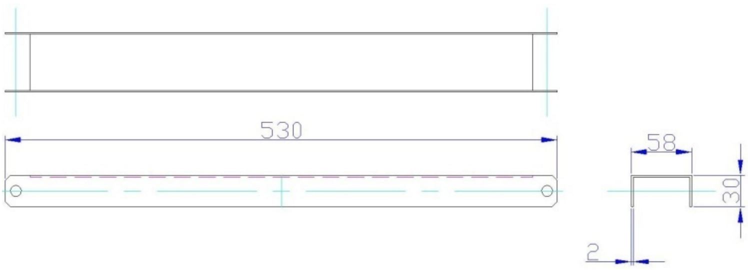
    dove $\gamma_M = 1.05$

    $N_{ed} / A < f_{yk}/\gamma_M$ = 950/228= **4.2 N/mm2**< 250/1.05= 238 N/mm2

    Ratio = 0.02 Verificato

Verifica carico di punta

Coefficiente di Snellezza del tirante **$\lambda = l_c/i$ = 24** < 150 per la verifica di stabilità al carico di punta il coefficiente di snellezza nelle membrature strutturali in presenza di azioni rilevanti deve essere inferiore a 150.



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USEFUL RESULTS FOR THE CUSTOMER

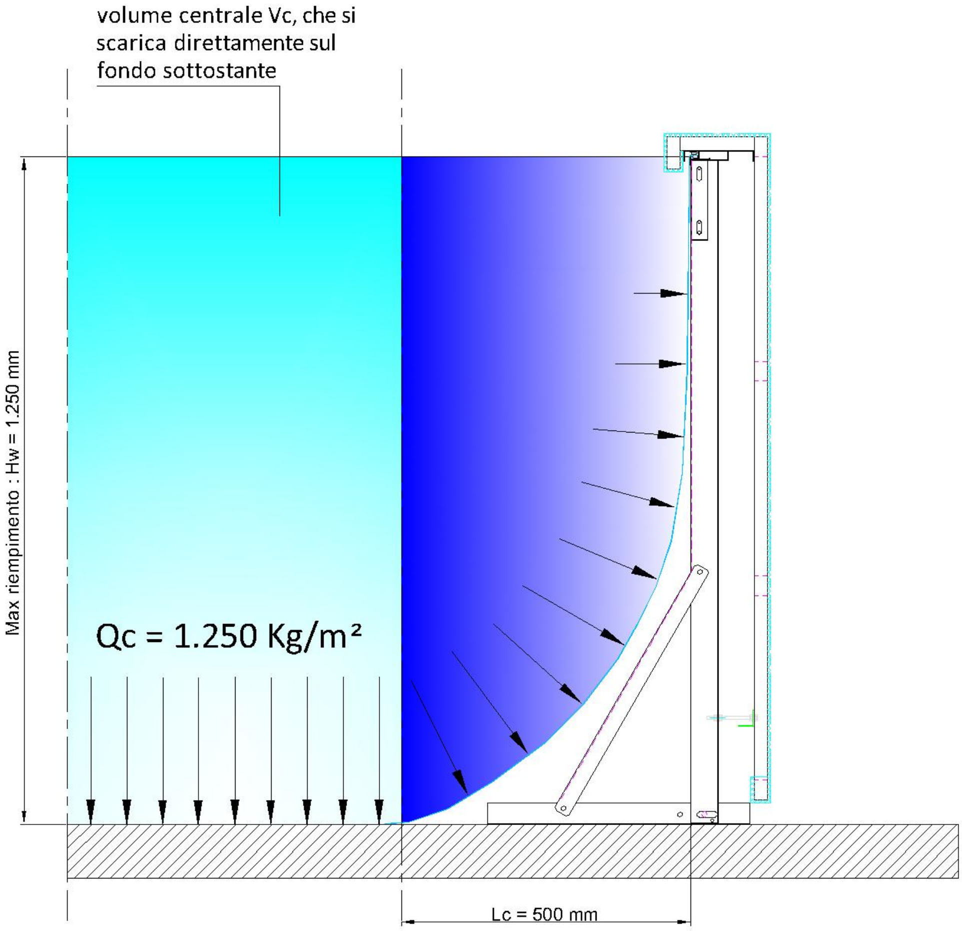
Below are some diagrams in which the Customer can immediately have an idea of the maximum (static) stresses that the pool in operation transfers to the underlying base.

- GROUND LOAD:

I. Below the **CENTRAL VOLUME** (pool surface removed 0.5 m from each side) the base is stressed by a UNIFORMLY DISTRIBUTED VERTICAL load equal to:

- **Qc = 1,250 kg / m_2 = 12,262 kN/m_2**

Fig. 14 – Section portion and Qc load



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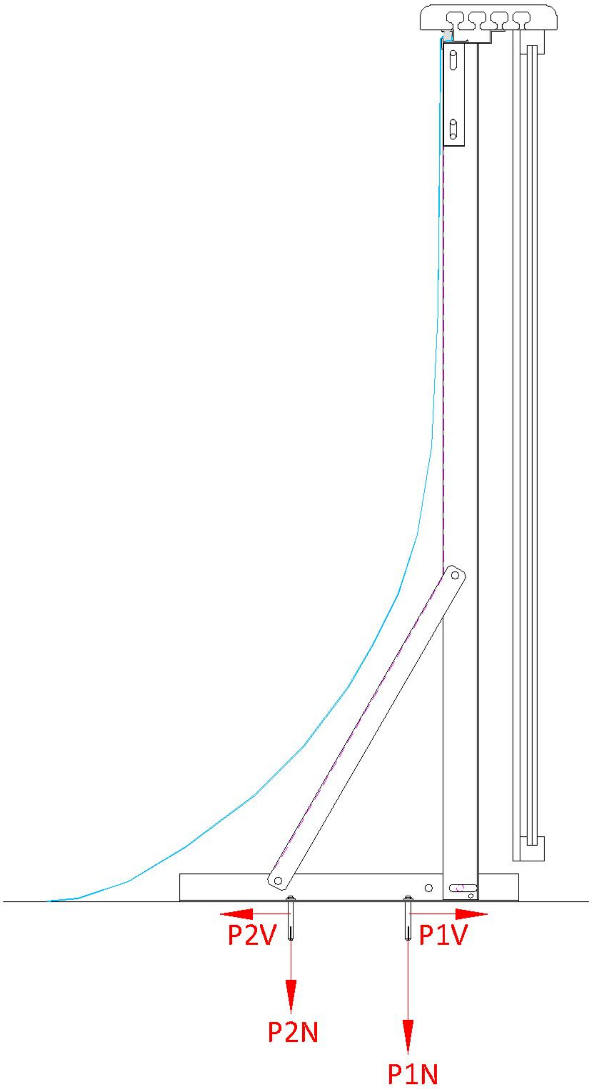
- LOADS CONCENTRATED ON THE SUPPORT POINTS:

II. **ALONG THE PERIMETER**, the stresses transferred to the base are PUNCTUAL: these are the CONCENTRATED loads transferred to the anchor pins. They assume the following MAXIMUM values (see direction and position for each in the graphic diagram):

- **P1N = 10,672 kN (vertical)** **P1V = 0.465 kN (horizontal shear)**
- **P2N = 0.828 kN (vertical)** **P2V = 0.465 kN (horizontal shear)**

Fig. 15 – Side view of the vertical support and loads "P"



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