4620100 POST-TENSIONING
COMMENTS FROM INTERNAL/INDUSTRY REVIEW

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Comments: (7/19/22, Internal)
"Close all ports except the inlet and outlet ports at the anchorage caps. Just prior to tendon installation, blow oil-free dry compressed air through one of the anchorage cap ports to remove standing water, moisture or debris. Continue to blow oil-free dry compressed air until the humidity of air inside the duct is less than 40% measured at the downstream end of blowing."

I understand the desire, but how will this work?

- Compressed air will not remove a puddle of water in the bottom of a low-point deviation
- How will they record the humidity of the air exiting the duct?

Response:
Below are responses to your comments.

- Compressed air will not remove a puddle of water in the bottom of a low-point deviation
  - The significant puddles will be removed thru the language in the section 462-7.2.1.8 just above the below quoted section. "Briefly open low point drains prior to tendon installation and again just prior to filler injection to allow for drainage of any water that may be present within the duct." The rationale for the 40% humidity is to remove condensation within the duct as much as possible. If the dry air is used long enough then all moisture would eventually be removed, however, this is something we plan to further evaluate from a timeframe perspective. At this time, we are just recommending blowing until the 40% humidity is achieved.
  - Blowing of dry air is already a method that is mentioned in the Specification that the Engineer can use to remove moisture when present. This would now be a necessary step for each tendon given the challenges with detecting moisture presence.
- How will they record the humidity of the air exiting the duct?
  - They can use a handheld humidity meter that should be simple to use in the field. Southern Blvd. (SR 80) in D4 performed humidity monitoring/drying on a PT bar duct due to the exceedance of the minimum days prior to injection and it appears to have worked well. I have attached their monitoring record as an example.

We are going to continue to evaluate and test some additional methods, with simplicity in mind, to ensure a dry duct prior to injection. The proposed changes are a step in that direction to minimize the potential for moisture until further guidance can be provided.

Let me know if you would like to discuss more.

Thanks,
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Comments: (7/27/22, Internal)
Here are some of my comments on the changes:

1. The moisture control items listed seems like a good practice that is being introduced, but it might have chances of introducing unwanted moisture into the system if the "Oil-free dry compressed" air used for testing is not monitored/checked.
2. There might not necessarily be an advantage of having multiple ports on the cap specifically in case of "Flexible filler" tendon. The Anchorage caps are made of ABS or nylon (for the systems currently on the Department APL) and the fittings used for the connections to inject the flexible filler are metal. In a controlled environment these connections work as intended but as observed on Wekiva this one of the most fragile part of the entire assembly. The heat from the flexible filler can cause failure at the connection.

   Unless the PT suppliers can make these holes stronger and provide a product that would make this connection stronger (essentially making these from stainless steel), the additional hole will create more problems for the contactor. On the other hand if the caps are made from stainless steel it should reduce the chances of failure at this connection.

3. For 960-2.2.2.1.5 "Install the anchorage cap such that the top and bottom holes form a vertical axis oriented 90 degrees from horizontal.", this is not practical as in most cases the tendon profile determines the orientation of the bearing plate on which the anchorage cap is to be installed. To accomplish this requirement each cap will have to be custom made for the tendon profile and bearing plate orientation, specific to the project.
4. For 462-8.2.1.1 – The exception now is only for the "Precast" box-girder segment, this will adversely impact the CIP box-girder as most of the internal longitudinal tendons (e.g. cantilever tendon) do not have the complete assembly. Testing the longitudinal tendons without all the components and sealing the construction joint termini will make it harder to pass the test. The most commonly used pressure gauges are analog and testing for loss of less than 1psi in an incomplete tendon will only make things difficult for the contractor.

Response:
1. Good comments. The air must meet ASTM D4285 (comment from Tim McCullough with SMO), the equipment will need to be tested prior to operation, and air humidity in the duct must be measured both at inlet and outlet.
2. Good input, thank you. The Department's intent is to add an additional port at the lowest location to drain any water laying in the bottom of the cap. This additional port serves multiple purposes. Since water is heavier than flexible filler, any water laying in the bottom of the cap prior to injection of flexible filler will remain there with no good way to remove it without a port for draining. For re-injection of flexible filler in a repair situation there is not sufficient room above the cap to inject filler by gravity feed (e.g. for tendons located just below the top flange in a box girder); in this case the lower port can be used to inject flexible

filler or grout to fill the void in the cap by low pressure hand pump. The Department will consider improving the ports connection requirement for the future specification revisions.

3. That is true when the anchorage cap is anchored to the wedge plate (some systems). However, most systems have the cap anchored to the bearing plate. In this case the cap orientation is depended on the bearing plate orientation.
4. Good input. For the CIP box girder, such as cantilever construction method using form-traveler, the Department only requires testing of the tendons within a completely assembled duct with duct couplers and both end anchorage caps installed. The partial duct assembly tendons are not required to be tested.

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Comments: (7/28/22, Industry)

I strongly recommend staying with the current 14 and 21 day restrictions.

If you do extend the time to injecting, the humidity should be held at 40% or lower starting within 24 hours of tendon stressing or installation. If not, the contractor may wait until day 13 or 20 to dehumidify the tendon to save money. By then the corrosion may have already began.

Also why is the extended time for extending 21 days to 60 days not the same period as 14 days to 30 days. Tendons preplaced already have a 7 day longer unprotected allowable time so it would seem the 60 days should be 21+(30-14)= 37 days max if not 30 flat to limit corrosion. 30 days unprotected is 30 days unprotected, period. Preplaced or not should not matter.

If the time is extended and after 14 days the humidity is found to be above 40%, how much time is allowed till the tendon is filled? How often are readings to be taken?

Tendon corrosion is the most critical component of segmental bridges to assure both safety and durability and has been the biggest cause for increased maintenance cost and traffic delays. This change seems to only increase the potential for corrosion and worsening maintenance issues. There seems to be a lot of potential for this to be abused or just ignored to the detriment of the structure.

Response:

1. Yes, the Department will keep the 14-day and 21-day restriction (without corrosion protection).
2. Agree. In case the contractor would exceed the 14-day and 21-day limit, the tendon must be dehumidified within 24 hours after PT steel placement and with continuous monitoring to ensure the air humidity is below 40%, in lieu of other corrosion protection methods/products.
3. See responses No.2 above. For SR 80 Sunrise Blvd. project, the air humidity in the duct was manually checked every few days. However, in the future we are looking for a dehumidification system with the ability check humidity continuously.

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Comments: (8/18/22, Industry)

If you would like to reference an ASTM standard for establishing oil-free dry compressed air, there is an ASTM standard that all of our shops use when they perform abrasive blasting. The standard has been included or can be provided upon request for consideration. Just a consideration. If you think its valuable, it may be appropriate to be used throughout the section.

9. Close all ports except the inlet and outlet ports at the anchorage caps. Just prior to tendon installation, blow oil-free dry compressed air, meeting ASTM D4285 through one of the anchorage cap ports to remove standing water, moisture, or debris. Continue to blow oil-free dry compressed air until the humidity of air inside the duct is less than 40% measured at the downstream end of blowing.

10. Provide an absolute seal of anchorage and duct termination locations per the pre-approved system drawings.

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Response:
Thank you, Tim. Good recommendations which we can include in the final specification language as suggested.
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