

**4002100-DISPOSITION OF CRACKED CAST-IN-PLACE CONCRETE
RESPONSE TO COMMENTS FROM INDUSTRY REVIEW**

Bob Graham
bobgraham9@aol.com

Comments:

Parts of this spec are very onerous. Bridge decks are currently designed with little or no expansion joints and are therefore going to crack. Where and how much is anybody's guess. FDOT, with the new spec would shift the risk of determining the repair costs at bid time to the contractor. I believe FDOT should include the appropriate crack repair pay items in the bid and have their designers determine the quantities, thus everyone is bidding on a level playing field. Naturally if the contractor does not pour or cure according to spec then FDOT will not want to pay for any repairs (even though it was going to crack anyway). I guess that is why we have DRB's. Bob Graham

Response: In general deck slabs generally crack due to environmental conditions that were not properly addressed during the concrete pour and/or poor construction practices during placement. While concrete cracking cannot be eliminated due to the nature of concrete pours and the material itself, it is the responsibility of the Contractor to place concrete that is free of cracks (other than small irreparable widely dispersed micro-cracks) and other deficiencies (voids, honeycombs, etc.), and to repair those cracks and deficiencies that could affect the long term durability and structural integrity of the concrete.

The Department has had several projects over the last several years where deck slabs have cracked. Our first hand observation of the resolution process has shown that the current 400-21 gives little guidance to the CEIs and the Contractors on how to inspect/identify, evaluate, monitor and determine the structural effects of cracks for cast-in-place concrete components; how to determine who is responsible for doing the identification and evaluation of cracks; how to determine when cracked concrete should be replaced or repaired; how to properly repair cracked concrete; and how to determine who is responsible for making these decisions. Additionally, the current 400-21 addresses the size but not the intensity of cracks, and the repair methods shown in Table I are out of date with respect to current technology. As a result the Department reviewed several specification provisions and CPAM sections, and formed a Committee consisting of six (6) people (from the FDOT State Construction, State Structures Design, State Materials, and District Maintenance Offices) that worked on this problem for two (2) years and came up with the following approach to addressing these issues:

1. In regards to preventing deck cracking, Article 400-16 was changed a few years ago to require evaporation monitoring prior to concrete pours to determine when concrete pours should be postponed or when evaporation counter measures are needed, and to get curing compound on a deck slab in time to prevent the formation of shrinkage cracks. Articles 400-7 and 400-15 were also changed a few years ago to require that long bridges (in excess of 300') be profilographed and

planned, in lieu of manually or mechanically floating the concrete surface. Eliminating the use of water during the finishing of deck slabs further reduces the possibility of deck slabs developing shrinkage cracks.

2. Article 400-21 was re-written by the Committee to eliminate the confusion and ambiguity stated in the first paragraph of this response. Specific repairs were developed to optimize the structural integrity and durability of the repaired concrete and 400-21 specifically identifies when a Contractor needs to engage the services of a Specialty Engineer. The proposed specification and tables were Beta tested in the field by State Material Office, State Construction Office and CEI personnel to determine appropriate repairs for cracked concrete on several projects over a one (1) year period with good results.

3. Finally, CPAM 10.3 was modified a few years ago to clarify to the CEIs the administrative responsibilities for making decisions, such as when the Contractor needs to hire a Specialty Engineer and who has input and ultimate authority over the decision making process.

All three (3) of the above actions have or are in the process of being implemented in an attempt to achieve a better product and to speed the investigation and correction of cast-in-place cracked concrete.

Ghulam Mujtaba
State Materials Office

A. General Comments:

1. The proposed specification is a complete replacement of the 2007 version of the Standard Specification. The specification that has been sent for review shows only a few modifications in the form of additions and strike through. It is not clear if the changes are made in a special provision or supplemental specifications. A clean copy in the form of the rewrite should have been sent. This is confusing.

Response: A note immediately below the header entitled “DISPOSITION OF CRACKS IN CAST-IN-PLACE CONCRETE (REV 12-8-06)” states “ARTICLE 400-21 (Pages 390 and 391) is deleted and the following substituted.” This is the way that the State Specifications Office chose to present this proposed specification change for statewide review.

2. The crack survey and mapping should be the responsibility of the contractor and the Department should review and approve it. The proposed specification requires the project personnel to survey the cracks and submit the report to the contractor for review comments. It indicates that the Engineer will make the final decision. This process is not in accordance with the contractor quality control process.

Response: I agree. However, this was the compromise that the State Construction Office worked out with FTBA.

3. The proposed specification should mention that the investigator should determine the cause of the cracks in the concrete structure

Response: The Engineer (CEI) makes the final determination as indicated in 400-21.4. However, CPAM Flowcharts 10-3-5 (for Concrete Construction in general) and 10-7-12 (for Post-Tensioned Bridges) which address the inspection and resolution of cracks, gives administrative guidance to the CEI as to who in the Department has technical input into this process. As indicated in these flowcharts, the ultimate decision will be made with the concurrence of the District Construction Engineer.

4. The survey should include information about the time of the first occurrence of the cracks or the time when they were first exhibited.

Response: Since this is a CEI responsibility and not a Contractor responsibility, this responsibility is specifically addressed in 10.3.5.3 (for Concrete Construction in general) and 10.7.6.9 (for Post Tensioned Bridges).

5. It is important to note if the cracks are active or dormant.

Response: In general structural cracks are active and nonstructural cracks are dormant. Sub-article 400-21.3 addresses how cracks are determined to be structural or nonstructural. Cracks are monitored over the life of the construction project as indicated in 400-21.2 so that bridge components will receive the full loading and structural cracks should be at their widest before they are repaired and the bridge is final accepted.

6. There should be a penalty for the acceptance cracked concrete, when the deficiencies are caused by contractor's negligence.

Response: I agree, but this is a contract management responsibility, and the Districts have made it clear that they want the latitude to manage these situations on an individual basis.

B. Specific Comments:

1. 400-21 Disposition of Cracks in Cast-In-Place Concrete
Change the title to "Disposition of Cracked Cast-In-Place Concrete". The content of the article is related to the disposition of concrete, not disposition of crack.

Response: Agreed, the change will be made.

2. 400-21.1 General

Change to read, “The survey, investigation, and disposition of cracked cast-in-place concrete are described herein.”

Response: Agreed, the change will be made.

3. 400-21.2 Investigation, Documentation and Monitoring, Sentence 1
Change to read, “The Contractor shall perform a thorough survey of the exhibited cracks in the cast-in-place concrete structures.”

Response: Disagree, see written response to your Comment No. A,2 above.

4. 400-21.2 Investigation, Documentation and Monitoring, Sentence 2
Change to read, “The survey includes the measurements of the crack width, length, and depth.”

Response: Disagree, the depth of the crack can only be determined by taking cores, and cores are not needed for all cracks.

5. 400-21.2 Investigation, Documentation and Monitoring
In the contractor quality control projects, it is better if the contractor’s quality control manager report that cracks have been exhibited. The crack survey shall be done by contractor and verified by the Department. It is important to determine the cause of the crack and also note if the cracks are active or dormant.

Response: Disagree, see written response to your Comment No. A,2 above.

6. 400-21.2 Investigation, Documentation and Monitoring, Sentence 5
The sentence is fragmented. The Engineer will monitor ... determined by Engineer”

Response: The sentence appears to be OK.

7. 400-21.2 Investigation, Documentation and Monitoring, Last Sentence
It is not clear that which type of personnel should the contractor provide to perform crack monitoring. The personnel may be technicians or helpers to assist the Engineer related to the safety. The roles and responsibilities of the Department and Contractor should be known.

Response: As discussed earlier, the Engineer (or his designees) is performing the crack inspection and monitoring work. This is stated every sentence in sub-article 400-21.2 except the last one, where the Contractor is required to provide access to the Engineer to perform the crack inspection and monitoring work.

8. 400-21.3 Classification of Cracks, Sentence 2
Define “shallow”

Response: Agreed, the word “shallow” will be defined.

9. 400-21.3 Classification of Cracks, Last Sentence

This should be revised. The contractor should survey the cracks and prepare a report related to cause of the cracks, their repair method, and proposed credit to the Department for acceptance of concrete. The Engineer should verify the information and review the proposed repair method.

Response: Disagree, see written response to your Comment No. A,2 above.

10. 400-21.4 Resolution, Paragraph 2

Change to “...structural stability and durability of cracked concrete structures...”

Response: Disagree, the sentence as worded gets the point across.

11. 400-21.4 Resolution, Paragraph 4

Change “...as determined by Engineer.” to “...as required by the Contract Documents.”

Response: Disagree; the Engineer has to be responsible for determining whether to accept a repair proposal from the Contractor for the “Investigate to Determine Appropriate Repair or Rejection” portion of Tables 1 and 2.

12. Table 2, Note 6

The Note. No.6 does not show any reference to any items in the Table.

Response: It is a general reference that applies to both tables.

Jerry Stanley
ghstanley3@verizon.net

Comments:

I think Rusty Birchall could not have made it more clear. This change in the specs is insane.

Jerry

Response: Noted.

Rusty Birchall
Cone & Graham, Inc.
rbirchall@conegraham.com

Comments:

In general, I think this rewrite of the current spec (2007) is awful. There is nothing wrong with the spec in the 2007 book. Why are they trying to reinvent the wheel here? I think the method of determining crack type is vague and leaves too much open to interpretation. This spec forces the contractor to bid on an unknown quantity of cracks of unknown severity and unknown treatment method. That means high cost to FDOT because of the risk inherent in forcing the contractor to assume responsibility for all cracking.

Response: Section 400-21 needs to change because there is confusion in the field among Contractors and CEIs when concrete cracks on who is responsible for performing the crack inspection and making the decisions, and what repairs are needed. This confusion has historically led to countless field delays which has cost Contractors time and money. The specification change as proposed herein is much more specific than the current version of 400-21 for how inspections are to be performed, what repairs are needed, and at what point the Contractor needs to hire a Specialty Engineer. It is and has always been the responsibility of the Contractor to place concrete that is free of cracks (other than small irreparable widely dispersed micro-cracks, which are irreparable and do not affect the structural integrity or durability of the concrete component in question). Therefore, it is the responsibility of the Contractor to repair cracked concrete at no expense to the Department, unless unforeseen circumstances beyond the Contractor's control are encountered or the design itself proves to be the cause of the cracking.

Specifically:

400-21.2 - "with concurrence of the Engineer." - Why would I need his concurrence to inspect the deck for cracks. Perhaps the intent is to say "in conjunction with". This seems like something that the Engineer is going to do anyway. Why burden the contractor further with an onerous specification when FDOT is likely going to do one of their own because they won't trust the contractor's?

Response: This is an old comment from a courtesy review that was afforded to FTBA before this specification was sent out for statewide review, and since the proposed specification has changed subsequent to FTBA review, this comment no longer applies. The Engineer is now responsible for crack investigation, documentation and monitoring.

400-21.2 - "...inspect....a minimum of 7 days after the bridge has been opened to full unrestricted traffic." How will this be accomplished? On a major interstate or arterial, when will this be done? At night, when it is difficult to see cracks? What happens if the bridge shows additional cracking after opening to traffic. Whose liability is that?

Response: The bridge needs to be inspected for cracks after it is burdened with full dead and unrestricted traffic "live" load to determine that it will function as

designed (free of cracks that can negatively affect its structural integrity and durability). Seven (7) days is the minimum time the bridge needs to be burdened with full traffic load in order to confirm that new cracks are not developing. Obviously, this inspection will need to be scheduled on a project by project basis, and the use of MOT and temporary lighting may be needed. If the bridge develops cracks, the cracks will have to be repaired. The cost of repairing the cracks is now and will remain the responsibility of the Contractor, unless the Contractor can prove that it is a design defect in which case the Department will pay the Contractor to repair the cracks (unless it is a Design-Build project where the Contractor is responsible). Please note that if the Contractor inspects each component 7 to 31 days after casting (as required in 400-21.2), the likelihood of finding new shrinkage cracks is small, which means that cracking that occurs after the bridge is burdened with full unrestricted traffic will most likely design related. Obviously the Contractor accepts the liability of working in and around traffic.

400-21.3 - "Evaluate cracks and recommend whether cracks are nonstructural or structural" This is going to be left to the contractor? Wouldn't this fall under the qualifications of an Engineer, not a contractor? Is anyone going to accept the contractor's "recommendation"?

Response: This is an old comment from a courtesy review that was afforded to FTBA before this specification was sent out for statewide review, and since the proposed specification has changed subsequent to FTBA review, this comment no longer applies. The Engineer is now responsible for classification of cracks.

400-21.4 - Resolution - "No additional compensation or contract time shall be allowed for repairing or replacing cracked concrete." Why not? If a contractor has constructed the bridge in accordance with plans and the placement and curing specifications, and the bridge cracks, what has he done wrong? If the bridge cracks after placement of the deck during the addition of dead or live loads, why is the contractor responsible for it? How is a contractor going to determine an amount prebid to place in his proposal to cover the cost of an unknown quantity of cracking.

Response: It is assumed that this comment is addressed primarily to deck slabs. The successful placement of an uncracked deck slab is based on science not luck. The Contractor needs to have good control of the concrete material properties from the plant, and the Contractor needs to place and cure the concrete within the parameters outlined in the specifications. There are many factors that can adversely affect the successful placement of a concrete decks slab, such as: the mix design and admixtures, weather conditions, workmanship, placement time, application of curing compound, etc. All of the above except for the weather are under the direct or indirect control of the Contractor. In this regard, a change was made to 400-16.1 a few years ago that allows the Contractor to use science to mitigate the fickle nature of the weather. The evaporation limit in 400-16.1 needs to be calculated using predictions for concrete temperature, relative humidity, ambient air temperature and wind velocity, and is based on American Concrete Institute publication ACI

308R. In order for this to be done properly, this requires the Contractor to take the time to research concrete temperatures and weather conditions, including taking wind measurements from the bridge deck level and comparing this measurement with the published weather predictions to correlate the data for future pours. If Contractor determines that the evaporation limit in 400-16.1 may or will be exceeded on the day of the pour, the Contractor may cancel the pour or take counter measures, such as: the use of evaporation retarder, wind screens, performing night pours, etc.

In the event that the concrete cracks and the Contractor has documented that everything was done in accordance with the plans and specifications and it can be determined that the cracking was indeed design related, the Contractor will be entitled to additional compensation and time. Otherwise, it is, it will and it always has been the responsibility of the Contractor to repair the cracks at no expense to the Department, and under these circumstances the Contractor would receive no extension in time.

Keith Waugh
kwaugh@lewarecc.com

Comments:

I see nothing wrong with 400-21 as it appears in the 2007 Standard Spec. book.

This re-write looks like it should belong in FDOT's guidelines for CEI inspection, other than the last sentence of 400-21.4.

I foresee additional cost and conflict from this proposed specification.

Response: See the written response to Bob Graham and Rusty Birchall above.

Ron Meade

Comments:

Spec 4002100 (wasn't available from the drop down menu)

Response: I defer the answer to this comment to the State Specifications Office, who actually distributed this proposed specification change for statewide review.

Section 400 - 21.4 Resolution - Last sentence was changed to included the extra wording that was caused by inadequate curing effort or inadequate construction practice as determined by the Engineer.

Response: This comment appears to have been made to an earlier version of this proposed specification change, because the last sentence in 400-21.4 clarifies that the Engineer is responsible for making all final decision with regard to crack resolution.

It seems by adding this extra wording we are sending the message that if cracks occur that don't appear to be caused by inadequate curing or inadequate construction practices, then we will pay the contractor additional compensation to repair or replace.

Response: If the Contractor followed the specifications and the concrete cracked as a result of a design defect or some circumstance beyond the Contractor's control, the Contractor would be entitled to additional time and compensation.

Tables 1 and 2 should include the wording non-structural, since these tables only apply to non-structural cracks.

Response: It would be nice and simple to add the word "nonstructural" in the heading of Tables 1 and 2. However, the portions of these Tables entitled "Investigate to Determine Appropriate Repair or Rejection" and "Reject or Replace", refer to cracked areas of concrete that have structural implications. The reason these cracked areas of concrete have structural implications is because the size and intensity of the cracks can affect the structural integrity of the cracked component, even if the concrete cracked for nonstructural reasons, such as curing. Please be aware that sub-article 400-21.4 clearly states "repair nonstructural cracks in accordance with Tables 1 and 2 where applicable" and "for disposition of structural cracks provide a structural evaluation and written recommendation by a Specialty Engineer."

Daniel F. Haldi
D-5
386-740-3516

Comments:

Great job, new spec version!

Response: Thanks!

Section -21.2: The Engineer will inspect as soon as surface is visible, ADD "and" between 7 and 31 days after full dead load, and a minimum of 7 days after unrestricted live We want all three times not one or the other.

End Comments. Thank-you.

Response: There is a comma after casting, which puts all three times of inspection in a series (after casting, between 7 and 31 days, and a minimum of 7 days after...).

-21.3.1: REPLACE everywhere LOT with words like "area, section", etc. to conform to T. Malerk not using LOT.

Response: The word "LOT" is a concept and term used in other Sections of the Standard Specifications and the Materials Manual and is well understood in the CEI and materials testing community. The use of this term "LOT" was recommended by the three (3) State Materials Office members of the committee that participated in the collective writing of this proposed specification.

Eric Jagers
352-267-9587

Comments:

1. It would seem to me that the Department should identify whether or not cracks are present and to what extent. After the discovery of such cracks it should be the Contractor's responsibility to monitor or provide an independent engineer to perform some sort of Engineering Analysis. It should be handled by having the Contractor submit a DDM and determine themselves what the disposition of the in place concrete and its structural adequacy.

Response: The way the specification assigns responsibility to the Contractor and the Engineer is a compromise worked out between FTBA and the State Construction Office as a result of earlier review comments made by FTBA during a courtesy review.

Rodney G. Powers
352-955-6690
rodney.powers@dot.state.fl.us

Comments:

400-21.1 General: The survey, investigation and disposition of cracked ~~disposition of~~ cracks that develop in cast-in place concrete ~~shall be in accordance with this section~~ are described herein.

Since the "survey" is part of the investigation the word "survey" should be omitted; also, the word "are" should be inserted between the words "concrete" and "described."

Response: Agreed. We will change the sentence to read as suggested.