

**CAPO-TEST pullout testing
(ASTM C 900 and EN 12504-3)
on
shotcrete without and with
steel fibers**

July 1st, 2015

GERMANN INSTRUMENTS A/S

Emdrupvej 102 - DK-2400 Copenhagen NV - Denmark

Phone: (+45) 39 67 71 17 - Fax: (+45) 39 67 31 67

E-mail: germann-eu@germann.org, Internet: www.germann.org

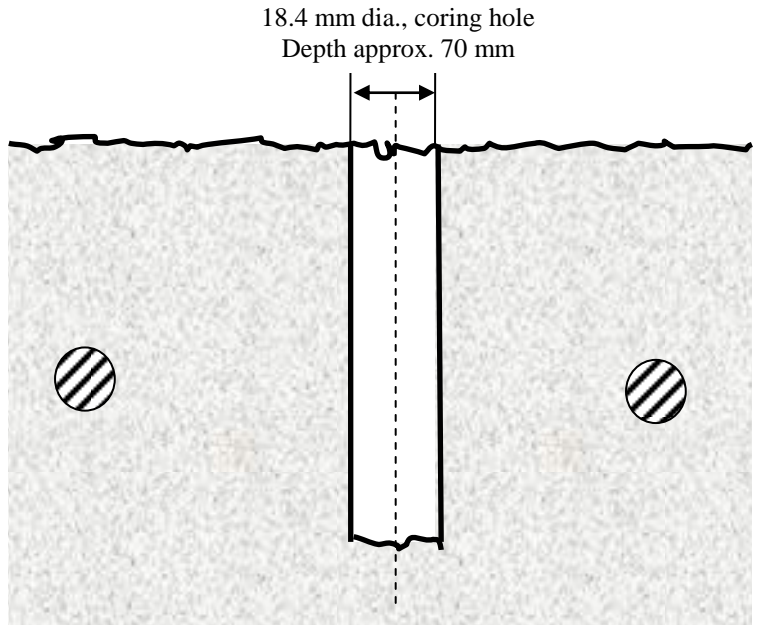


Test Smart – Build Right

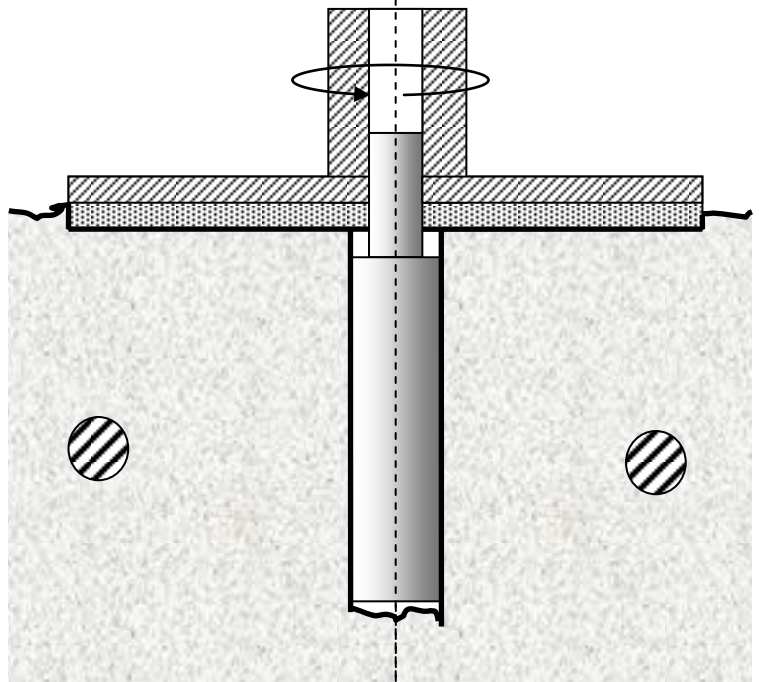
PROCEDURE



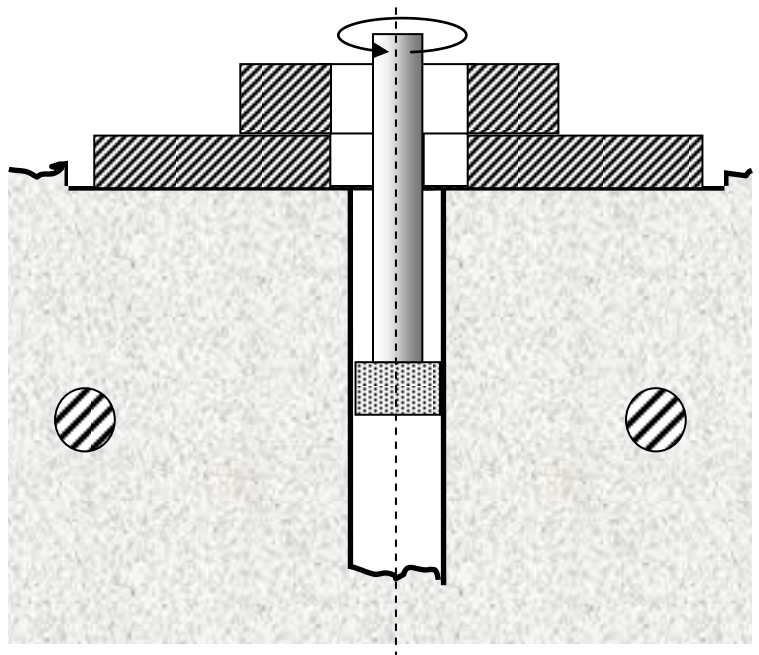
After locating reinforcement the test position is chosen in the center of the reinforcement mesh. Coring with a water cooled 18.4 mm diamond coring bit takes place to full 70 mm depth of the coring bit



The centering brass rod is inserted in the hole and the diamond planning wheel is centered on the rods top. Planning takes place water cooled by pressing the units axel connected to the drill machine against the surface, which has to be plane in its total circumference. The parts are removed

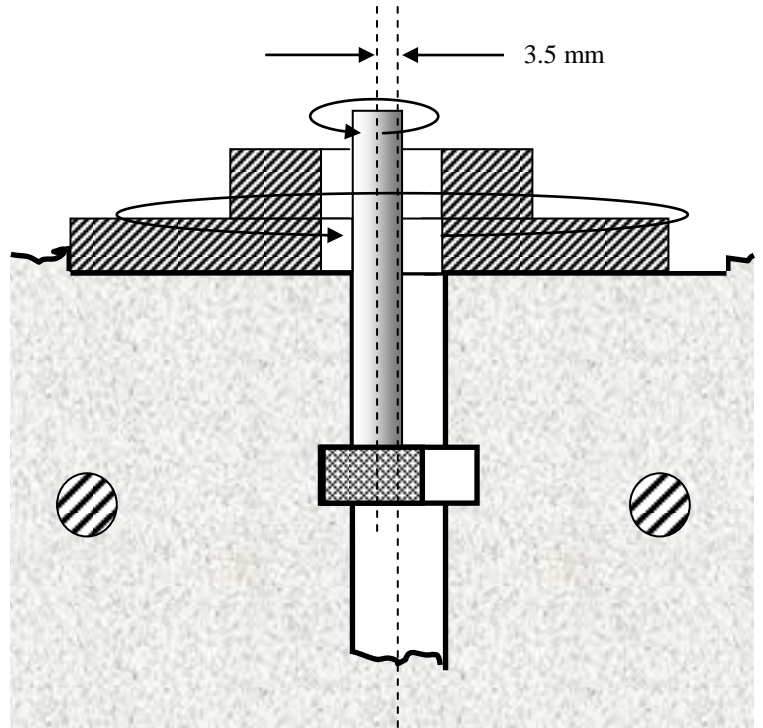


The diamond recess router shown above is inserted in the drilled hole and turned on. The bit is water cooled. The flange of the recess router has to rest firmly against the planed surface

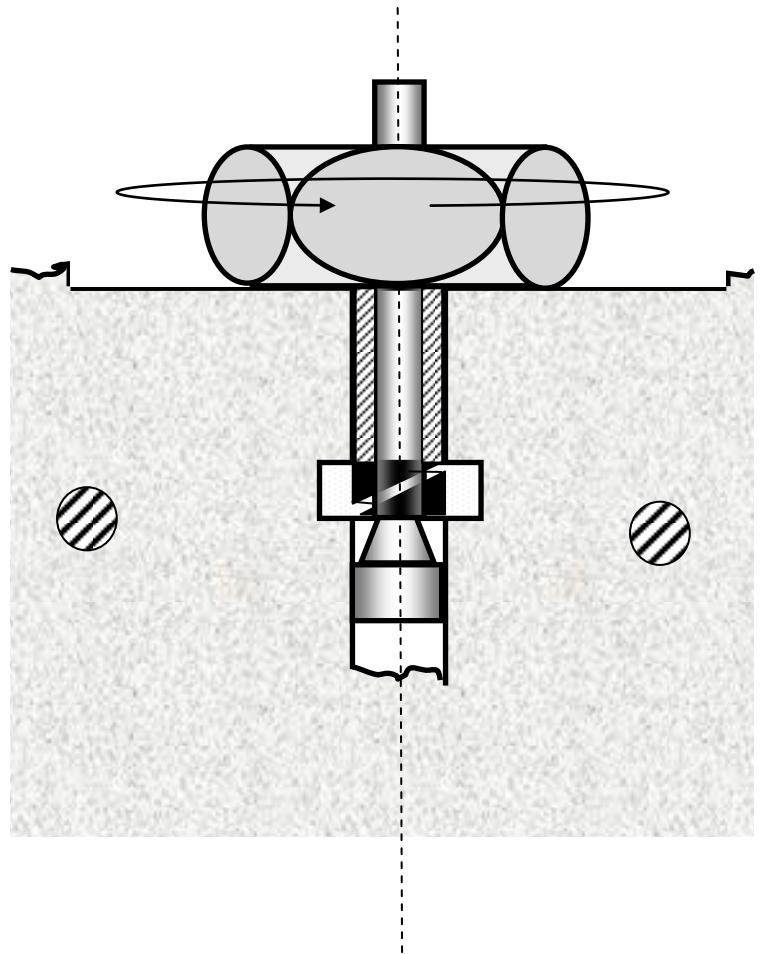




Recess routing takes place by pressing the flange of the router against the planed surface and moving it sideways in bigger and bigger circles until the recess router shaft follows the side face of the cored 18.4 mm hole. Notice the position of the operators fingers. The diameter of the recess has to be $25.4 \text{ mm} \pm 0.2 \text{ mm}$ after routing and the depth to the recess 25 mm.

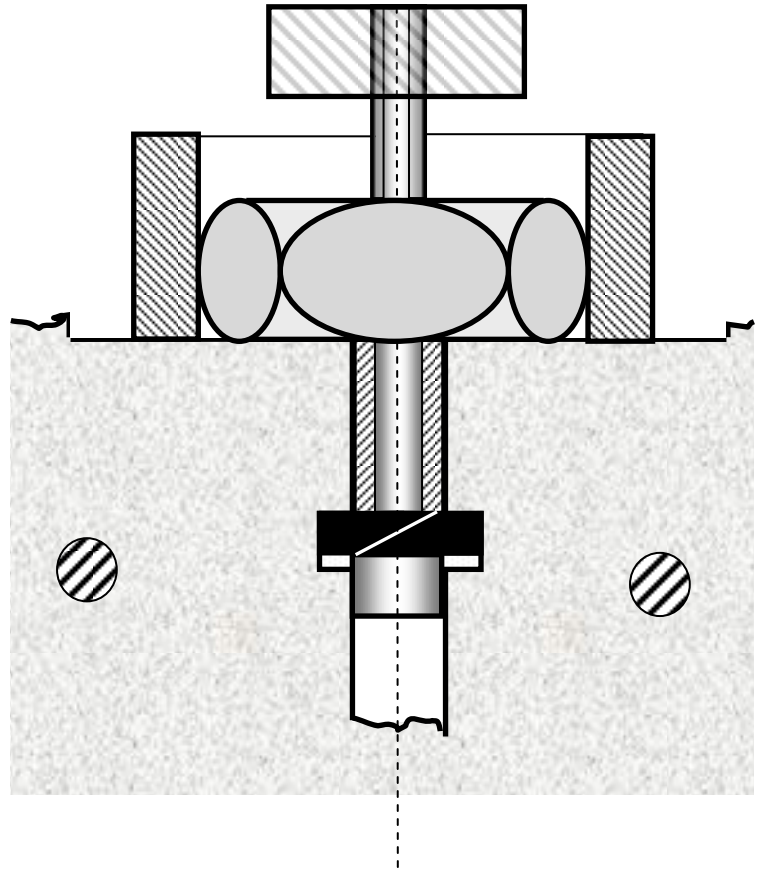


The assembled expansion tool with installed CAPO ring (above) is inserted in the hole and expansion of the ring takes place as shown below by turning the big nut to fully expanded position of the ring while keeping the center pull bolt in the same position. The cone pull bolt will be pulled against the CAPO ring, which will unfold in the routed recess.





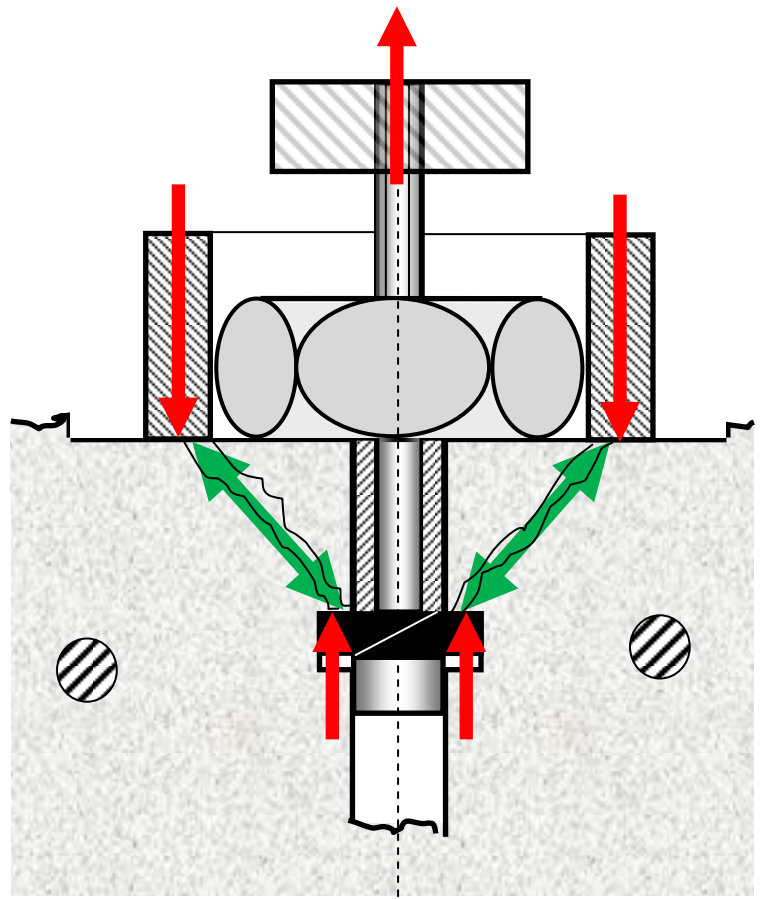
After fully expansion of the CAPO ring in the routed recess the counter pressure is installed on the surface and the coupling threaded to the center pull bolt



The hydraulic CAPO-TEST instrument is coupled to the coupling and the slack removed between instrument and counter pressure. Loading takes place by turning the instruments handle slowly.

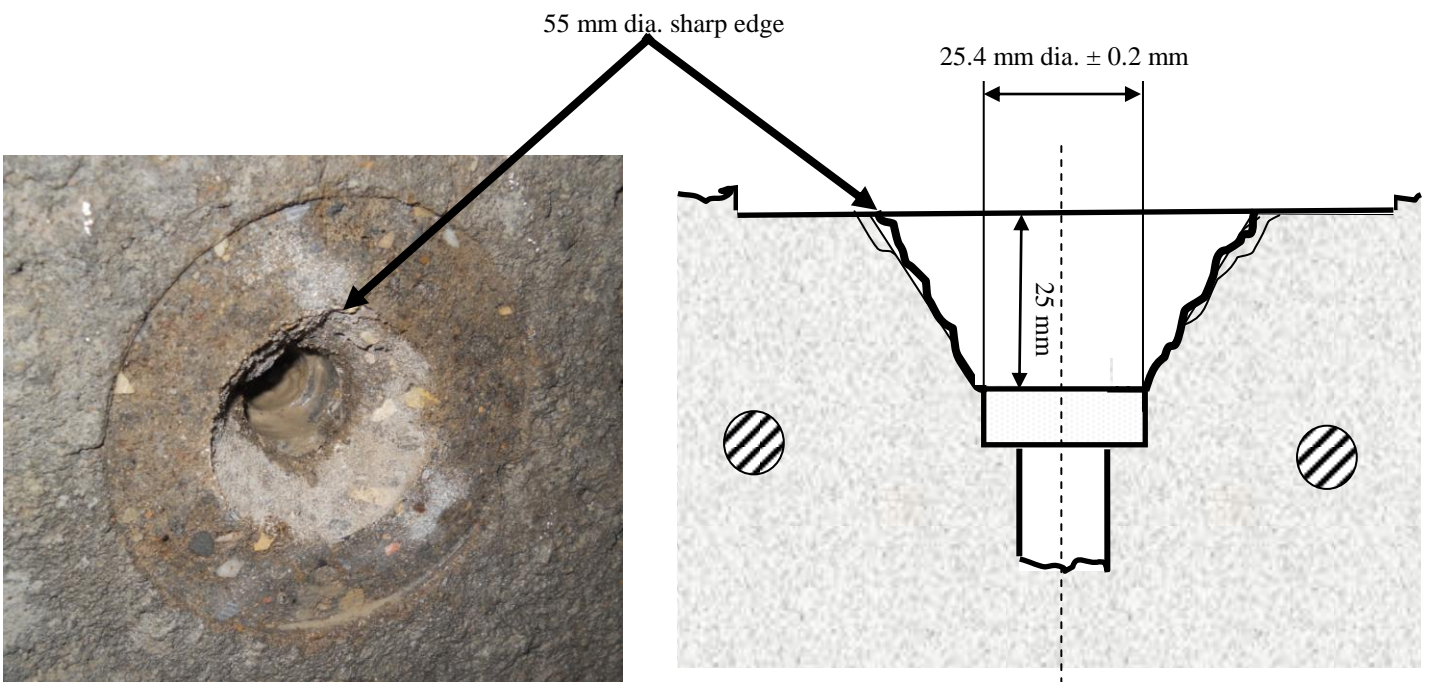
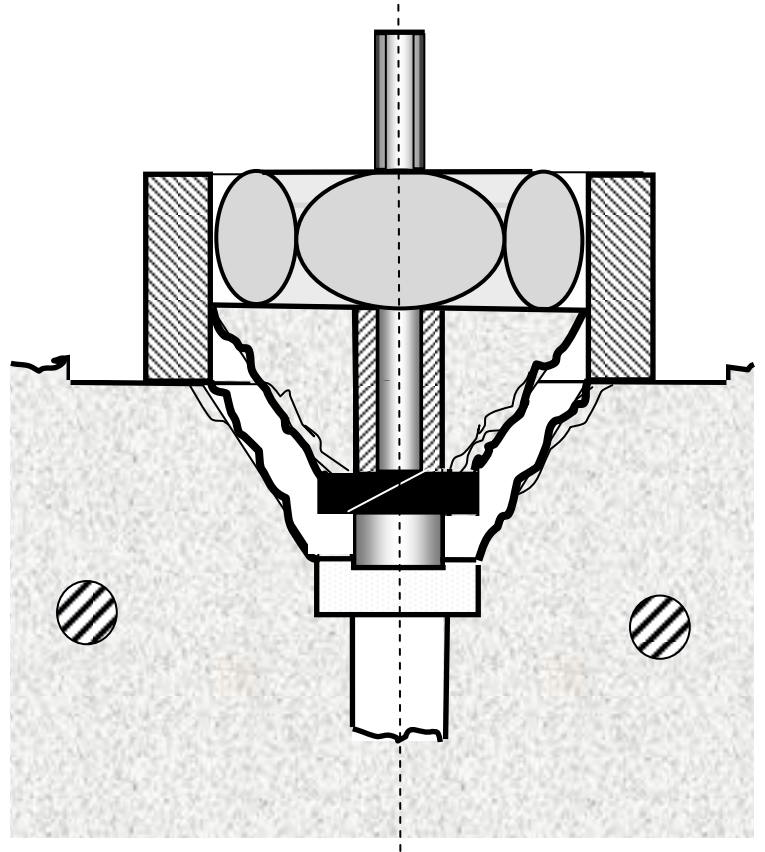
During pullout compression forces are formed in a strut between the expanded ring and the counter pressure on the surface. This is why the pullout force correlates very well to compression test made on standard specimens. At the end of the test a sliding failure is formed between the outer edge of the expanded ring and the inner edge of the counter pressure.

The maximum load in kN is recorded by the instrument and correlated to standard compressive strength of e.g. cylinders.





The completed CAPO-TEST.
Notice the unfolded CAPO ring on the cone pull bolt.



CAPO-TEST failure.

The criteria's for correctly performed testing:

1. Sharp 55 mm in diameter edge (no spalling on the planed surface) from the inner edge of the counter pressure
2. Routed recess diameter 25.4 mm \pm 0.2 mm
3. Depth to the recess 25 mm from the planed surface

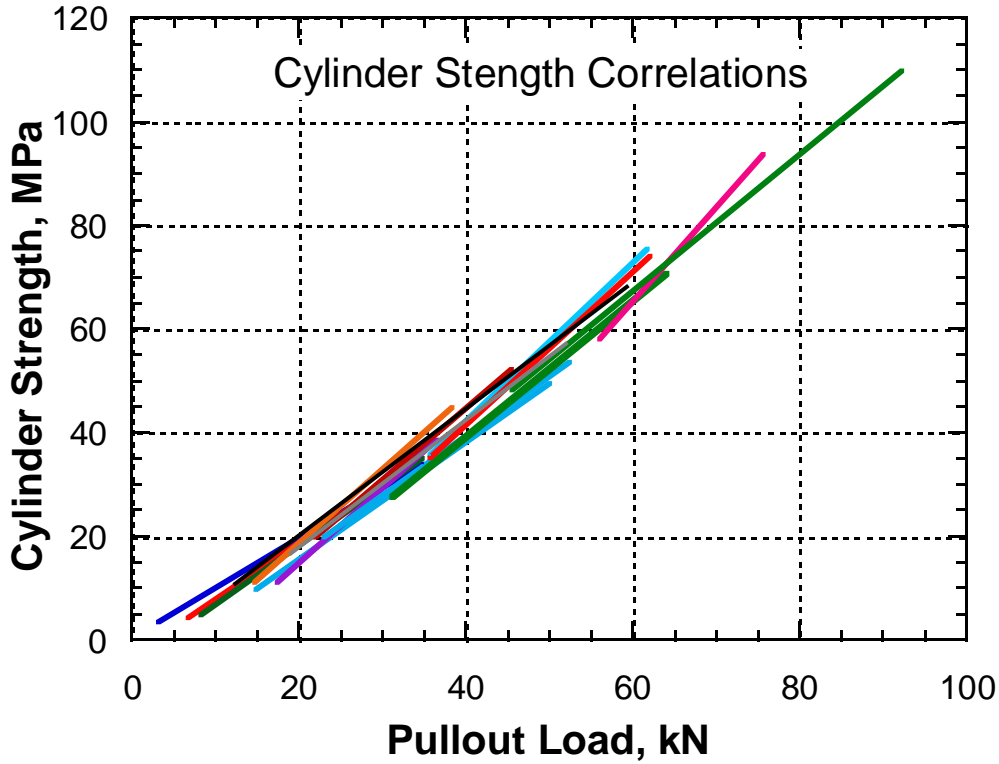


Capo-Test failure on shotcrete with steel fibers

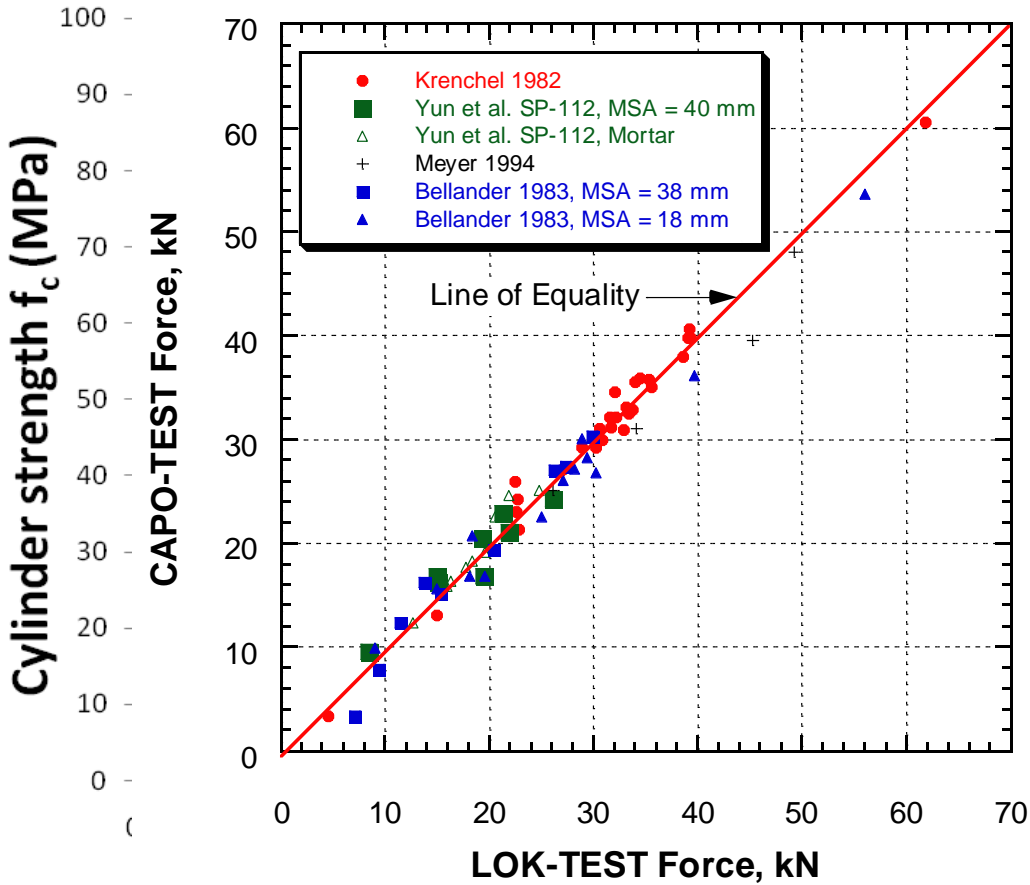
Variation:

Normally, on homogeneous shotcrete, the variation on the CAPO-TEST is 3-4%

Correlations to 150 mm x 300 mm cylinder strength

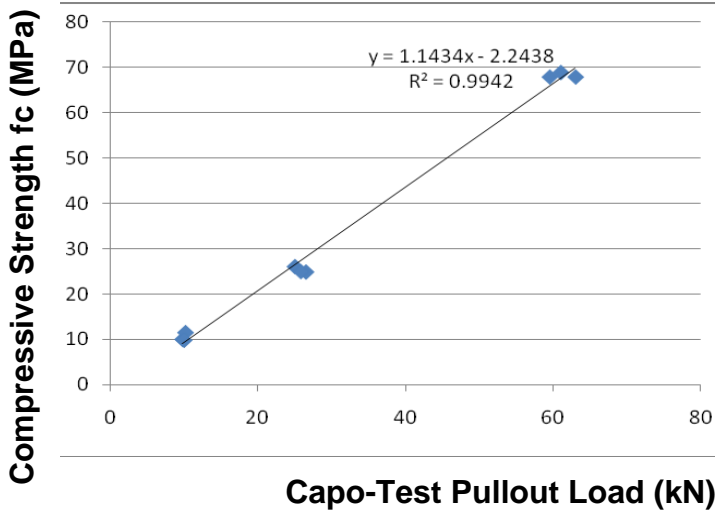


Twenty major correlations between LOK-TEST and standard cylinder 150 mm x 300 mm compressive strength performed from 1982 to 2010



Relationship between LOK-TEST and CAPO-TEST

General Correlation

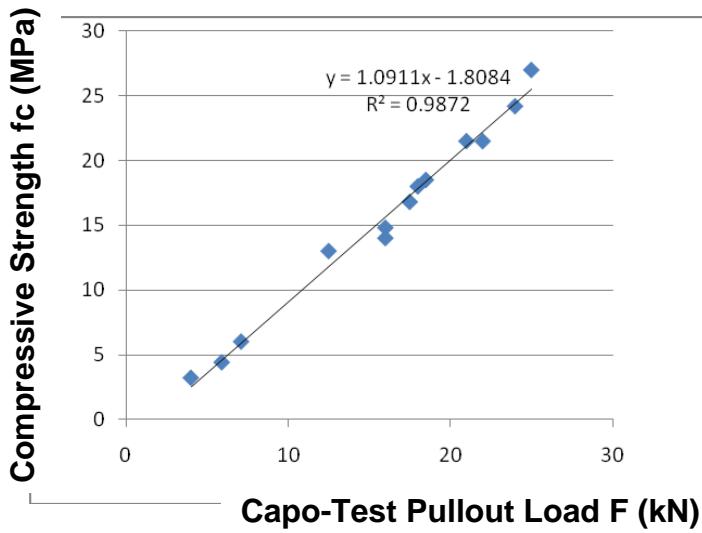


Krenchel, 1984

Max. 8 mm aggregate size

Average of 2 CAPO-TEST performed on opposite vertical faces on 200 mm specimens compared to one cylinder (150 mm x 300 mm).

Specimens water cured and fully hardened



Yun et al, 1988

Mortar

Average of 2 CAPO-TEST on vertical faces and 4 cores (150 mm x 300 mm) on slabs 1000 mm x 1000 mm x 300 mm

Specimens with wet burlap, fully hardened.

