Structures Committee Agenda

September 30, 2014

Turnpike HQ, Orlando

1:00 PM

1. **1:00- 2:30- Juan Castellanos/ Randy Cropp.** Design-Build Structures Foundation Questions- review and discuss the following questions and answers. See attached document for Department responses to these questions.
    a. Why are the roles and responsibilities for the Department, Designer, and Contractor different between Design-Build and Design-Bid-Build projects?
    b. What are the different roles and responsibilities between DBB and DB projects?
    c. What were the changes to the foundation requirements for DB projects implemented in July 2013?
    d. What were the changes to the foundation requirements for DB projects implemented in July 2014?
    e. What is the role of the CTQP Pile Driving Inspector on DB projects?
    f. Why should out of tolerance issues be addressed prior to or part of the foundation certification package on DB projects?
    g. Why is driving beyond practical refusal an issue on DB projects?
2. **2:30- 2:45- Juan Castellanos/ Randy Cropp.** Structures Foundations Questions- review and discuss the following questions and answers. See attached document for Department responses to these questions.
    a. What are the pile driving requirements when steel sheet pile is adjacent to piling?
    b. What are the requirements to perform dynamic testing on pile splices?
3. **3:00- 3:15 Break**
4. **3:15- 3:45- Juan Castellanos.** Protection of structures- review summary of a specification change proposed for July 2015 implementation. See attached document.
5. **3:45- 4:00- Randy Cropp.** Mass concrete and size requirements for mass concrete.
6. **4:00- 4:15- Dan Hurtado.** Possible revisions to expansion joint specification- Specification Article 400-10.
7. **4:15- 4:30- Randy Cropp.** Other.

Protection of Structures
Summary of Changes

The protection of existing structures is currently addressed in Article 455-1.1. This article is referenced even if the construction activity is not related to foundation construction such as installation of drainage and vibratory compaction of earthwork. To clarify the requirements for any construction activity, the language in Article 455-1.1 Protection of Existing Structures will be moved to a new Section 108.

The new section will include the following articles:

- Settlement Monitoring and Inspection
- Vibration Monitoring
- Groundwater Monitoring
- Measurement and Payment

Settlement Monitoring and Inspection

The requirements will be the same as the current requirements in Article 455-1 with the following additions:

- Installation of foundations for miscellaneous structures. The plans will indicate the structures that require settlement monitoring and inspection.
- Roadway compaction operations. Settlement monitoring and inspection will be required within 200 ft of vibratory compaction operations and as shown in the plans.

Vibration Monitoring

The requirements will be the same as the current requirements stated in 455-1. The plans will indicate the structures that require vibration monitoring.

Groundwater Monitoring

The requirements will be the same as the current requirements stated in 455-1. The plans will indicate the locations for groundwater monitoring.

Design-Build Structures Foundation Questions

1. Why are the roles and responsibilities of the Department, Designer, and Contractor different between Design-Build (DB) projects and Design-Bid-Build (DBB) projects?

The roles and responsibilities of the Department, Designer, and Contractor are different due to the nature of the contract type. These differences were recognized when FDOT started using DB contracting.

In traditional DBB construction projects, the design is performed by the Department utilizing consultants or FDOT personnel. During construction the Department performs foundation testing and specifies to the contractor the installation and the acceptance criteria.

In DB projects the DB team is responsible for the design and construction. Installation and acceptance criteria are defined by the DB team through its Geotechnical Foundation Design Engineer of Record. Due to this, the Department requires the DB team to submit signed and sealed foundation certifications. This has been the process since the Department started using DB contracting.

In addition, DB projects include a verification process. This process started from the beginning of our DB practice because FHWA required verification for Federally funded projects and the Department has seen the benefits of continuing this practice even on non-Federally funded projects. The verification process is justified because deficiencies and failures are discovered in pile foundations that have been certified.

2. What are the different roles and responsibilities between DBB and DB projects?

As stated above, the roles and responsibilities of the Department, Designer, and Contractor during foundation construction change significantly from a DBB project to a DB project.

In a DBB project, the Department will:

- Perform load tests, dynamic tests
- Establish final authorized lengths for piles and shafts
- Establish driving installation criteria
- Provide inspectors and inspect the construction of the foundation
- Maintain foundation installation records

In a DB project, these activities are performed by the DB Team. In addition, the DB Team will certify the foundation.

In a DB project, the Department's role changes. The Department will:

- Observe and review the construction, inspection and testing procedures

- Review field installation logs
- Review submittals related to installation plans, final lengths, foundation installation criteria, certification packages (CEI and DGE/GE)
- Verify foundations (CEI and DGE/GE)

In October 2013, a new CPAM chapter 10.12 was implemented to establish a standard procedure for CEI to administer foundations in DB projects. This procedure identifies the roles and responsibilities of the personnel involved in the administration of DB projects on behalf of the Department. On January 30, 2014, during the DB Workshop II, the topic "DB vs. DBB Roles and Responsibilities Geotechnical" was presented which explained the differences between these two types of contracts in geotechnical work and presented the main topics of CPAM Chapter 10.12. This presentation can be found using the following link.

http://www.dot.state.fl.us/construction/OnlineRegistration/DB-Expo2014/DesignBuildExpo_2014.shtm

3. What were the changes to the foundation requirements for DB projects implemented in July 2013?

There were no changes of content that would adversely affect industry. The changes that were made were the movement of RFP language to the specifications. These changes went out for internal and industry in October 2012 and were published in the July 2013 Workbook. The comments and responses can be reviewed using the following link.

http://www.dot.state.fl.us/specificationsoffice/Implemented/WorkBooks/History/Jul13/Default.shtm

- **SP4550000DB**. The Department transferred the majority of the language from the RFP Section VI "Design and Construction Criteria, B. Geotechnical services" to the new Section SP4550000DB. In addition to the language relocation we included changes to expedite the processing of construction submittals such as installation plans, certifications, installation letters, and certification packages and making the verification process simpler. Frequency of VT was also reduced.
- **SP1050813DB.** The Department transferred the majority of the language from the RFP Section V "Project Requirements and Provisions for Work, C Geotechnical Services" to the new subarticle in Section 105.

4. What were the changes to the foundation requirements for DB projects implemented in July 2014?

The following changes went out for internal and industry review and are applicable to DB projects only. The comments and responses can be reviewed using the following link.

http://www.dot.state.fl.us/specificationsoffice/Implemented/WorkBooks/History/Jul14/Default.shtm

- **455-5.10.7:** Optional Set-up approach. Resistance factors table was revised to include EDC or PDA for dynamic testing. This change only applies to DB projects because it is a design related specification.
- **455-5.17**: Added language to clarify that pre-driving inspection of piles is required including activities such as handling piles, jetting, predrilling, and preforming. This change only applies to DB projects because the DB team is responsible for the pile inspection. In conventional projects the Department performs the inspection.
- **455-5.18**: Deleted paragraph requiring inspection of void piles including under water video or still photography prior to certifying the piles. Reason is that on conventional projects, the Department performs this inspection and will do the same for DB projects since this inspection is the kick off to the biennual Department bridge inspections.

There have been other changes which incorporate changes to the DBB Section 455 that also apply to the DB Section 455. For example, the following change to 455-15.8 applies to both DB and DBB:

- **455-15.8**: Improved language to clarify that at the time of concreting, fluid, pH, and viscosity testing are not required when water or natural slurry is used. In this case the fluid will not need to meet the minimum density, only the maximum density. Also required fluid testing frequency was reduced from every 10 ft to every 30 ft.

5. What is the role of the CTQP Pile Driving Inspector on DB projects?

The role of the CTQP Pile Driving Inspector is the same on a DBB project and a DB project. The difference is who provides the CTQP Pile Driving Inspector. On a DBB project, the Department typically contracts with a CEI firm to provide the inspection services. On a DB project, the DB Team provides the inspection services.

The Department considers qualified inspection very important to make sure the foundations are installed without damage and meet the design requirements. The Department has required foundation inspection by qualified technicians since the 1990s, even before QC 2000 started.

The Department expects and requires the same level and quality of inspection on DB projects as the Department performs on DBB projects. It is not the intention of the Department to request more or less inspection from the DB team than what is normally done on DBB projects.

There have been recent discussions regarding the need for a CTQP Pile Driving Inspector to inspect the unloading of piles at the project site from the delivery truck to storage. The inspection of this activity is part of the CTQP Pile Driving Inspector training and the Department performs this inspection on DBB projects. There are not separate CTQP Pile Driving Inspector

training classes for DBB and DB projects. As such, the Department expects and requires this inspection on DB projects by the Design-Build Team.

6. **Why should out of tolerance issues be addressed prior to or part of the foundation certification package on DB projects?**

The foundation certification package must take into consideration the as-built condition of that foundation to account for such things as load conditions related to tolerances, position, capacity, damage, etc. The certification of the foundation by the Geotechnical Foundation Design Engineer of Record does not eliminate other contract requirements.

7. Why is driving beyond practical refusal an issue on DB projects?

Driving beyond practical refusal is a concern on DB projects for the same reason it is a concern on DBB projects- risk of damage to the pile. The piling need to be evaluated when practical refusal is achieved to determine if minimum tip elevation has been achieved, if the elevation to which the pile has been driven will provide the required lateral and axial capacity. A piling that has been driven beyond practical refusal cannot have its integrity determined definitively by a PDA. Extraction of the pile would be the only certain way to determine if the pile has sustained damage. The certification of the foundation by the Geotechnical Foundation Design Engineer of Record does not eliminate other contract requirements.

Structures Foundation Questions

1. What are the pile driving requirements when steel sheet pile is adjacent to piling?

The requirements are to install the piles to achieve the stated capacity. Any reduction in capacity due to the proximity and removal of temporary steel sheet pile is an issue that should be considered and addressed during design with capacity confirmed during construction as needed.

A sheet pile wall may affect the capacity of piles to be driven adjacent to the wall depending on the proximity and the depth of the sheet pile wall. An increased "temporary" capacity is induced due to additional lateral stresses that are generated by driving a displacement pile next to a rigid element (sheet pile wall). This has been evidenced in the field when piles next to sheet piles penetrate less than expected and at higher blow counts than that observed in test piles that were driven away from or without the presence of a sheet pile. Later, when the sheet pile is extracted this "temporary" capacity may diminish as a result of relaxation and vibrations. If the temporary sheet pile proximity effect is not considered during design or during driving of the piles, an inspector will accept piles with an apparent higher capacity than the piles will have after the sheet pile is extracted. If the pile is not instrumented after the sheet pile is removed, an inspector

will have no way of establishing the final capacity of the pile. As a consequence piles may end up with a nominal bearing capacity lower than intended.

Designers may handle this issue by:

- Using braced systems with short penetrations instead of cantilever walls.
- Ensuring minimum pile tip is safely below the sheet pile tip.
- Pre-drilling.
- Providing a minimum distance from the sheet piling.
- Adding an additional load to the nominal bearing capacity.

This topic was discussed at the 2013 Design Expo. Use the following link to view the presentation.

http://www.dot.state.fl.us/officeofdesign/training/designexpo/2013/Presentations/CastellanosJuan-Foundation%20design%20Considerations%20to%20reduce%20construction%20problems.pdf

2. What are the requirements to perform dynamic testing on pile splices?

Article 455-7.8 requires dynamic testing of dowel spliced piles. Due to the lack of prestress in the vicinity of the splice, spliced piles are weaker resisting tensile stresses than a non-spliced pile. For example, for dowel spliced piles 50 feet and longer the allowable tensile stress is only 250 psi (section 455-5.11.2) which is over five times less than the prestressed section.

Why do we need foundation inspection prior to driving?

Juan F. Castellanos, P.E., State Construction Geotechnical Engineer

Pile handling

Pile improperly picked. Note the obvious bending in the pile

Pile Handling

Same pile, now in the ground.

Pile Handling

Close up pictures of the same pile showing the cracking.

Pile handling

Pile improperly picked by one point only. Note the obvious bending in the pile

Pile handling

Pile improperly picked by one point only.

Pile handling

Same pile.

Pile improperly handled. Damage was not documented prior to pile being predrilled and set to drive. Fortunately this pile was properly instrumented by a skillful PDA Engineer, who detected the damage and requested the pile extraction.

Same pile as before

Pile handling

Pile handled by a crane….and a backhoe!

Pile handling

Pile improperly supported

Pile Handling

This pile was attempted to be picked with 3 points. But only the middle point was engaged, and the pile ended up being pick up in the middle. The result: pile broke in two pieces

Pile Handling

This is a close up of the previous pile

Pile Handling

This damaged pile is already set up in the template ready to be driven.

Pile Handling

Another pile damaged during handling

Pile Handling

same pile back side

- Inspectors need to ensure that certain predrilling/preforming requirements established in the driving criteria and plans are met. See following slides.

Driving Criteria

End Bent 1

Pile driving of 85 foot, 190-ton (380-kip) Nominal Bearing Resistance piles may be accepted if one of the following conditions is met:

1. Practical refusal (20 blows per 1 inch) with a minimum stroke height of 7.0 feet is reached with less than ¼ inch rebound and the pile has achieved the required minimum penetration in accordance with FDOT Specification 455-5.8. For the determination of minimum pile penetration, "firm bearing material" in Specifications 455-5.8 is defined as 30 blows per foot with a minimum stroke of 5.5 feet.

2. The required blow count and corresponding stroke height as shown in the following table are achieved for 2 feet of consecutive driving with generally increasing blow counts with pile rebound less than ¼ inch and the pile has achieved the required minimum penetration in accordance with FDOT Specification 455-5.8. For the determination of minimum pile penetration, "firm bearing material" in Specifications 455-5.8 is defined as 30 blows per foot with a minimum stroke of 5.5 feet.

Driving Criteria

Minimum Stroke Height (feet)	Minimum Required Blows Per Foot
6.0	94
6.5	84
7.0	76
7.5	70

Note: Preform Elevation for End Bent 1: 0 foot as shown in the plan.

Performing/predrilling requirements

Driving Criteria Letter-Driving Requirements

Cushion requirements

The above driving criteria are based on using the same hammer driving system as used for the test piles, consisting of an ICE I-30 pile driving hammer and hammer cushions consisting of 2-inch thick Nylon and ½-inch thick aluminum (total of 2½ inches in thickness) and a new 9-inch thick plywood pile cushion. Preforming/predrilling shall be the same as during the test pile program. If there is any change in the hammer driving system for production piles, please notify the Engineer so new driving criteria can be determined.

Performing/predrilling requirements

Driving Criteria Letter-Driving Requirements

Driving Requirements

Driving shall begin with a hammer stroke of approximately 5.0 feet or less and continued until achieving 50 blows per foot or more before being increased to between 5.0 and 6.0 feet. When 50 blows per foot or more is achieved with a stroke between 5.0 and 6.0 feet, the stroke height may be increased to between 6.0 and 7.0 feet. When 70 blows per foot or more is achieved with a stroke between 6.0 and 7.0 feet, the stroke height may be increased to between 7.0 and 8.0 feet. Driving shall continue with a hammer stroke between 7.0 and 8.0 feet until the required NBR is achieved. At no time shall the hammer stroke exceed 8.5 feet. Should the blow count fall below 30 blows per foot at any of the above stroke heights reduce the stroke setting immediately by one foot and repeat this process, as necessary.

Predrill to natural ground surface elevation of approximately +21.0 feet.

Pile Data Table

PILE DATA TABLE												
INSTALLATION CRITERIA								DESIGN CRITERIA				
BENT OR PIER	PILE SIZE (IN.)	NOMINAL BEARING RESISTANCE (TONS) (A)	TENSION RESISTANCE (TONS)	MINIMUM TIP ELEVATION (FT.)	TEST PILE LENGTH (FT.)	REQUIRED JET ELEVATION (FT.)	REQUIRED PREFORM ELEVATION (FT.) (C)	FACTORED DESIGN LOAD (TONS)	DOWN DRAG (TONS)	TOTAL SCOUR RESISTANCE (TONS)	NET SCOUR RESISTANCE (TONS)	E
NORTHBOUND BRIDGE (BRIDGE NO. 100525)												
END BENT 1	18	190	N/A	(B)	N/A	N/A	+0	123	N/A	N/A	N/A	
PIER 2	18	176	N/A	(B)	85	N/A	+0	114	N/A	N/A	N/A	
PIER 3	18	176	N/A	(B)	N/A	N/A	+0	114	N/A	N/A	N/A	
END BENT 4	18	190	N/A	(B)	115	N/A	+0	123	N/A	N/A	N/A	
SOUTHBOUND BRIDGE (BRIDGE NO. 100524)												
END BENT 1	18	190	N/A	(B)	100	N/A	+0	123	N/A	N/A	N/A	
PIER 2	18	176	N/A	(B)	N/A	N/A	+0	114	N/A	N/A	N/A	
PIER 3	18	176	N/A	(B)	105	N/A	+0	114	N/A	N/A	N/A	
END BENT 4	18	190	N/A	(B)	N/A	N/A	+0	123	N/A	N/A	N/A	