

# CONCRETE AND MASONRY FLOORS

## Screwed connectors



**V CEM-E**



**MINI CEM-E**



**CT CEM**

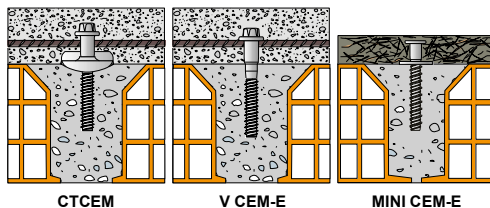
**TECNARIA®**

# FLOOR STRENGTHENING

# REINFORCEMENT OF CONCRETE AND MASONRY FLOORS

## Existing beam: dimensions

The width of the beam must be such that the connector has an adequate lateral covering of concrete throughout its whole embedded depth.



## Tecnaria connectors

**CT CEM:** screw connector with a base plate which anchors itself to the existing slab. A high performance connector offering outstanding mechanical strength properties.

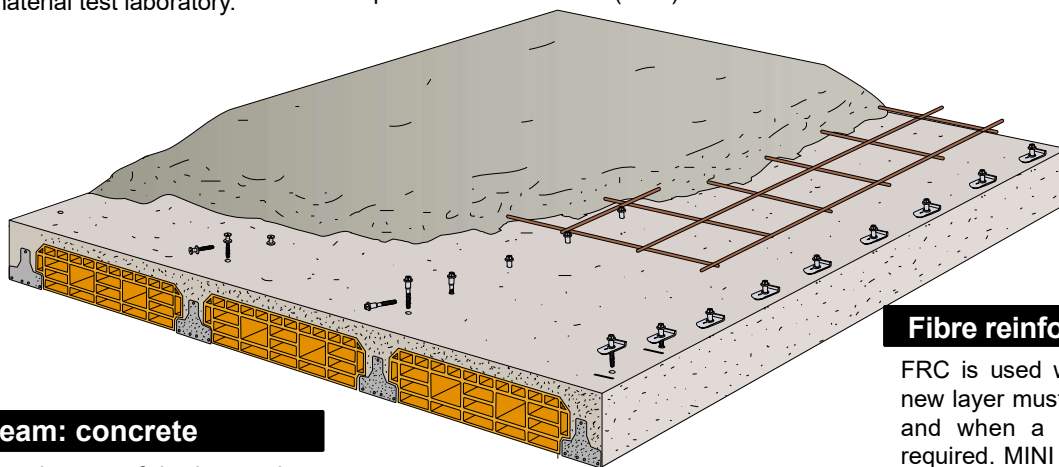
**V CEM-E:** screw-only connector used for less demanding applications.

**MINI CEM-E:** connector designed especially for connecting thin layers of high performance concrete (FRC).

## Existing beam: reinforcement

The steel bars in the bottom of the beam must be checked as they are also a part of the resistant structure for the reinforced floor.

Their diameter and quantity must be carefully checked and type of steel noted. The tensile strength of the steel can be easily determined by undertaking a testing at a material test laboratory.

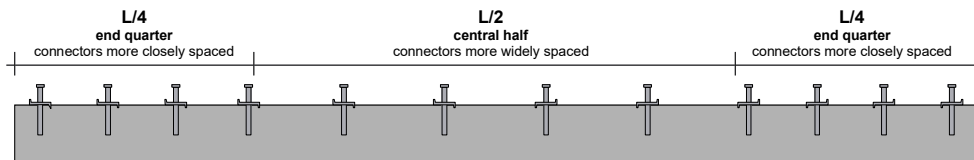


## Existing beam: concrete

The bending resistance of the beam, the shear resistance and the resistance of the connector depend on the compressive strength of the existing concrete.

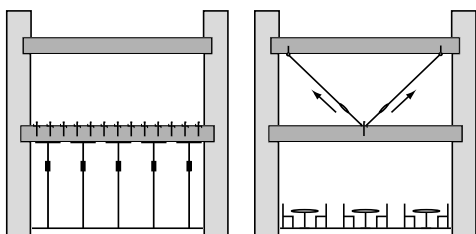
## Positioning of connectors

The number of connectors to be positioned is determined by calculation (on average about 6 to 10 elements per m<sup>2</sup>). They will be fixed closely spaced near the walls and more widely spaced in the centre of the beam.



## Shoring

Floors should be shored before the new casting takes place to achieve maximum efficiency of intervention. Where it is not possible to have access to the underside of the floor, the floor can be hung by means of stays.



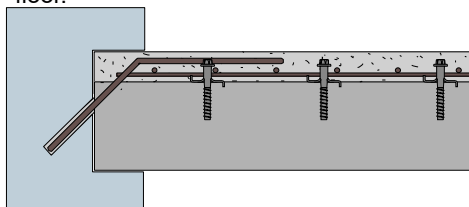
## Mesh reinforcement

A suitably dimensioned electrowelded mesh (normally Ø 6 20x20 cm) must always be placed in the middle of the slab. It is not necessary to fix the mesh to the connectors.

The mesh cannot be used with fibre reinforced concrete.

## Connection to the walls

If the existing floor does not have a perimeter beam resting on the walls, it is advisable to join the slab to the bearing walls round the perimeter of the floor. This precaution brings benefits in terms of stiffness and seismic resistance of the floor.



## Concrete

Structural concretes of a minimum class C25/30 with a minimum thickness of no less than 5 cm are normally used. No technical installations must pass through the load-bearing slab. Dampen the floor before pouring the concrete.

## Light structural concretes

The use of structural light-weight concrete is recommended especially. In seismic areas as it reduces the dead load of the strengthened slab yet maintains a high mechanical strength.



## Fibre reinforced concrete (FRC)

FRC is used when the thickness of the new layer must not exceed 20 or 30 mm, and when a reduction of the load is required. MINI CEM connector is used in this case.

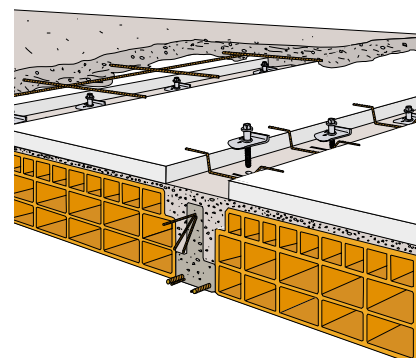


## Floor thickness

It is good construction practice for the total thickness of the reinforced floor to be equal to at least 1/25 of its length (e.g.: 500 cm span=20 cm total height)

## Insulation

The addition of a panel of rigid insulating material on top of the existing floor increases the section without excessively increasing the weight. The greater depth improves the reinforcement. Advantages are obtained in terms of strength, stiffness, the number of connectors used, and partly, the value of thermal and acoustic insulation.



# CTCEM connector

Plate 60x50 mm - screw Ø 14 mm

## The high performance connector.

The connector consists of a toothed plate and a 10.9 steel stud threaded at the lower part and with a hexagonal head. The base plate contrasts the tendency of the stud to rotate, therefore giving a high level of resistance to any movement. The plate also prevents any crushing of the concrete and brings a large area of concrete into contact with the connector so as to give a greater shear resistance. The fixing is completely mechanical. There is no need for resins or chemical additives. The connection is quick and easy, economic and clean. The head of the connector protrudes for a height of 40mm.

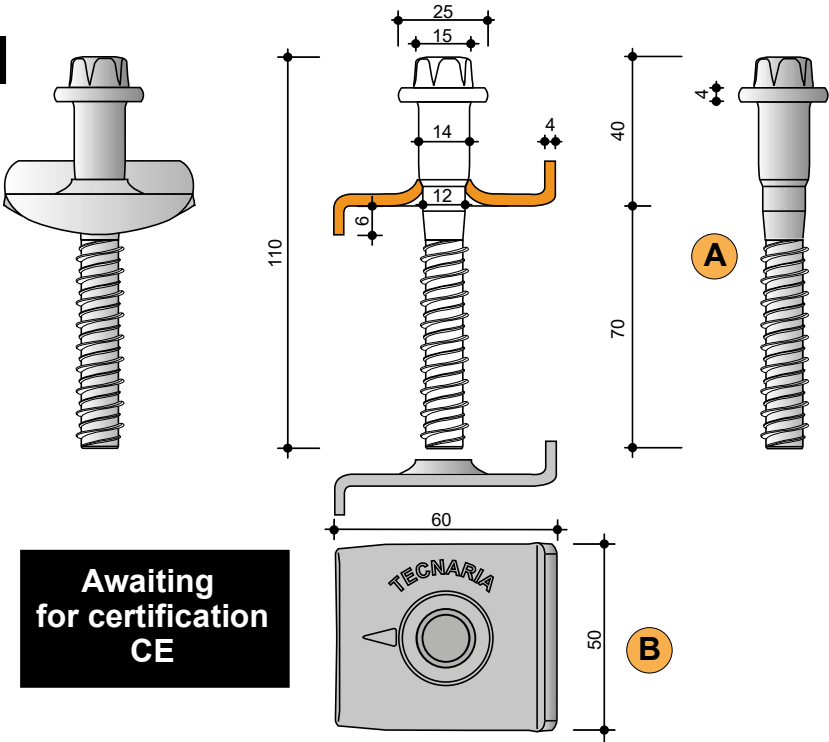
### Data Sheet

The **TECNARIA** stud connector with screw and toothed plate for integrating concrete casting consists of:

- A)** A Ø 14 mm shank of 10.9 hardened steel, with 15 mm hexagonal head and fake washer, and Ø 12 mm threaded body.
- B)** A 60x50 mm, 4 mm thick toothed steel plate with rectangular base. The stud connector and the base plate, thanks to their particular conformation, come together during the embedding process.

**Specifications:** Stud connector with screw and toothed plate for concrete casting integration. Element composed of a Ø14 mm shank of 10.9 hardened steel, with washer and 15 mm hexagonal head. The Ø12 mm threaded body has a truncated conical section at the lower end allowing it to be inserted into the central hole of the 60x50x4 mm stabilizing plate folded on two sides.

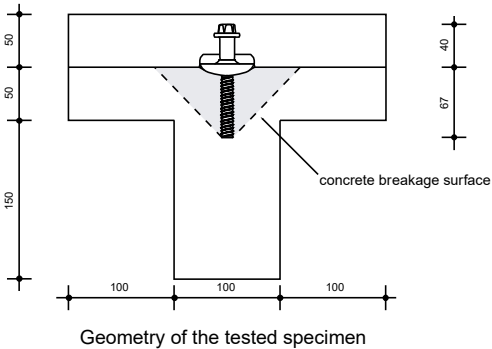
Code	Height connector
CT CEM 14/040	40 mm



### Strength of the CTCEM connector

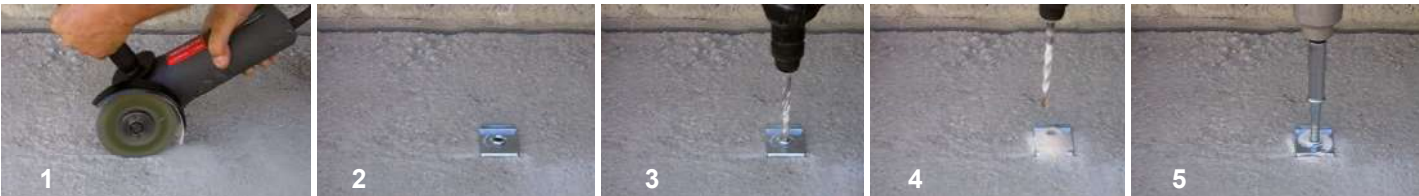
Mean breaking load medio $P_{um}$	Characteristic breaking resistance $P_{Rk}$	Design load (S.L.U.) $P_d$	Allowable load (T.A.) $P_{adm}$
35.7 kN	26.7 kN	21.4 kN	14.2 kN

The table shows the reference values relating to the tests carried out at the Laboratory of Building Science of the University Institute of Architecture in Venice (Italy). These tests were carried out according to the procedures indicated in Eurocode 4 ENV 1994-1-1. The results shown are for connectors connecting a C25/30 concrete structure with a C25/30 concrete slab. The geometries of the two connected parts are such that the breakage surface of the concrete is



### Strength of the CTCEM connector

- When the floor has a concrete topping, locate the position of the beams.
- Mark the positions where the connectors are to be fixed.
- Make incisions in the concrete with an angle grinder to the following dimensions: width 4 mm, depth 5 mm, direction transverse to the direction of the beam (fig. 1).
- Place the base plate into the notch with the folded part facing downwards. The arrow on the top must be parallel to the beam, towards the central point (fig. 2).
- Drill a hole with an 11 mm drill bit to a depth of 75 mm (fig. 3).
- Remove the cement dust (fig. 4).
- Insert the screw in the hole and tighten it for its whole length with an impact wrench (or with a screwdriver with clutch). Take care not to keep screwing after contact between the plate and the screw has been made (fig. 5).





# Connector V CEM-E

Shank Ø 14 mm - screw Ø 12 mm

**This connector offers the quickest form of installation.**

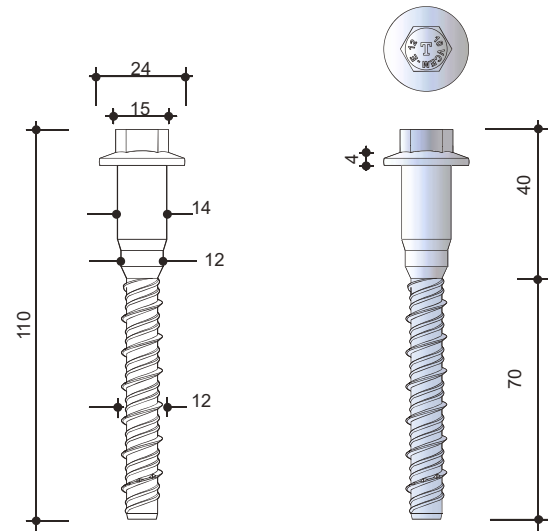
The connector comprises a carbon steel screw with hi-low thread (lower part) and hexagonal head (upper part). It is fixed by dry screwing the screw 70 mm, into a specially made hole in the concrete. The head should protrude by 40 mm. Fixing is completely mechanical, as no resins or chemical additives are required. The tip of the screw has a special heat treatment that allows it to carve the concrete in the best possible way. The connection process is therefore fast, economic and clean.

## Data Sheet

The **TECNARIA** screws connector is used to integrate a new concrete layer with an existing one consists of a Ø 12 mm shank of hardened carbon steel with a 70 mm threaded part and a 15 mm hexagonal washer head, (Ø 24 mm washer), for a total length of the screw of 110 mm.

**Specifications:** Hardened steel screw stud connector for concrete casting integration comprising a Ø 14 mm shank of hardened carbon steel, with 15 mm hexagonal washer head and a 60 mm long, Ø 12 mm threaded body, for a total length of 110 mm.

Code	Connector height
V CEM-E 14/040	40 mm



## Strength of the V CEM-E connector

The VCEM-E connector is CE marked. Its shear strength is calculated using Eurocode 2 EN 1992-4 from the data given in ETA 20/0831 (CEM 12.5).

### Shear resistance in case of application on a solid slab

Strength of existing concrete	Shear resistance $P_{Rd}$
C20/25 non-cracked	12.30 kN
C20/25 cracked	8.61 kN
C25/30 non-cracked	13.75 kN
C25/30 cracked	9.62 kN

20  
DoP: 20/0831  
EAD 330232-00-0601



The values indicated are calculated using the Eurocode formulae and indicate the pry-out failure of the existing concrete. Shear strength  $P_{Rd}$  of the steel of connector V CEM-E: 28.50 kN.

## Installation of the V CEM -E connector

Remove the existing flooring and strip any covering to the concrete joists. In the case of a floor with concrete topping, locate the joists through special probes. Anchor the connectors on the joists.

Mark the points where the connectors are to be fixed, following the guidelines (fig. 1).

- Drill a hole with an 10 mm bit to a depth of 85 mm (fig. 2).
- Remove the cement dust using a blowing or suction device in the hole (fig. 3).
- Insert the screw in the hole and tighten it all the way with an impulse driver or electric driver with clutch (fig. 4).
- Make sure not to over-tighten the screw (fig. 5)



# MINI CEM-E connector

Shank Ø 10 mm - screw Ø 10 mm

## The connector used with thin additional slabs

MINI CEM-E is the new screw connector with CE mark, designed to join a thin slab (from 20 mm) with concrete floor joists, including those with reduced dimensions. This connector is recommended in particular for joining the joists to high performance fibre reinforced concrete slabs. Thanks to the Hi-Low thread, it can be dry fixed into the support without the need for resins or other adhesives. Its free-spinning washer permits correct contact with concrete surfaces that are not perfectly level.

## Data Sheet

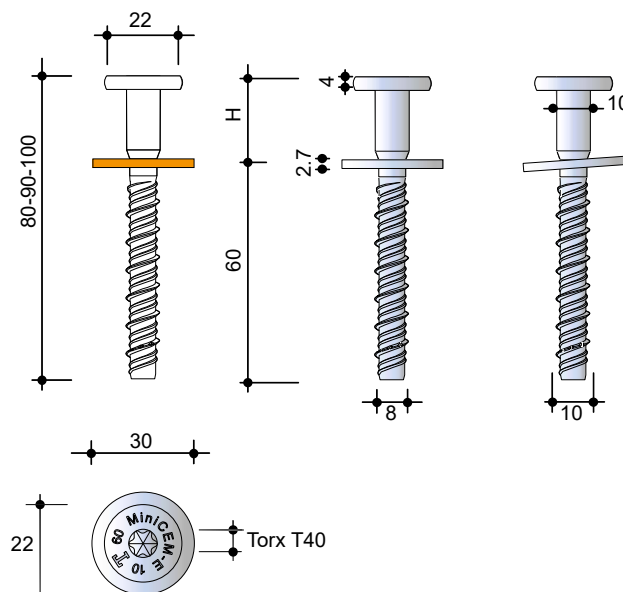
The connector comprises:

**A)** A shank in hardened carbon steel. The lower part has a hi-low thread for concrete that measures 10 mm in diameter and 60 mm in length. The upper part is a stud 10 mm in diameter and 20, 30 or 40 mm in length, with a 22 mm head and a T40 Torx recess.

**B)** A Ø 30 mm, 2,7 mm thick free-spinning washer in steel

**Specifications:** Stud connector with galvanised screw for concrete casting integration. Element comprising a shank in hardened carbon steel with Ø 10 mm, 60 mm threaded body; a Ø 10 mm, 20, 30 or 40 mm stud with a pre-assembled 2,7 mm thick free-spinning steel washer 30 mm in diameter and a T40 Torx recess.

Code	Connector height
MINI CEM-E 10/020	20 mm
MINI CEM-E 10/030	30 mm
MINI CEM-E 10/040	40 mm



## Strength of the MINI CEM -E connector

The MiniCEM-E connector is CE marked. Its shear strength is calculated using Eurocode 2 EN 1992-4 from the data given in ETA 20/0831 (CEM 10.5).

### Shear resistance in case of application on a solid slab

Strength of existing concrete	Shear resistance $P_{Rd}$
C20/25 non-cracked	9.90 kN
C20/25 cracked	6.93 kN
C25/30 non-cracked	11.07 kN
C25/30 cracked	7.75 kN

20  
DoP: 20/0831  
EAD 330232-00-0601



The values indicated are calculated using the Eurocode formulae and indicate the pry-out failure of the existing concrete. Shear strength  $P_{Rd}$  of the steel of the MINI CEM-E connector: 13.04 kN.

## Installation of the MINI CEM-E connector

Remove the existing flooring and strip any extra covering of the concrete joists.  
In the case of a floor with concrete topping, locate the joists through special probes.  
Anchor the connectors on the joists.

- Mark the points where the connectors are to be fixed, following the guidelines (fig. 1)
- Drill a hole with an 8 mm bit to a depth of 70 mm (fig. 2)
- Remove the cement dust using a blowing or suction device in the hole (fig. 3)
- Insert the screw in the hole and tighten it all the way with an impulse driver or electric driver with clutch (fig. 4).
- Make sure not to over-tighten the screw (fig. 5)



# Tecnaria Connectors: the applications

## Use of metal connectors with fibre reinforced concrete (FRC)

FRC (Fibre Reinforced Concrete) is a cement based (concrete or mortar, single or multi component) composite material, with added fibres of various types and geometries. This composition gives the concrete a high level of resistance to traction and compression, significant ductility, and higher shear resistance than traditional concrete.

Regulations don't currently provide a clear view of all the possible fields of application in the structural sector, as they are not strictly classed as concretes.

They have recently been used for anti-seismic adaptation, or for the reinforcement of floors, to obtain rigid planes with smaller slab thicknesses (in the range of 25 mm) and limited weights.

In order to ensure the efficiency of the rigid plane, it is, however, still necessary to guarantee a certain level of bond with the existing structure, both when joining the beam to the slab and the beam to the masonry elements. Bearing this in mind, some FRC manufacturers recommend to carry out extremely demanding preparation works on the surface being consolidated when reinforcing hollow bricks and concrete floors, such as the roughening of the support through mechanical abrasion, followed by surface cleaning and preparation with a primer applied with a roller.

Tecnaria **MINI CEM-E** metal connectors are installed on the upper surface of concrete joists. All that is needed are simple drills.

**MINI CEM-E** connectors have undergone extensive laboratory tests. Thanks to the specific head conformation and reduced heights (20 mm, 30 and 40 mm), they can be used with FRC.

## Resistance to slipping between two surfaces

### Resistance to slipping

When two concrete layers are cast at different time, it is possible that a resistance to natural slipping movements exists, due to the irregularity of the surface being consolidated. However, in itself, the shear resistance is unable to guarantee a complete binding of the two surfaces. It will only be possible to take into account the resistance contributed by the cohesion between the materials if a headed connector is used. In simple terms, the surfaces may be classed as:

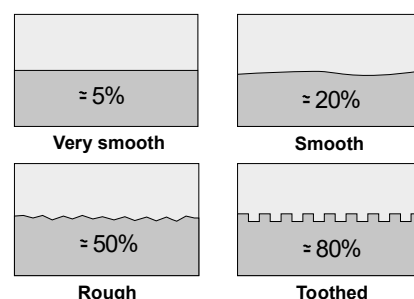
A) **Very smooth**: if cast on smooth formwork.

B) **Smooth**: in case of simple vibrated surface cap. This is the most frequent case.

C) **Rough**: roughness obtained artificially using mechanical means.

D) **Toothed**: appropriately prepared and cast using purposely shaped elements.

In the case of exposed hollow bricks or hollow bricks covered by a very thin layer of mortar, for the purpose of safety contribution must be considered as equal to zero.



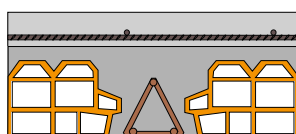
Resistance contribution shown as a %

## Limitations of use

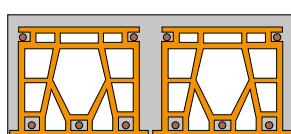
### Type of floors

Reinforcement operations with the technique of the connected concrete slab are very often conditioned by the lack of reinforcement on the underside of the joist, by the poor resistance of the concrete used and by degradation of the concrete, as well as, on occasions, by flaws in design. Careful assessments on the actual condition of the floor being consolidated are therefore required.

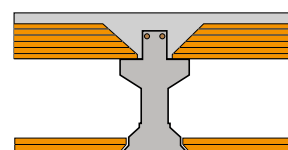
Therefore, the technique proposed is well suited to prefabricated joist floors 'Bausta type', while it is difficult for 'Sap type' or 'Varese type' floors, where the concrete joists are of a very small sizes.



"Bausta"



"SAP" floors

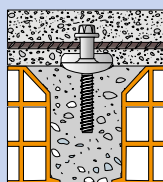


"Varese" floors



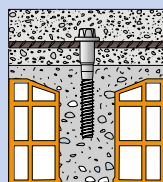
### Minimum joist size

CTCEM  
V CEM-E



Existing floor  
without cap

CT CEM  
V CEM-E



Existing floor  
with cap

MINI CEM-E



Existing floor  
with or without cap

### Degradation of concrete

The use of connectors is not appropriate where there is a carbonation of concrete and subsequent oxidation of the steel reinforcement. In this case, it will be necessary to assess other solutions that will not cause stress to the concrete.



### Collapsed brick

Floors which have excessive sagging often have suffered a breaking of the bottom layer of the hollow bricks. The floor structures must, first of all, be made safe using an appropriate system. The connection with a new slab will then reduce the flexibility of the floor, preventing the problem of collapse from occurring again.

# TECNARIA CONNECTORS: ACCESSORIES

Tecnaria proposes a series of accessories to facilitate the installation of **CTCEM**, **V CEM-E** and **MINI CEM-E** connectors.

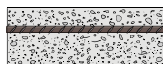
## Impact wrench (code ACT-DW292)



Electric impact driver; its characteristics make it ideal for fixing the connector screws into the concrete, 1/2" fitting.  
Weight: 3.2 kg  
For connectors: **CTCEM**, **V CEM-E** and **MINI CEM-E**

*Related item: hexagonal drive*

## Drill bit for concrete (code PC11160100X)



Drill bit for concrete, diameter 11 mm, working length 100 mm, SDS Plus fitting. With 4 cutting edges, extremely resistant in reinforced concrete.

*Allows the hole to be made in the concrete for inserting the connector screw.*

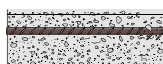
For connectors: **CTCEM**

## 15 mm 1/2" socket (code ACT-BE15-Q)



15 mm hexagonal drive, with 1/2" square fitting.  
For tightening the connector screw.  
For connectors: **CTCEM** e **V CEM-E**

## Drill bit for concrete (code PC10160100X)



Drill bit for concrete, diameter 10 mm, working length 100 mm, SDS Plus fitting. With 4 cutting edges, extremely resistant in reinforced concrete.

*Allows the hole to be made in the concrete for inserting the connector screw.*

For connectors: **VCEM-E**

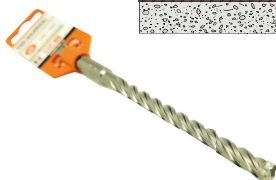
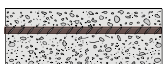
## Adapter 1/2" for hex drive bits (code ACT-IE6-Q)



6 mm hexagonal drive 1/2" square fitting.  
To be used in combination with Torx T40 bits.

For connectors: **MINI CEM-E**

## Drill bit for concrete (code PC08160100X)



Drill bit for concrete, diameter 8 mm, working length 100 mm, SDS Plus fitting. With 4 cutting edges, extremely resistant in reinforced concrete.

*Allows the hole to be made in the concrete for inserting the connector screw.*

For connectors: **MINI CEM-E**

## Torx T40 hexagonal drive bit (cod. BIT-T40-HEX25)



Torx T40 hexagonal drive bit

To be used with the 1/2" adapter.  
Subject to wear.

For connectors: **MINI CEM-E**

## CERTIFICAZIONI

The shear strength of the CTCEM connectors and the effectiveness of the connection have been experimentally verified following the test procedures given in Eurocode 4 UNI - EN1994-1-1 at the Laboratory of Building Science of the University Institute of Architecture in Venice.

The **V CEM-E** and **MINI CEM-E** connectors are CE marked according to ETA and DoP 20/00831, according to EAD 330232-00-0601.



## CALCULATION SOFTWARE: a precious aid for designers



Tecnaria offers professionals a calculation programme for rapidly dimensioning reinforcement interventions on concrete and masonry floors with Tecnaria connectors.

This useful design tool can be downloaded free of charge from the site  
[www.tecnaria.com](http://www.tecnaria.com)