# LIFT PILE®

## LIFT AND FIX

**PRESSURE MICROPILES WITH ADJUSTABLE PRELOAD DEVICE**

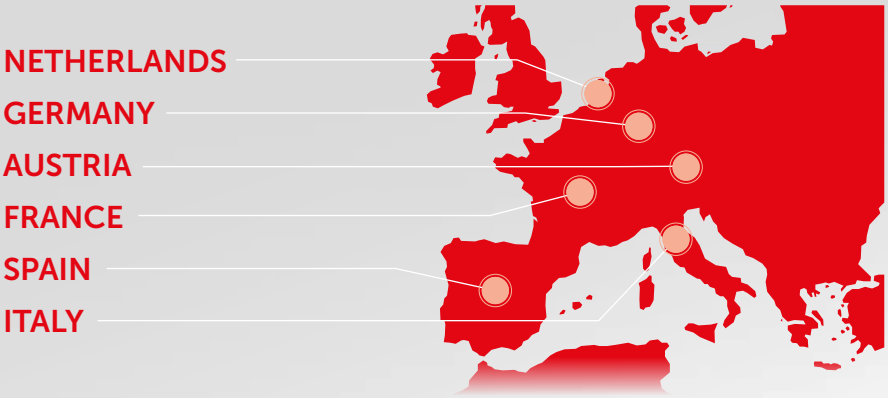
EUROPEAN PATENT FILED

NOVATEK®
Foundation repair

# OUR COMPANY

Novatek provides a range of foundation and flooring repair interventions with a range of new, patented and well proved technologies, such as pressure micropiles with adjustable preload device, grouting with expanding resins, self-drilling micropiles and armored resin piles. Our methods have been developed to be minimal invasive and have been tested and certified through thousands of interventions.
Foundation settlements can lead to cracks or gaps in the walls and at worst, to the shifting of the building. You might notice that, due to the settlement and shifting of the house, the doors and windows are not closing properly, and the floors can get uneven and sink, opening cracks and causing planarity unevenness.
When problematic foundation issues occur, it is necessary to find a solution by reinforcing the foundations and increasing the bearing capacity of the soil.

Novatek offers advanced technologies allowing solving quickly and fully settlement and shifting issues of homes and industrial buildings. Novatek technologies keep the building practicability and a 15 year warranty is offered as well. Unlike the common repair techniques, which can be very expensive and disruptive, Novatek solutions are minimal and do not require any digging.
With over 20 years of experience Novatek is present all over Italy and in other Europeans countries such as Spain, France, Germany and Austria, Switzerland and Netherlands.




# **LIFT PILE**® what is it?

LIFT PILE® is an innovative system allowing lifting and repairing structures by transferring the load of the building down through the upper weak layer of topsoil to the stronger layer of subsoil below. The LIFT PILE® is made of a **pressure micropile of rolled steel** and an **adjustable preload device**.

1. Pressure micropile
2. Micropile tip
3. Adjustable preload device
4. Threaded joint
5. Micropile with threaded joint

# LIFT PILE® what is it?

LIFT PILE® module detail

Driving of a LIFT PILE® module

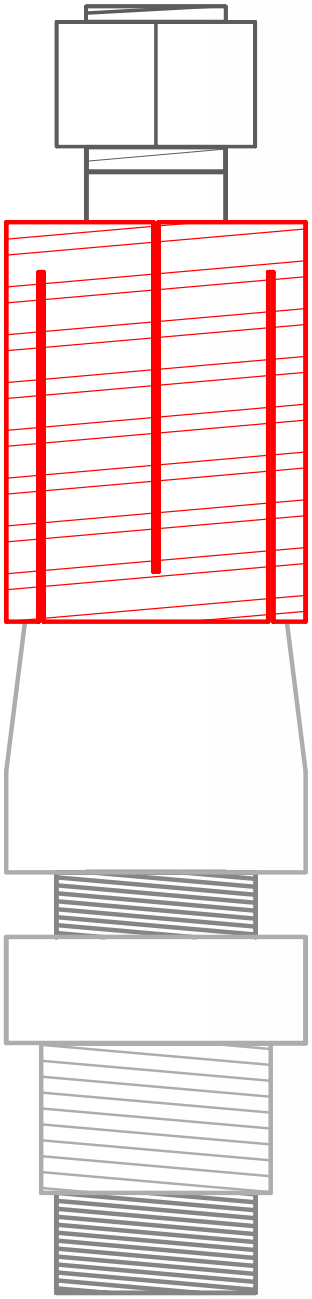
A pressure micropile is a cylindrical structure composed of rolled steel modules connected together by a threaded joint. They are driven into the soil by the pressure exerted by a hydraulic jack. The jack is anchored to the structure to be repaired and lifted by means of steel bars.


Pressure gauge to read the driving pressure

Driving of a LIFT PILE® module

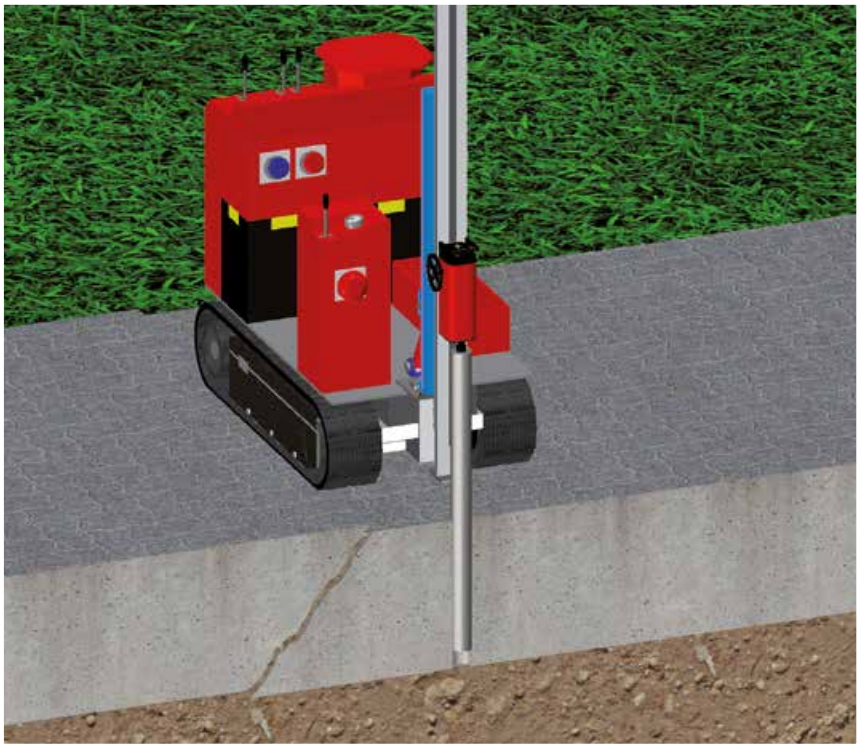
# LIFT PILE® what is it?

The **adjustable preload device** is a piece of steel connected to the top of the micropile and stuck inside the foundation. Once the process is completed, it is possible to proceed with the micropile preloading by means of a specific key torque until the design capacity is reached.



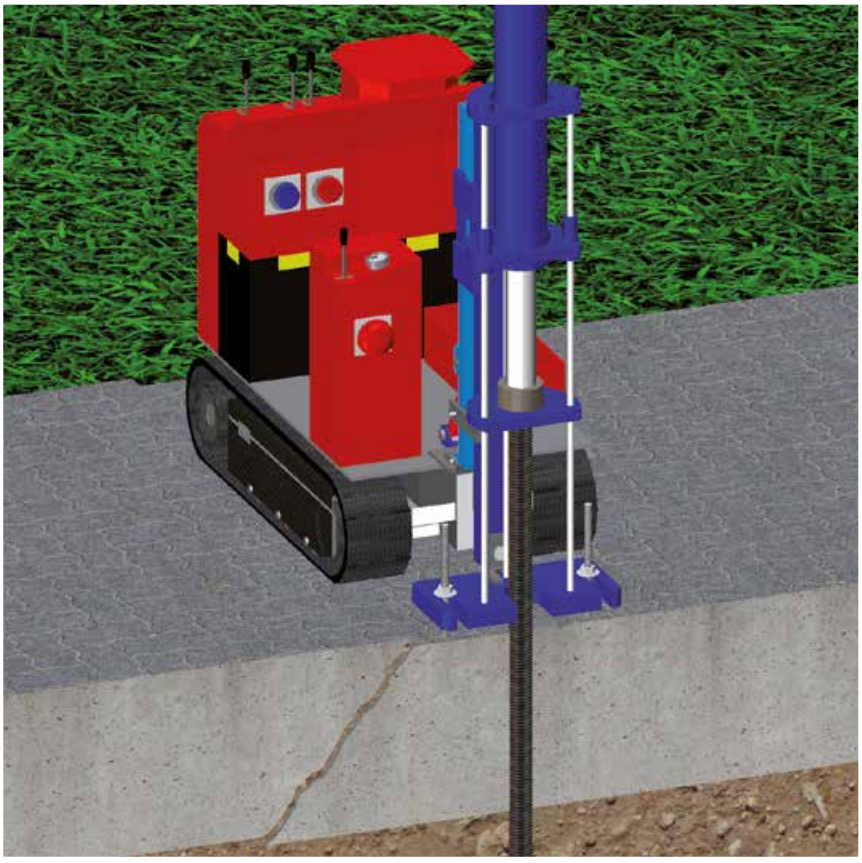
## **STEP ONE**
## DRILLING OF THE FOUNDATION

The first step is the boring of a 64mm (2.52") diameter hole, crossing the foundation until reaching the soil underneath.



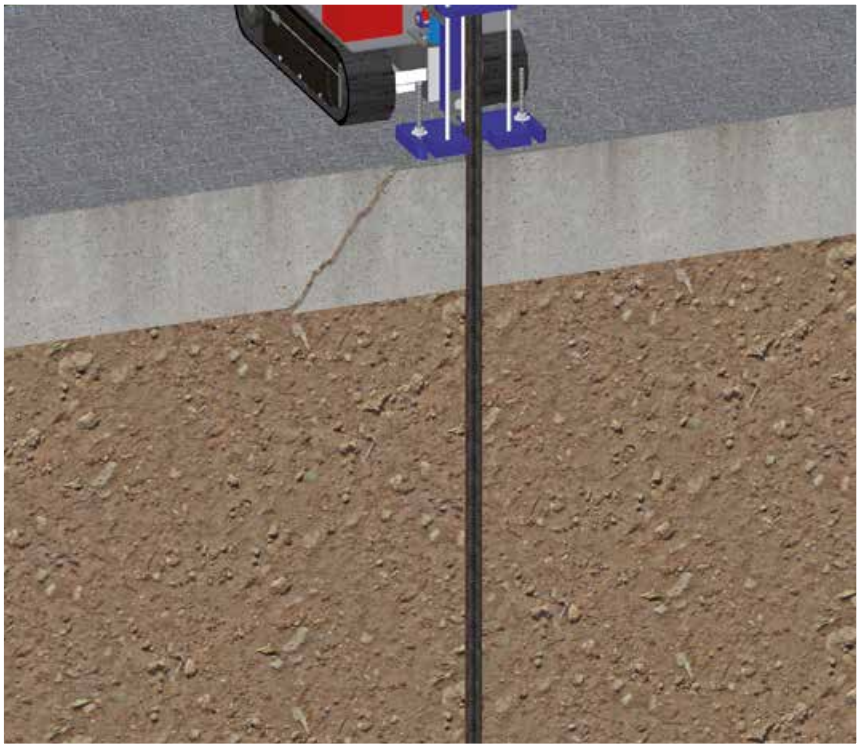
## **STEP TWO**
## MAKING ANCHORS AND MICROPILE INSTALLATION

The following step involves two drilled in, grouted threaded rods (20 mm diameter steel bars / 0.79") around each micropile for securing the foundation to the hydraulic jack necessary for the driving. The micropile is driven through the central hole by the pressure exerted by the hydraulic jack, using the two anchors as counter force. The one meter long modules (3.28") are connected to each other by means of high resistance steel threaded joint.



## **STEP THREE**
## DRIVING THE MICROPILE INTO DEPTH

The micropile, often with an added tip to make the driving easier, reaches the underneath soil, which is strong enough to contrast the driving pressure. LIFT PILE® generates along its shaft a radial compaction action on the soil, thus further increasing the end-bearing capacity of the pile.



## **STEP FOUR**
## INSERTING THE ADJUSTABLE PRE-LOAD DEVICE

Once the design depth and pressure are obtained, it is time to put on the **adjustable pre-load device** to connect and secure the micropile's tip to the foundation.

## **STEP FIVE**
## STARTING THE ADJUSTABLE PRE-LOAD DEVICE

Once secured, the pre-load device is started by means of torque screwdriver until the design pre-load and lifting requirements are satisfied.

## **STEP SIX**
## LOCKING OF THE MICROPILE

At the end of the preloading and lifting operation, the LIFT PILE® is securely locked inside the foundation by casting of expanding cement mortar for grouting, like MasterFlow 928.

# Fields of **APPLICATION**

## 1 Lifting and repair of shifting or sinking structures

- *Sloping buildings*
- *Differential settlements and cracks on the structure*

## 2 Pre load of slabs on grade for the building of new or prefabricated structures

## 3 Increase of the foundation bearing capacity in case of raising of the height

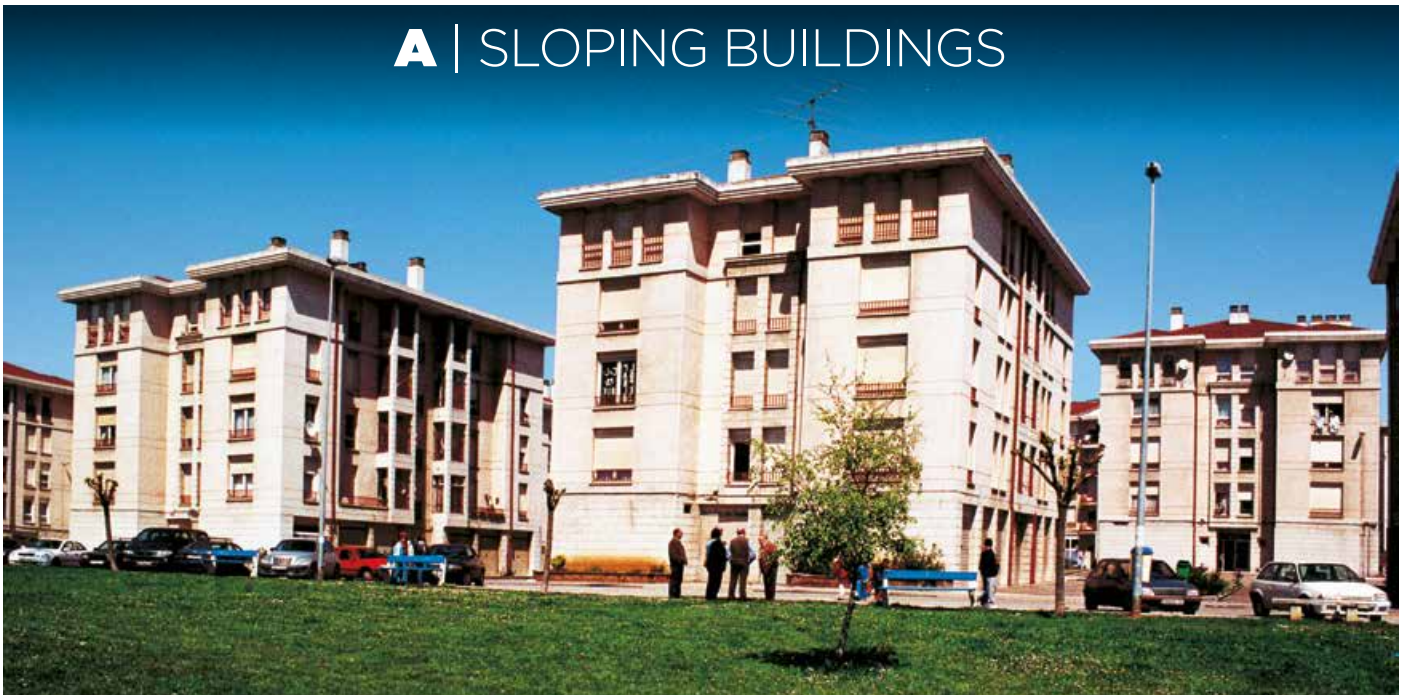
## 4 Concrete foundations, floorings or footing repairs

- *Industrial flooring supporting heavy machineries or their passage*
- *Flooring supporting racks*
- *Outside pavements*
- *Tanks and silos*
- *Reinforced concrete bases*
- *Swimming pool foundations*

# LIFTING AND REPAIR OF SHIFTING OR SINKING STRUCTURES

**1**

## A | SLOPING BUILDINGS



### MAIN CAUSES

- Poor mechanical features of the soil;
- Undersize of the foundation bearing capacity;
- Soil settlements due to groundwater level;
- Gradual and progressive soil washout on one side, due to the poor rainwater regimentation or leaks in the utilities;
- Variations of the loads imposed on the structure;
- Presence of trees and shrubs roots in the immediate vicinity of the property.

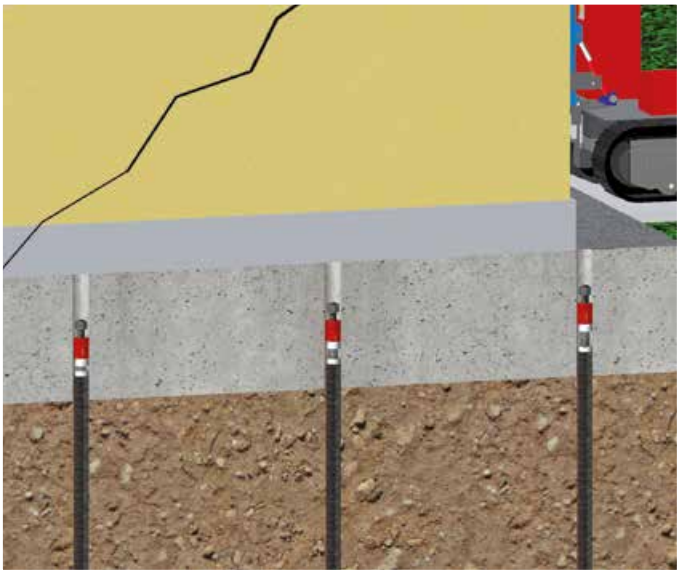
# LIFTING AND REPAIR OF SHIFTING OR SINKING STRUCTURES

**1**

## B | DIFFERENTIAL SETTELMENTS OF THE BUILDINGS WITH CRACKS ON THE STUCTURE

### MAIN CAUSES

- Poor mechanical features of the soil;
- Undersize of the foundation bearing capacity;
- Soil settlements due to groundwater level;
- Gradual and progressive soil washout on one side, due to the poor rainwater regimentation or leaks in the utilities;
- Variations of the loads imposed on the structure;
- Enlargement on backfill;
- Presence of trees and shrubs roots in the immediate vicinity of the property.



# PRE LOAD OF GRADE SLABS FOR THE BUILDING OF NEW OR PREFABRICATED STRUCTURES

**2**

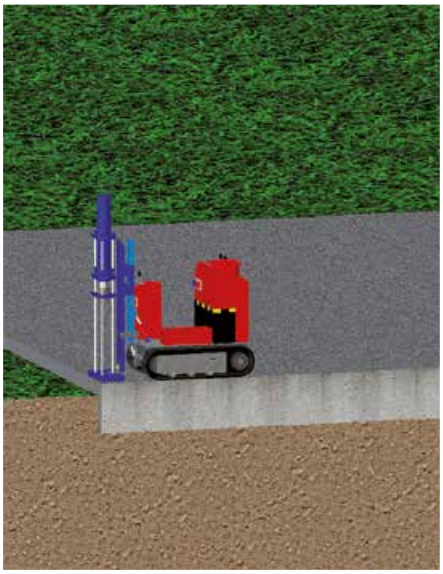
## MAIN CAUSES

**In the design phase:**

- Poor soil mechanical features upcoming after geotechnical tests;
- Soil settlements due to the groundwater level movements.

**At runtime:**

- Undersize of the foundation bearing capacity;
- Failures in the foundation design or making.



# INCREASE OF THE FOUNDATION BEARING CAPACITY IN CASE OF RISING OF THE HEIGHT

3

Interventions of lifting and repairing of grade slabs for load increase due to the raising of the height.

## MAIN CAUSES

- Inadequate backup foundation bearing capacity;
- Variations of the loads imposed on the structure.

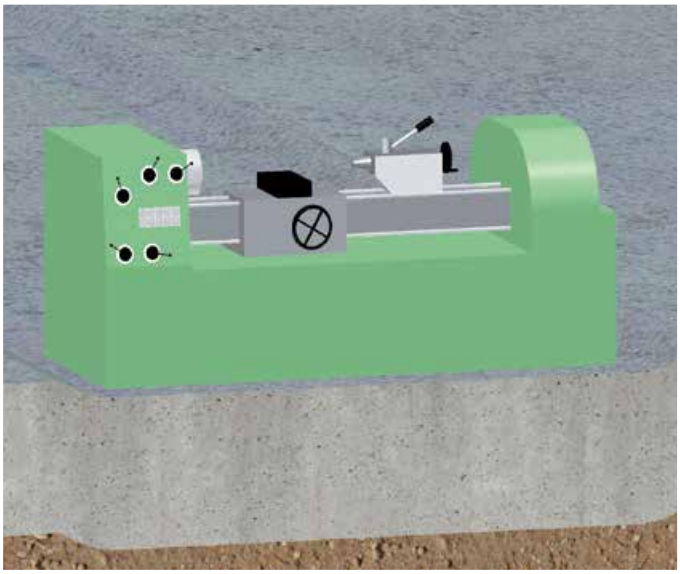
# CONCRETE FOUNDATIONS, FLOORING OR FOOTING REPAIRS

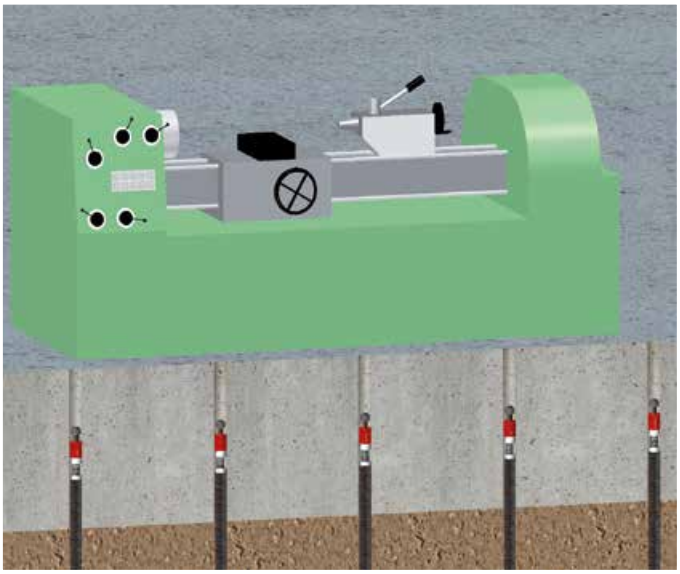
**4**


## A | INDUSTRIAL FLOORING SUPPORTING HEAVY MACHINERY OR THEIR PASSAGE

MAIN CAUSES

- Vibrations of heavy machinery and production lines;
- Poor mechanical features of the soil;
- Undersize of the foundation bearing capacity.





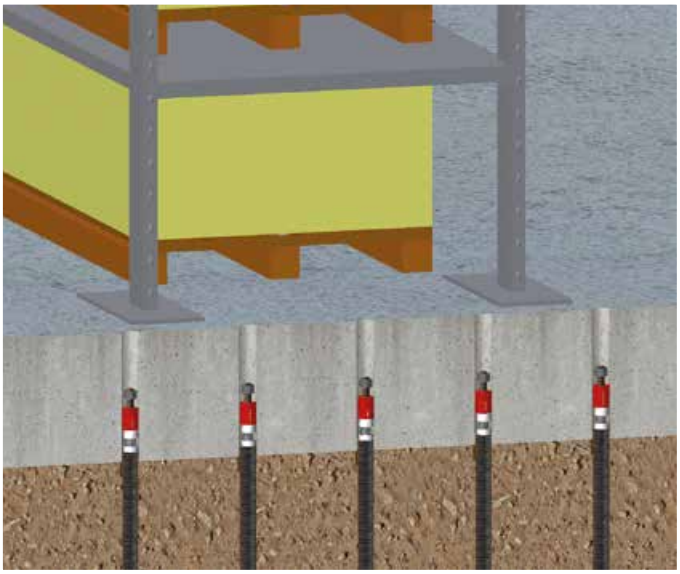
# CONCRETE FOUNDATIONS, FLOORING OR FOOTING REPAIRS

**4**

## B | INDUSTRIAL FLOORING SUPPORTING MEZZANINES OR SHELVING

MAIN CAUSES

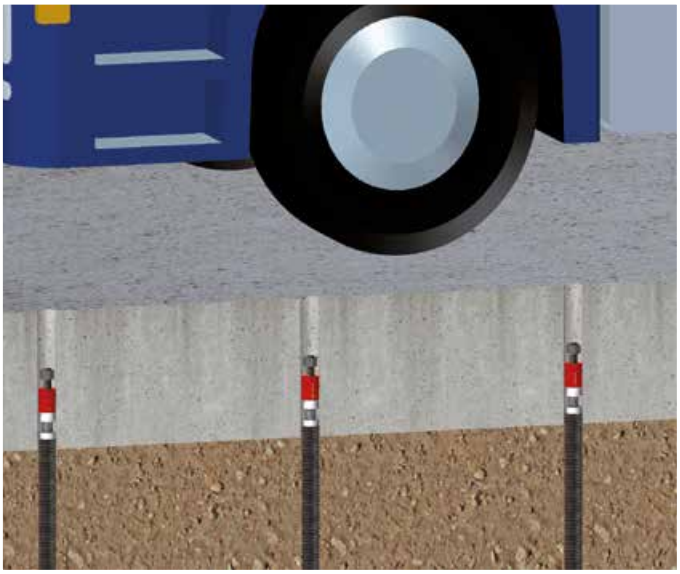
- Poor mechanical features of the soil;
- Undersize of the foundation bearing capacity.



# CONCRETE FOUNDATIONS, FLOORINGS OR FOOTING REPAIRS 4


## MAIN CAUSES

- Vibrations from heavy vehicles and heavy machinery movements;
- Soil settlements from groundwater level;
- Uneven soil washout from poor regimentation of rainwater or leaks in the utilities;
- Variations of the loads imposed on the structure;
- Poor soil mechanical features (on backfill);
- Presence of trees and shrubs roots in the immediate vicinity of the structure.

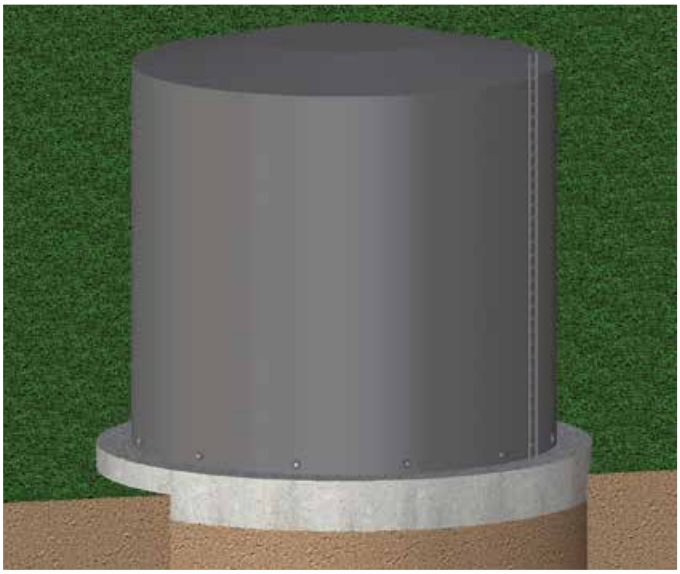


# CONCRETE FOUNDATIONS, FLOORINGS OR FOOTING REPAIRS 4

## D | SILOS AND TANK FOUNDATIONS

MAIN CAUSES

- Poor mechanical characteristics of the soil;
- Undersize of the foundation bearing capacity;
- Cyclic variations of the loads imposed on the structure.



# CONCRETE FOUNDATIONS, FLOORING OR FOOTING REPAIRS

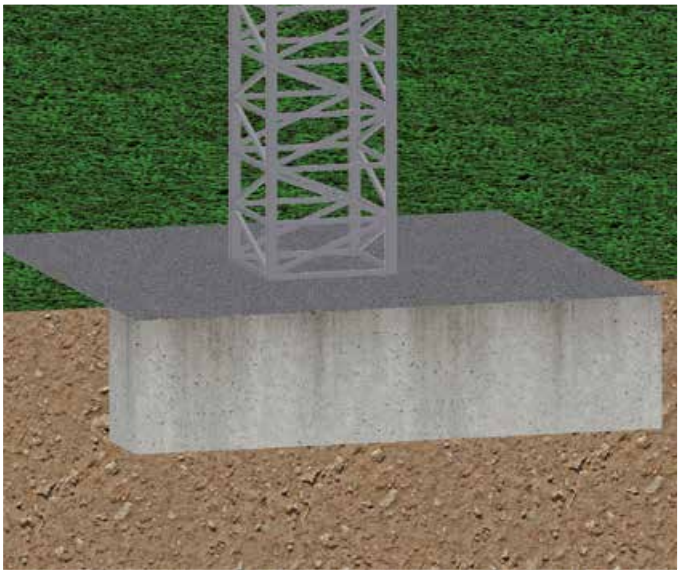
**4**

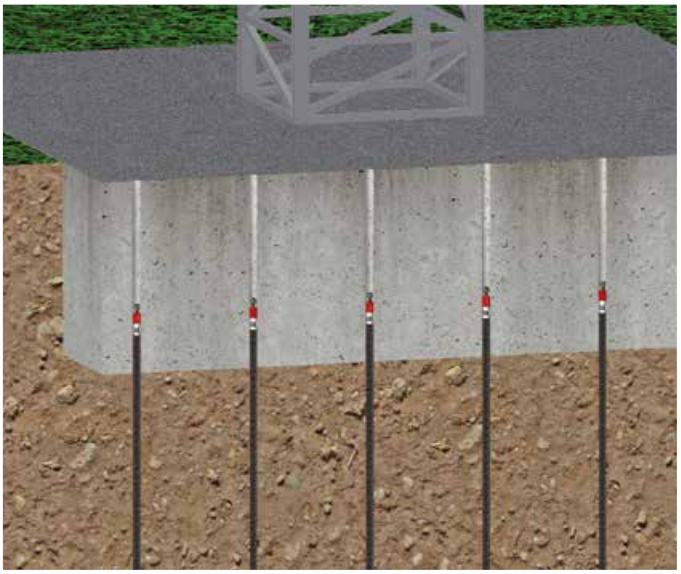
## E | REINFORCED CONCRETE BASES

Lifting and repair of trellises, cranes, bridge cranes, telephone or television antennas and metallic structures for advertising signs.

### MAIN CAUSES

- Poor mechanical characteristics of the soil;
- Undersize of the foundation bearing capacity;
- Undersize of the foundation for the contrast of horizontal loads (wind and earthquake).





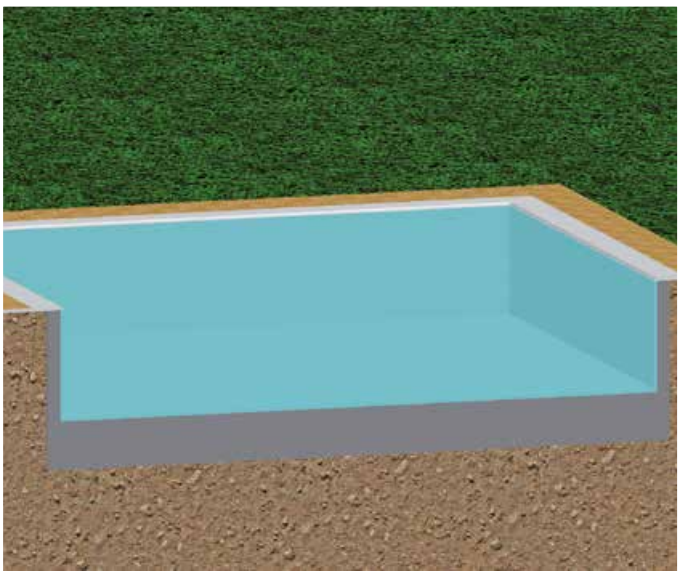
# CONCRETE FOUNDATIONS, FLOORING OR FOOTING REPAIRS

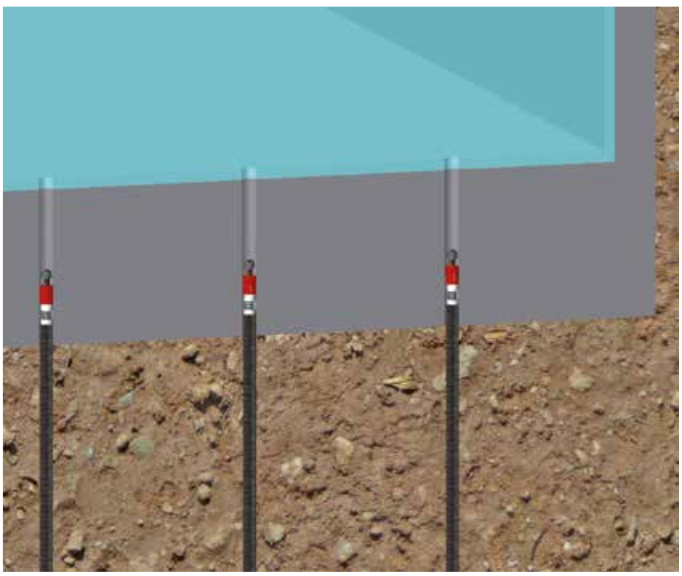
4

## F | SWIMMING POOL FOUNDATIONS

MAIN CAUSES

- Poor mechanical characteristics of the soil;
- Undersize of the foundation bearing capacity;
- Cyclic variations of the loads imposed on the structure.





# ADVANTAGES

## LIFTS AND REPAIRS

The adjustable preload device lifts and repairs the structures until they are level, even by more than 30 cm.

## IMMEDIATE CHECK

The bearing capacity of each LIFT PILE® is individually tested during the intervention and calibrated by means of the device.

## HIGH DESIGN BEARING CAPACITY

LIFT PILE® allows reaching the design capacity by means of the pressure exerted by the jack.

## QUICKNESS AND MINIMAL DISRUPTION

Quick interventions with no need for soil removal, keeping the building practicability and the structure's function.

## PRELOAD INTERVENTIONS

LIFT PILE® allows the designer to diminish the structural stresses on the foundations of new buildings.

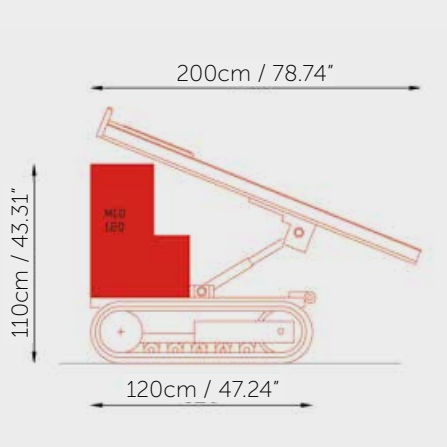
## IMMEDIATE RESTORATION AND NOVATEK WARRANTY

The customer may close the cracks immediately after the intervention. The LIFT PILE® repairs have a 15 years warranty.

# Impact and **OPERATION ROOM**

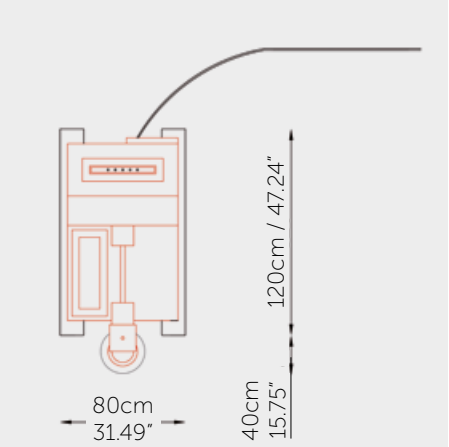
The operation room regarding each step of the works and further executive notes for working conditions with particular room limits are described here below.

## SPACES AND DIMENSIONS FOR THE USE OF THE HALF TRACK MACHINERY WITH CORE DRILL COLOUMN OR PILING COLOUMN




Sectional dimensions of the half-track machine with piling column and closed coring column

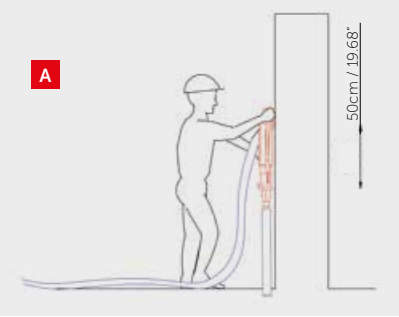

Sectional dimensions of the half-track machine with piling column and opened coring column

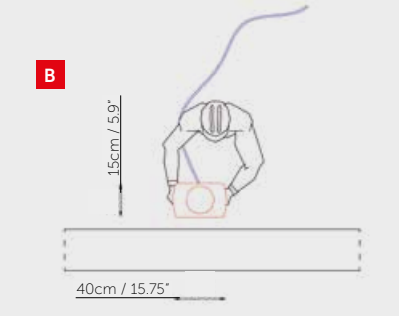


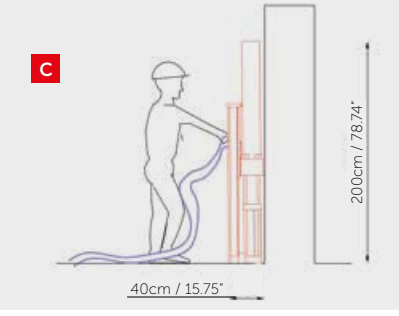

Dimensions in plan of the medium half-track with piling drill column and opened coring column

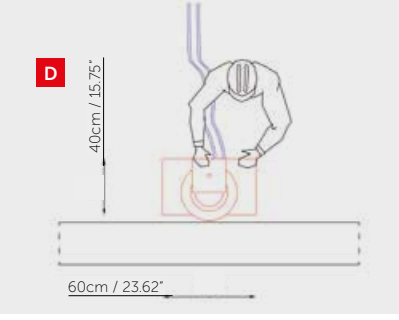
Half-track vehicles have been designed for their use inside buildings, in fact they demonstrate limited dimensions in height, are equipped with rubber tracks not to ruin the inner flooring and are electrically powered to reduce noise to a minimum and avoid the emission of any exhaust gas. It is possible to drive LIFT PILE® even in presence of reduced space by using manual perforators and transportable hydraulic jacks.

## DIMENSIONS AND SPACES NECESSARY FOR THE USE OF THE HAND CORE DRILL COLUMN AND THE PILING COLUMN




### Making the foundation piercing hole with hand core drill column

**A** Sectional dimension of an operator using a hand core drill column

**B** Plant dimension of an operator using a hand core drill column

### Making of the deep micropile with hand piling column

**C** Sectional dimension of an operator using a hand piling column

**D** Plant dimension of an operator using a hand piling column

# **BEARING CAPACITY** calculation

Thanks to the intervention technique adopted by NOVATEK it is possible to define the behaviour of each LIFT PILE® by different methods:

- Analytical methods of calculation based on correlations with static and dynamic penetration tests;
- Checking of the piling data available for each single driven-in micropile, collected in situ during the working phase;
- Load test.

## PILE BEARING RESISTANCE EXTIMATED BY MEANS OF ANALYTICAL METHODS

Pile capacity can be calculated using standard penetration tests and cone penetration tests or pressuremeter tests. The ultimate bearing capacity of a pile Qf may be on two values, the base capacity Qb and the shaft capacity Qs.

$$Qf = Qb + Qs - W = Ab^{*}qb + \Sigma\,(As^{*}\tau s) - W$$

Where:
Qf= ultimate bearing capacity
Qb= base capacity
Qs= shaft capacity
W= micropile weight (can be ignored)
Ab= area of the base
As= surface area
qb= normal stresses ultimate failure strength
$\tau s$= ultimate shear strength

There are many proposals for calculation of the ultimate bearing capacity Qf starting from the results of penetrometer tests in situ.

## INTERVENTION SIZING CRITERIA AND VERIFICATION OF PILING PRESSURE

The method used for the insertion of the micro piles allows constant monitoring of piling pressure throughout the driving process. Taking into account the reference value of the bearing capacity of the single micropile calculation, by means of the correlation with the penetration tests, it is possible to use, thanks to the Novatek technique, an additional method to verify the piling effective capacity of each drilled micropile . In particular, by monitoring the piling pressure on the service gauge of the piling tool, it is possible to determine, as safety measure, the characteristic capacity of each micropile.

Recalling the size of the piling jack:
*Intern diameter: 12 cm (4.72")*
*Thrust section: 113 cm2 (17.51 sq. inch)*

The table on the right shows the correspondence between piling resistance ($R_{dr}$) and piling pressure ($P_{dr}$), in bar, exerted by the hydraulic jack used for the installation and piling loading of the micropiles.

| $P_{dr}$ [bar] | $R_{dr}$ [kN] |
|---|---|
| 100 | 113 |
| 120 | 136 |
| 140 | 158 |
| 160 | 181 |
| 180 | 204 |
| 200 | 226 |
| 220 | 249 |
| 240 | 271 |

Relationship between $P_{dr}$ e $R_{dr}$.

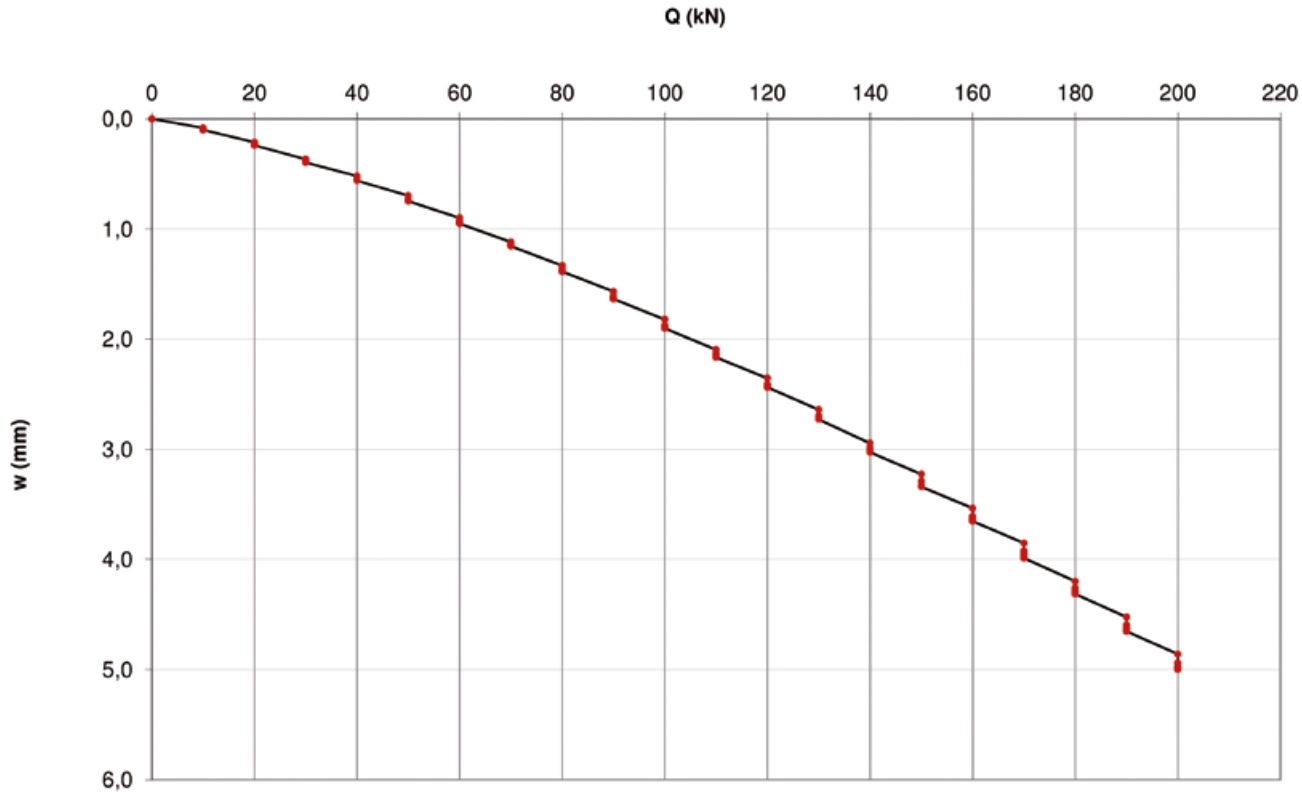
The value of the piling resistance ($P_{dr}$) can be considered to be safe in comparison to the characteristic resistance of the single micropile (Rk), since in the long term, in saturated cohesive soils, driven micro-piles often record an increased bearing capacity, as the pore overpressures dissipate with time in the days following the piling operations. Furthermore, the resistance to vertical movements of the micropile, in static conditions, once the driving is completed, will be governed by the static friction sliding steel ground coefficient, which is higher than the dynamic friction coefficient mobilized during the piling step.
The intervention technique developed by Novatek allows overcoming most of the problems originated by the poor intrinsic reliability when adopting of a geotechnical model of soil.
It often proves to be extremely advantageous, in terms of verification of compliance with the design requirements, having the possibility to decouple the sizing of the piling intervention from the only depth of driving of the micropiles.
Thanks to the intervention technique developed by Novatek, it is possible to verify the design requirements regarding the piling pressure during the execution phase and not only by the achievement of a reference depth. In particular, the installation of pressure micro piles LIFT PILE® will be suspended only at the effective achievement of piling pressure ($P_{dr}$) corresponding to the design piling resistance.
So it is possible, in some intervention areas, to fix the micro piles deeper than calculated by means of analytical methods.

# **BEARING CAPACITY** calculation

## LOADING TESTS

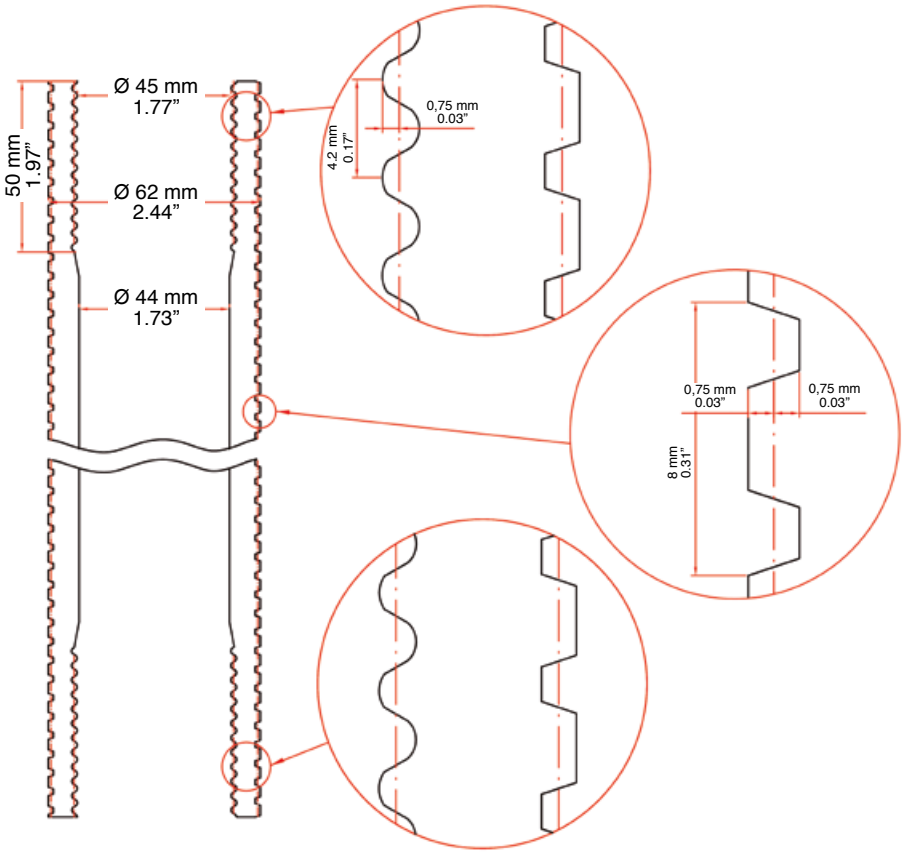
Loading tests can be made for the design or the checking of the piling process.
Depending on the case they can be made before sizing the intervention or at the end of the work.

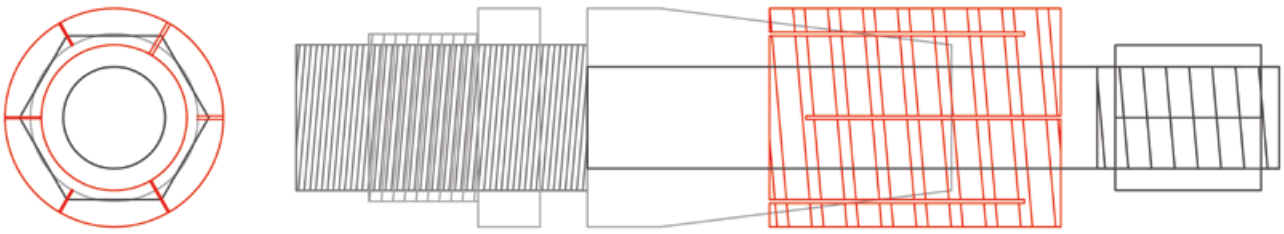
Thanks to these tests it is possible to reconstruct the load-subsidence curve of the tested micropile.
Here below you can find an example:

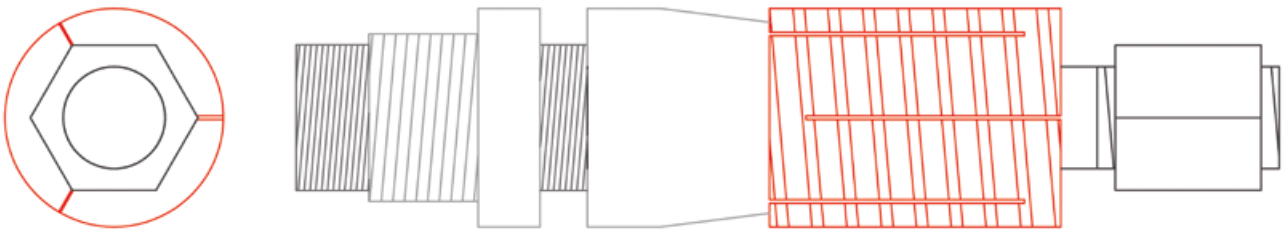


# PRESSURE MICROPILE LIFT PILE®
# IN ROLLED STEEL 62X8mm (2.44X0.31")

The Novatek micropile is entirely made of steel S355.
Outer diameter: 62 mm (2.44 inches)
Thickness: 8 mm (0.31 inches)
Single module length: 1 m (3.28 ft)



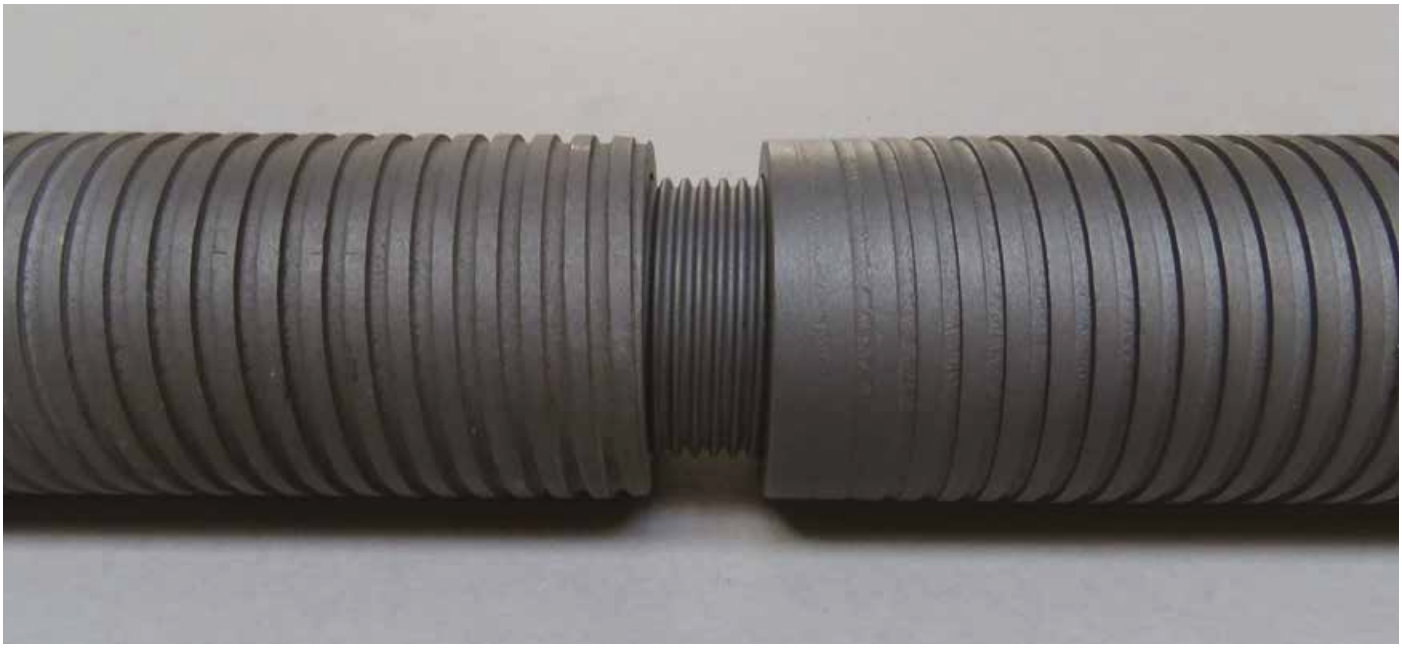


# TECHNICAL SPECIFICATIONS

## ROLLING

The rolling is a process carried out with rolling elements affecting and consolidating the surface of the material without chipping. This process gives the Novatek micropile a roughness over the entire length of the pole, increasing the lateral surface by 46%.
The rolling is performed for two main advantages: the processing increases both the lateral friction, and therefore its adherence to the ground, and the corrosion resistance of the micropile.

Detail of the rolling of the pressure micropile LIFT PILE®

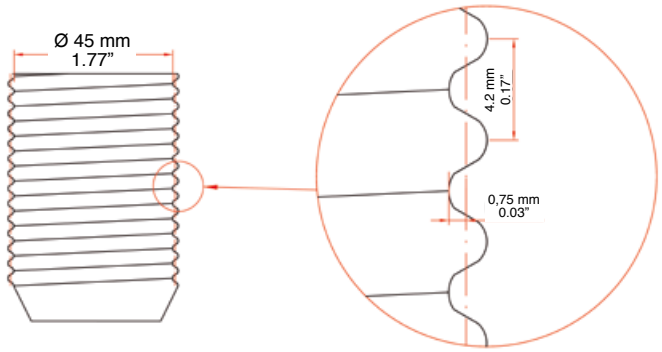


Detail of the connection of modules of the pressure micropile LIFT PILE®

# TECHNICAL SPECIFICATIONS

## THREADED JOINTS FOR MODULAR ELEMENTS CONNECTION

The different micropile modules are fixed to each other by means of threaded grub screws with dimension and geometry reported in the following drawing.




Grub screw for module connection of micropile dimensions in mm.

# SPECIFICATION ITEMS

## LIFT PILE® - PRESSURE MICROPILES WITH ADJUSTABLE DEVICE

### SITE PLANT

Installation and removal of the construction site. Preparation and removal of a complete production unit consisting of all machinery, equipment, and personnel necessary for the micropiles driving.

### INSTALLATION OF THE LIFT PILE® MODULES

The micropile is made of tubular modules of S355 steel, one meter long (3.28 feet) and sized 62x8 mm (2.44x0.31”). The intervention requires the boring of holes diameter 6.4 cm (25.19”) that vertically cross the foundation until they reach the soil underneath. The modules, connected to one another by grub screws, are driven through the holes by means of a hydraulic jack until they reach the soil.  No soil removal is required. The hydraulic jack is equipped with a pressure gauge allowing reaching the necessary pressure to drive the modules into the soil and, at the same time, to check the unit capacity of each micropile.  The gauge is removed as soon as the micropile meets a stratigraphic level allowing resisting with an extreme bearing capacity of 250 kN

The value of the embedding strength can be considered to be safe with respect to the characteristic resistance Rk of the single micropile. In fact, in the long term, particularly in saturated cohesive soils, pressed micropiles register an increase of the bearing capacity. This is due to the dissipation of pore pressures in the days after piling.

### CONNECTION AND DEVICE STARTING

The preload device is a steel element connected to the micropile top and stuck inside the foundation. At this step the device is started by a torque wrench until it reaches the design bearing capacity.

### GROUTING AND COMPLETION OF THE LIFT PILE®

Once reached the repair and lifting project value LIFT PILE® is securely cemented to the foundation/pavement with special expanding grouting mortar type MasterFlow 928.

Novatek is at your disposal for any inquiry,
visit and free quotation.

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NOVATEK

Foundation repair

# TIE-PILE

NOVATEK® Foundation repair

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