

Repair – Remedial Measures for PT Applications

Question:

What are the usual problems that we can witness during a PT application on the field?

Answer:

DURING INSTALLATION

PC STRAND:

-Welding application: Avoid any welding. Replace the strand prior of threading.

-Corroded – oxidized surface: Surfaces must be free of detrimental dirt, mill scale, rust, paint, grease, oil or other foreign substance, such as fins or tears. Minor rusting, which discolours the metal may exist, but all loose mill scale and scale rust must be removed. Brushing (by using a dry woollen cloth or soft brush) for cleaning blue metal is not required. There shall be no evidence of pitting or visual flaws. Oil for anticorrosion purposes must be soluble water. In case of oil protected strand, wash the tendon with water. Immediately blow air so as to dry the strands and ducts.

DUCTS:

-Damage of ducts: Punctures, cuts, tears or bends. Prior of strands threading replace the defected area with a new piece of duct of a proper length and diameter. In case of any damages after strand threading, your main concern is to avoid concrete penetration inside the duct during concrete which can block the tendon. Cover properly the defected area with PVC tape at a distance of at least 10cm from the defect from both sides. If damaged area is big (more than 10cm x 10cm) cover locally the whole outer diameter of the duct with the same duct material (steel). Use a steel wire and PVC tape to properly tight the patch. In case of a plastic duct, it is recommended to use a heat shrink patch of proper thickness covered by PVC tape properly wrapped around the outer diameter. Clean properly the area prior of heat shrink process avoiding dust and other foreign objects which can prevent the proper bonding of patch onto the duct.

-Corroded – oxidized steel duct surfaces: Surfaces must be free of detrimental dirt, mill scale, rust, paint, grease, oil or other foreign substance, such as fins or tears. Rusting, which discolours the metal may exist, but all loose mill scale and scale rust must be removed. A rusted steel duct may increase the friction during stressing, and this should be taken into account during elongation measurements.

-Settlement of stirrups: Check all tendons elevation and repair its proper geometry. If needed use a crane to hoist the tendon carefully avoiding any stress to reinforcement cage.

-Bended ducts at stirrups: Check carefully if any damage, tear, cut or puncture of duct. Your main concern is to avoid concrete penetration inside the duct during concrete which can block the tendon. In all cases wrap locally the duct with PVC tape. A bended duct may increase the friction and wooble coefficient and this should be taken into account during stressing and elongation recording/measurements.



DURING CASTING

-Voids, cracks and concrete improper pouring at anchorage areas: In case of cracks, honeycombs or voids close to the anchorage zone and prior of stressing, demolish carefully the area and apply a strong epoxy resin following manufacturer's guidelines and instructions. Avoid any damage of tendon's duct. Wait at least the resin achieving a strength of minimum 40MPa strength prior of the stressing works.

-Concrete penetration inside the trumpet (bearing plate): Try to investigate the depth of concrete penetration. Use a long chisel or drill and demolish concrete avoiding any damage to the strands over length. Place the anchor head from one side only (case of tendon having both ends free), install the stressing mono-jack and apply carefully load so as to verify that tendon can be elongated during stressing and is not blocked. This process requires extreme precaution avoiding any breaking or extreme draw-back of strands. Check how many strands are released and can be stressed. A new study regarding the PT design must be applied taking into consideration the number of free strands per tendon.

-Improper over-length of strands at stressing ends: Measure carefully the distance required in strand over-length for jacking (grabbing of jack's wedges). In case of tendon having both sides free, use a mono-strand and slightly apply load only to the short over-length strand so as to draw-back at the required distance. In case of a dead-end tendon check how many strands cannot be stressed. A new study regarding the PT design must be applied taking into consideration the number of strands per tendon.

DURING STRESSING

-Broken strand: This commonly can be affected due to improper orientation of anchor head (twisted strands), due to excessive application of stressing load or improper calibration of pressure gauges (false readings). Investigate the reason. Check equipment and calibration of gauges. A new study regarding the PT design must be applied taking into consideration the number of un-broken strands per tendon. Replace the broken strand if applicable.

-Elongation is less than the expected while stressing: Common reason is a locked area of tendon. 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. In case of strands unblocking consider higher friction during stressing. A new study regarding the PT design must be applied taking into consideration possibly overstressing so as to overcome the friction. If not the case and the tendon remains 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.

-Elongation is more than the expected while stressing: Common reason is the slipping of strands from the other side. In case of visible dead anchorage check the condition of strands and wedges. Replace wedges if needed. In case of a non-visible dead anchorage stop the multi – jacking process and apply mono-strand jack so as to determine the number of loosen strands per tendon. A new study regarding the PT design must be applied by overstressing the neighbouring tendons with the required missing stressing load.

-Cracks at anchorage zone and misplacement of trumpet (bearing plate) while stressing: Common reason is voids of concrete at anchorage areas. Using a mono-strand jack carefully release the tendon's stressing force. Demolish carefully the defected area and apply a strong epoxy resin following manufacturer's guidelines and instructions. Avoid any damage of tendon's duct. Wait at least the resin achieving a strength of minimum 40MPa strength prior of the stressing works.



-Recording differences of elongations/loads: If the calculated elongation is reached before the calculated load is obtained, continue stressing till elongation does not exceed 1.05 times (stressing load less than 80% of strands UTS). If the calculated load is reached before the calculated elongation is obtained, continue stressing till load does not exceed 1.05 times (stressing load less than 80% of strands UTS).

-Recording differences of elongations more than ±5% from the theoretical calculations while the maximum required stressing load has been obtained: Double check the modulus of elasticity of coils used in the tendon. If more than one coil is used with different modulus E, re-calculate the mean value of E based on the strand's protocols and re-study the expected elongation. If -%5 continue stressing till load does not exceed 1,05 times (stressing load less than 80% of strands UTS). If +%5 while required stressing load is obtained re-study the PT design and check if any problem.

DURING GROUTING

-Broken and blocked venting tubes: Blocked tubes must be cleared prior of grouting using a rigid steel bar of small diameter. If necessary, use a drill but record the drilling depth to avoid any contact with the strand/tube. In case of broken tubes, use a coupler of smaller diameter and tight up with wire or steel collar. Use pressurized air and check all venting and grouting tubes. Re-design the whole grouting process using any other alternative inlet-outlet.

-Grout volume/quantity is larger than the theoretical calculated: Commonly a concrete void is filled with grout. Continue the process till full filling of tendons.

-Leaking of grout from concrete or grout caps: Tight the connection bolts of grouting caps. Check the grouting pressure (must be less than 3-5 bars). Use a fast-curing resin to cover external leaking points.