Blocked Tendon

Question:

How can we realize that a tendon is blocked and if yes what shall we do?

Answer:

PRELIMINARY

Punctures, cuts, tears or bends in PT sheaths (plastic or steel), commonly occurred during bar reinforcement positioning, may lead to PT sheaths damages and allow concrete penetration inside the sheaths during casting which may block the strands inside the tendon.

Improper vibration procedures, i.e. hard impact and sloppy contact of vibration needles onto the sheaths during casting, may lead to punctures and other damages, unscrewed couplers, misaligned ducts, loosen tapping saddles, damaged venting pipes etc.

Finally, careless installation, i.e. improper coupling of ducts and wrapping of sealing tapes, improper tightening/sealing of grouting ancillaries such as tapping saddles and grouting ports, inadequate sealing of duct with the bearing plates, gaps and slots of contact areas of bearing plates with shutters and moulds or voids at the dead-end anchorages (bulb/onion types) may also allow penetration of concrete by blocking a significant length of the strands inside the sheaths.

THE PROBLEM

a. Concrete penetration inside the sheath:

During stressing you may realize than the elongation is less than the expected. Stop the stressing procedure.

Try to investigate where the sheath is blocked. Using the formula:

$\delta = (F \times L) / (E \times A_t)$, or $L = [\delta \times (E \times A_t)]/F$, where:

δ= elongation in mm

F= stressing force in KN

L=length of tendon in mm

E=actual modulus of elasticity in KN/mm^2 and

A_t=tendon section (number of strands x area of each strand) in mm^2

You may have an indication about the operable length (L) of the tendon considering that the elongation is proportionally to the length of the tendon (less elongation than the expected is meaning that less length of the

tendon is operable because of concrete blockage), therefore, after this specific length (L) the tendon should be blocked.

b. Concrete penetration inside the trumpet (bearing plate):

During anchor head installation you will witness that the area inside the bearing plate is blocked.

Photo of a blocked tendon in anchorage area

SOLUTION

a. Concrete penetration inside the sheath:

PHASE A:

Install the stressing mono-jack and apply carefully load on each strand so as to un-blocked. This process requires extreme precaution avoiding any breaking of strand. Do not stress more than 50% of the final stressing force. In case of unblocked strands consider higher friction during stressing. A new study regarding the PT elongation may be applied taking into consideration possibly overstressing so as to overcome the friction. Allow sufficient hose length between the mono-strand and the pump because of the rotation of the mono-strand along its axis during the process.

PHASE B:

By calculating the theoretical operational length L (as described above 2.a), initiate local demolition works at that area. Carefully remove concrete without cutting or damage the reinforcement till you reach the duct. Use a long chisel or drill and demolish concrete avoiding any damage to the strands. Drill a small hole/opening on the duct carefully without damaging strands so as to check if the tendon is blocked. Continue small drillings along the tendon till you find the unblocked area. Cut the sheath's wall carefully without damaging strands. The process is time consuming and difficult since the access (for tools and hands is limited). Remove concrete debris as much as you

can. Use a long chisel and a sledgehammer. Upon completion use an air blower and remove dust, filths and other foreign objects. Put a piece of duct (same material with the installed sheath) covering the cut area of sheath. This piece must have dimensions slightly larger than the cut area. Apply carefully stucco or pasta to seal the sheath's patch avoiding any opening. Finally use a strong epoxy resin to fill all the demolished area (follow manufacturer's instructions).

Photo of demolished area exposing sheath

PHASE C:

If not the case and the tendon is remained blocked, a new study regarding the PT design must be applied by overstressing the neighbouring tendons with the required missing stressing load. Grouting must be applied from all venting and grouting tubes so as to eliminate any chances for improper grouting.

b. Concrete penetration inside the trumpet (bearing plate):

PHASE A:

Follow above SOLUTION a.PHASE A

PHASE B:

Try to investigate the length of this blockage. Use a long chisel or drill and demolish concrete avoiding any damage to the strands. Try as deeper and far as you can. Repeat above SOLUTION a.PHASE A. If still blocked, that means the concrete has covered a considerable length beyond the trumpet. Follow above SOLUTION a.PHASE B.

PHASE C:

Follow above SOLUTION a.PHASE C