

Section 10.6

UNDERWATER BRIDGE CONSTRUCTION INSPECTION

10.6.1 Purpose

The purpose of this section is to provide a standard procedure for conducting underwater bridge construction inspections on active bridge construction projects ~~that are in progress~~. The procedure specifies the type of bridge member that requires underwater inspection, the type of underwater inspection required and the frequency of inspections. ~~Also, specified are~~ the qualification requirements for firms and individuals performing underwater inspections are also specified.

10.6.2 Authority

~~FHWA Approved: March 18, 2009~~

Section 20.23-(~~34~~)(a), Florida Statutes ~~(F.S.)~~

Section 344.048(3), Florida Statutes ~~s~~ ~~(F.S.)~~

Section 336.045, Florida Statutes ~~(F.S.)~~

10.6.3 General

~~Defects in bridge components that are underwater have historically been uncommon; however, in recent years the frequency of underwater defects that develop during construction has increased. Sometimes these defects are not discovered until project final acceptance or after because underwater inspections are not routinely performed during construction. Construction debris that is disposed of by the Contractor underwater where it is out of sight is often overlooked prior to final acceptance or is not discovered until the final inspection if at all. In order to prevent such oversights in the future, performance of routine underwater bridge construction inspections as part of standard Construction Engineering and Inspection (CEI) services may be required depending on the~~

~~circumstances described herein.~~ Procedures for performing ~~the required~~ underwater inspections are presented herein and the contractual requirements for providing consultant CEI services for underwater inspections are specified in the Standard CEI Scope of Services ~~under~~ **Section 9.3, On-Site Inspection.**

~~, which can be viewed at the following~~

~~Internet~~

~~link:~~

~~<http://www.dot.state.fl.us/Construction/DesignBuild/ConsultantCEI/ConsultantMain.shtm>~~

The CEI scope of services for projects having underwater members must ~~include provisions for~~ addressing the requirements ~~of this CPAM Section~~ [herein](#). The individual responsible for scope of services development ~~such as the Resident Engineer/Operations Center Manager or the District Consultant CEI Administrator~~ shall consult with the District Structures Maintenance Engineer and District Structures Design Engineer to determine if the project will utilize members with a history of underwater defects as described in **Section 10.6.4.1(a)**. If the project will utilize these type members then the CEI scope of services must include the higher level of underwater inspection effort required by **Sections 10.6.4.1 (a) and 10.6.4.2 (a)**. If the District chooses to have a comprehensive underwater debris survey done for the bed of the body of water on the alignment of the project prior to letting, then this should be added to the scope of services. These type surveys are not required by this procedure but they may be added at the discretion of the District. ~~Bottom surveys may be beneficial since they reveal debris that may be present prior to the start of construction, that disposal of, would not be the responsibility of the Contractor unless supplemental compensation was arranged for after letting.~~

~~This procedure is subdivided into two major categories of underwater structural members: (1) Piles and uncased drilled shafts and (2) Piers, footings, columns and walls. Within each major category three types of inspections may be required: (1) Initial, (2) Progress, or (3) Final. For example: in **Section 10.6.4**, structural member category 1, concrete piles and uncased drilled shafts, there are these inspection type **Sections: 10.6.4.1 Initial Inspection, 10.6.4.2 Progress Inspection, and 10.6.4.3 Final Inspection.**~~

Initial and progress inspections for projects ~~that are~~ managed by CEI Consultants, shall be performed by a commercial diving service or by a qualified bridge maintenance consultant ~~(see paragraph below for consultant qualification requirements)~~ hired by the CEI consultant. The diver/inspector in charge of the work in the field for the commercial diving service and who shall personally perform the required inspections underwater shall have

successfully completed National Highway Institute (NHI) training course number 130091, Underwater Bridge Inspection, or an equivalent course as determined by the Project Administrator (PA). Assistant divers are not required to take the NHI course. In lieu of NHI course completion, the diver/inspector in charge may be a Certified Bridge Inspector (CBI). CBI certification is administered by the [Florida Department's of Transportation](#) Office of Maintenance, Structures Maintenance Section which issues inspector certificates as proof of certification. Inspectors/divers shall submit written proof of successful NHI course completion or CBI certification to the PA prior to commencement of services. ~~All diving operations must comply fully with applicable Federal Occupational Safety and Health Administration (OSHA) regulations.~~

Initial and progress inspections for projects ~~that are~~ managed by in-house CEI staff, may be performed by a commercial dive service, ~~or~~ bridge maintenance consultant or by Department inspector/divers as determined by the District Construction Engineer based on consultation with the District Structures Maintenance Engineer. ~~If a~~ Commercial or consultant inspectors/divers ~~are used then they~~ must meet the NHI or CBI requirements above and may be provided through a District Construction Office General Engineering Consultant (GEC) services contract or through a local CEI consultant residency contact.

Final inspections for projects ~~that are~~ managed by CEI Consultants, shall be performed by the CEI consultant or by a subconsultant hired by the CEI Consultant; however, the firm providing the service shall be prequalified to perform bridge maintenance inspections and related services as required by **Florida Administrative Code (FAC) No. 14-75.003(5)(d)2, Qualification Requirements for Bridge Maintenance Inspection Consultants.** ~~On occasion, f~~ Final inspections may also be performed by in-house Department Certified Bridge Inspectors, ~~however, whether or not to~~ [The decision to](#) use Department inspectors will be determined by the District Construction Engineer based on consultation with the District Structures Maintenance Engineer.

Final inspections for projects managed by in-house CEI staff may be performed by Department CBIs or consultant inspectors, ~~however, whether or not~~ [The decision](#) to use Department or Consultant inspectors will be determined by the District Construction Engineer based on consultation with the District Structures Maintenance Engineer. If consultant inspectors/divers are used for in-house CEI projects then they must meet the requirements of **FAC 14-75.003** above and may be provided through a District Construction Office GEC services contract or through a local CEI consultant residency

contract.

10.6.4 Underwater Inspection of Concrete Piles and Uncased Drilled Shafts ~~(Note: for this procedure the term "member" will refer to piles and/or drilled shafts)~~

10.6.4.1 Initial Inspection

When time permits and within the allotted time (typically 8 hours) for [underwater foundation](#) member inspections, initial inspections may include a search for prohibited underwater construction debris that may have been deposited by the Contractor during construction operations. The need for a debris inspection will be determined by the PA with concurrence of the Department's Construction Project Manager based on whether or not there is reason to believe that the Contractor's debris disposal practices are questionable.

- (a) **Voided piles, cylinder piles and uncased drilled shafts with concrete surfaces directly exposed to open water ~~that have a history of underwater defects (cracks, spalls, voids, etc.)~~**

The purpose of the initial inspection is to revise pile driving or drilled shaft installation procedures and/or designs if defects develop during installation of the first members of the project. ~~Therefore, a~~ An initial underwater inspection of members shall be performed after all [foundation](#) members of the first pier or bent have been installed and if possible, before member installation for the next pier or bent begins and before footing or cap formwork is placed. ~~However, i~~ Inspection operations shall ~~in no way not~~ delay or impact the Contractor's construction operations. In certain environments, marine growth on the surface of members can advance enough to obscure the view of that surface within 7 days.

~~For this reason, t~~ The PA must determine if the rate of marine growth ~~is a factor in being able to perform an effective~~ will affect inspection of underwater surfaces. ~~Based on this determination, initial underwater inspections shall be performed prior to a time limit established by the PA if the installation of formwork or member installation at the next pier or bent will take place after the PA's limit.~~ During initial inspections, underwater inspectors shall inspect every visible submerged surface of designated members. If marine growth has obscured the view of concrete surfaces by the time inspections take place then

perform inspections as covered in ***FDOT Bridge Underwater Operations, Procedure No. 850-010-011, Section 7.2.1 and 7.2.2.***

An initial inspection shall be performed for each member installation system where the installation system is defined herein as the combination of one type member with its corresponding installation machinery as established during the member test program. Any significant change, as determined by the PA, of the installation system will require another initial inspection. The PA may also call for an initial inspection any time it is felt that member installation conditions (soil resistance, soil type, member depth, etc.) or procedures have changed enough to be considered a different installation system.

If the initial inspection reveals defects then the PA will take action as defined in applicable sections of the contract documents that may mandate repair, removal, etc. If action is not specifically covered by the contract documents then a written notice shall immediately be issued by the PA with a description of the defects and a request that the Contractor respond to the notice with a proposal for correcting current defects and for preventing future defects. The notice shall also recommend that the Contractor suspend the operation that is producing defects until an approved solution to the defect problem is agreed upon between the Department and Contractor ~~thus preventing additional defects~~. If the Contractor chooses not to suspend member installation operations after receipt of the defects notice, then the PA shall send a letter to the Contractor advising that if member installation continues, it is at the Contractor's risk ~~and~~ the consequence ~~of which~~ could be mandatory removal of defective members. The PA shall consult with appropriate parties (Project and District Geotechnical Engineer, EOR, District Structures Design Engineer, State Construction Structures Engineer, etc.) ~~in order~~ to develop a response to the Contractor's proposal for preventing further defects and to determine what action will be required to correct existing defects in accordance with ***Specification 6-11, 400-21 and CPAM Section 5.8.5, Defective Materials.***

Once member installation operations resume, another initial inspection must be performed and if defects are not revealed then progress inspections as described herein shall be performed. When defects are not found during the initial inspection then ~~it will be assumed that the~~ installation process and member design ~~are effective~~ and may continue contingent on the results of progress inspections.

(b) Members covered by 10.6.4 that rarely develop underwater defects

The PA will decide if an initial inspection is needed based on the effectiveness of the installation system's performance after the first pier or bent has been completed. If the PA is confident that members are not developing cracks, spalls or other defects during the first installation then an initial underwater inspection should not be needed. However, if the PA is uncertain about the development of defects then an initial inspection should be considered and the Construction Project Manager and project Geotechnical Engineer shall be consulted for concurrence prior to proceeding with an inspection.

10.6.4.2 Progress Inspection

When time permits and within the allotted time (typically 8 hours) for member inspections, progress inspections may include a search for prohibited underwater construction debris that may have been deposited by the Contractor during operations. The need for a debris inspection will be determined by the PA with concurrence of the Department's Construction Project Manager based on whether or not there is reason to believe that the Contractor's debris disposal practices are questionable.

- (a) **Voided piles, cylinder piles and uncased drilled shafts with concrete surfaces directly exposed to open ~~water that have a history of underwater defects (cracks, spalls, voids, etc.)~~**

The first and only progress inspection for bridges with 10 or less piers/bents having members exposed to open water (water piers/bents) shall be performed on all members in the pier/bent that contains the member closest to that representing 33% of all the members that will be installed in open water. An example is a bridge that has a total of 10 piers of which 5 are water piers each with 10 piles which makes a total of 50 water pier piles. So for this example the progress inspection will be performed on all piles in the second water pier because it contains pile 17 (33% of 50 = 17) of 50 or the pile that is closest to 33% of all water pier piles. For bridges with more than 10 water piers/bents, progress inspections shall be performed on all members in the water pier with the member closest to representing 25% of all water members installed and then again on all water members in the pier with the member closest to representing 65% of all water members installed. This selection criterion applies individually to each type member installation system that received an initial inspection. For example: if a bridge has 20 bents with solid 24 inch

square piles and 10 piers with 30 inch square voided piles then one progress inspection would be performed at 25% and one at 65% for the 24 inch piles and one progress inspection would be performed at 25% and one at 65% for the 30 inch piles.

During progress inspections, inspectors shall inspect every visible submerged surface of designated members. If possible, the members in the progress inspection pier/bent shall be inspected before member installation for the next pier/bent begins and before footing/cap forms are installed. However, inspection operations shall in no way delay or impact the Contractors construction operations. Also, comply with **Section 10.6.4.1(a)** for determining the significance of marine growth with regard to a time limit for inspections. If all members in the progress inspection pier have been inspected before the end of the routine inspection team day (typically 8 hours), then as directed by the PA, the inspection team shall also inspect as many members as possible in adjacent piers before the end of the routine inspection team day.

If a progress inspection reveals defects, the PA will take action as defined in applicable sections of the contract documents that may mandate repair, removal, etc. If action is not specifically covered by the contract documents then a written notice shall immediately be issued by the PA with a description of the defects and a request that the Contractor respond to the notice with a proposal for correcting current defects and for preventing future defects. The notice shall also recommend that the Contractor suspend the operation that is producing defects until an approved solution to the defect problem is agreed upon between the Department and Contractor thus preventing additional defects. If the Contractor chooses not to suspend member installation operations after receipt of the defects notice, then the PA shall send a letter to the Contractor advising that if member installation continues, it is at the Contractor's risk the consequence of which could be mandatory removal of defective members. The PA shall consult with appropriate parties (Project and District Geotechnical Engineer, EOR, District Structures Design Engineer, State Construction Structures Engineer, etc.) in order to develop a response to the Contractor's proposal for preventing further defects and to determine what action will be required to correct existing defects in accordance with **Specification 6-11, 400-21** and **CPAM Section 5.8.5, Defective Materials**.

Once member installation operations resume, whether or not suspension has taken place, another initial inspection must be performed and if no defects are observed then progress inspections shall resume at a frequency determined by the PA with the concurrence of the

Construction Project Manager. If defects are again observed, repeat this procedure.

(b) Members that rarely develop underwater defects

When the PA determines that an initial inspection is needed then depending on the results of that inspection, the PA may also consider requiring at least one progress inspection to confirm that defects are not developing as member installation progresses. Anytime defects are observed, comply with the procedure herein that covers what to do when defects are revealed.

10.6.4.3 Final Inspection (applies to all members covered by 10.6.4)

A final underwater inspection of piles, including fender piles, and uncased drilled shafts shall be performed prior to final acceptance of the project but not before the bridge has been carrying full unrestricted public vehicular traffic for at least 7 days. The written record of the bridge inspection shall be signed and sealed by a Professional Engineer registered in the State of Florida. Inspections shall be conducted in accordance *FDOT Bridge Underwater Operations, Topic No. 850-010-011* and be in full compliance with FDOT District Structures Maintenance Office procedures for routine underwater maintenance inspections. Prior to the start of any final inspection, the District Structures Maintenance Engineer (DSME) shall be consulted and inspections shall be performed according to the DSME's direction with concurrence of the Construction Project Manager. A copy of the records that are produced as a result of inspections shall be transmitted to the District Structures Maintenance Office and will be incorporated into the permanent bridge maintenance record and may serve as the official initial underwater bridge maintenance inspection report.

Final inspections shall include a search for prohibited underwater construction debris that may have been deposited by the Contractor during construction operations.

10.6.5 Underwater Inspection of Footings, Columns, Piers and Walls

10.6.5.1 Initial Inspection

An initial inspection will be required for the first members (footings, columns, piers or walls) constructed on the project that will be fully submerged during their service life. ~~and these are usually constructed within a cofferdam. A cofferdam allows these members to be constructed in a dry environment and; therefore, all concrete surfaces of members constructed within the cofferdam shall receive a thorough inspection after form removal and before the cofferdam is flooded. If c~~Cracks or other defects ~~have developed then corrections~~ must be ~~corrected~~ completed prior to flooding the cofferdam. ~~If defects have not developed before the cofferdam is flooded then they are not likely to form after flooding and before the superstructure dead load has been applied. For this reason, t~~The initial underwater inspection of the first fully submerged members of the project shall not take place until the superstructure load with the exception of traffic and pedestrian barriers, lighting, signing, signals, etc., has been applied to the pier and which shall be referred to as the "Initial Inspection Load".

Footings that will be partially submerged (waterline footings) during their service life will receive a final underwater inspection only and will not receive an initial or progress inspection unless cracks above water are found during the routine inspection required by **CPAM 10.3.5**. If a crack starts above water and ends below the water then underwater inspection procedures herein for fully submerged components shall apply to that waterline footing.

A significant amount of time will pass between flooding of the cofferdam and completion of the deck so aquatic growth will have developed on submerged concrete surfaces to a degree that is governed by the aquatic environment. Because of the growth, both a level I and II underwater inspection shall be performed in accordance with **FDOT Bridge Underwater Operations, Topic No. 850-010-011, Section 7.2.1 and 7.2.2**.

If defects are found during the initial inspection then a decision about what action, if any, shall be taken to correct the defects, and to prevent further defects in members not yet built, shall be pursued by the PA in accordance with **Specification 6-11, Specification 400-21** and **CPAM Section 8.11** and with assistance from the following participants as needed: Construction Project Manager, District Materials Office, District Structures Design Office, State Materials Office, State Construction Office and State Structures Design Office. When defects are found in the first pier of the project then an initial inspection shall be performed on the second pier of the project immediately or as soon as the Initial Inspection Load is applied. If defects are found in the second pier then the initial

inspection process will continue to the third pier, and so on, until the PA has required initial inspection of all piers or until the PA is satisfied that the defects are unlikely to occur on subsequent piers due to a change in construction practice or for some other rational reason.

If no defects are found during the initial inspection of the first fully submerged members of the project then the PA has the option of either performing Progress Inspections as the project advances or to continue Initial Inspections due to knowledge of construction problems during the building of other members.

10.6.5.2 Progress Inspection

Within the allotted time for member inspections (typically 8 hours), progress inspections may include a search for prohibited underwater construction debris that may have been deposited by the Contractor during operations. The need for a debris inspection will be determined by the PA with concurrence of the Department's Construction Project Manager based on whether or not there is reason to believe that the Contractor's debris disposal practices are questionable.

Once all Initial Inspections are complete then Progress Inspections shall be performed according to the provisions herein and in accordance with **FDOT Bridge Underwater Operations, Topic No. 850-010-011, Section 7.2.1 and 7.2.2**. For bridges with 10 or less water piers, perform one progress inspection on the water pier closest to that representing 33% of all the water piers installed. For example, if the bridge has 12 total piers and 8 are water piers then 33% of 8 is 2.6 which rounded off is 3; therefore, the third water pier would receive the only progress inspection required if no defects are found. For bridges with more than 10 water piers, progress inspections shall be performed on the water pier closest to representing 25% of all water piers in the project and then again on the water pier closest to representing 65% of all water piers in the project. If the designated pier has been inspected before the end of the routine inspection team day (typically 8 hours), then as directed by the PA, the inspection team shall also inspect as many other piers as possible before the end of the routine inspection team day. If defects are found during a progress inspection then the PA shall take action as described in **Section 10.6.5.1** for dealing with defects as well as with requiring inspection of other piers.

10.6.5.3 Final Inspection

A final underwater inspection of fully and partially submerged members including bulkheads, seawalls, etc. shall be performed prior to final acceptance of the project but not before the bridge has been carrying full unrestricted public vehicular traffic for at least 7 days. Perform final inspections of piers, footings, columns and walls in accordance with **Section 10.6.4.3**.

Final inspections may include a search for prohibited underwater construction debris that may have been deposited by the Contractor during construction operations. The need for a debris inspection will be determined by the PA with concurrence of the Department's Construction Project Manager based on whether or not there is reason to believe that the Contractor's debris disposal practices are questionable.