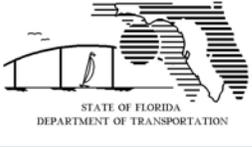


Design Conference 08
Construction Feedback


**OOPS!**



Lessons Learned

Thomas A. Andres P.E.  
Assist. State Structures  
Design Engineer

## Design Conference 08

### Results of Construction Survey

#### Lessons Learned

July 2008



Design
Construction



Design Conference 08
Construction Feedback




Lessons Learned

Thomas A. Andres P.E.  
Assist. State Structures  
Design Engineer

### Construction Survey – Why?

- Improve:
  - Department Policies
  - Specifications
  - Contract Plans
- Provide guidance to designers on future projects
- Avoid repeating costly supplemental agreements

<p><b>Design Conference 08</b></p>	<p><b>Construction Feedback</b></p>	
 <p><b>Lessons Learned</b></p> <p>Thomas A. Andres P.E. Assist. State Structures Design Engineer</p>	<p><b>Post-Design Services Things to Remember</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Changes to QPL systems</li> <li><input type="checkbox"/> Changes made in shop drawings</li> <li><input type="checkbox"/> Changes made to structures plans after letting</li> <li><input type="checkbox"/> Solving construction problems as ONE FDOT - setting precedence</li> </ul>	

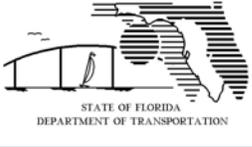
<p><b>Design Conference 08</b></p>	<p><b>Construction Feedback</b></p>	
 <p><b>Lessons Learned</b></p> <p>Thomas A. Andres P.E. Assist. State Structures Design Engineer</p>	<p><b>Topics Covered?</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Water hammer on voided piles</li> <li><input type="checkbox"/> Misc. Structures <ul style="list-style-type: none"> <li>▪ drilled shaft quality issues</li> <li>▪ nut stand-off distance</li> </ul> </li> <li><input type="checkbox"/> Field welding</li> <li><input type="checkbox"/> Temporary load conditions that need to be considered in design</li> </ul>	

<p><b>Design Conference 08</b></p>	<p><b>Construction Feedback</b></p>	
 <p><b>Lessons Learned</b></p> <p>Thomas A. Andres P.E. Assist. State Structures Design Engineer</p>	<p><b>Topics Covered?</b></p> <ul style="list-style-type: none"><li><input type="checkbox"/> Settlement of temporary shoring</li><li><input type="checkbox"/> Rehabilitation projects</li><li><input type="checkbox"/> The use of adhesive bonded anchors</li><li><input type="checkbox"/> Facilitate future bridge widenings (MSE wall volumes)</li></ul>	

<p><b>Design Conference 08</b></p>	<p><b>Construction Feedback</b></p>	
<p><b>Lessons Learned</b></p> <p>Thomas A. Andres P.E. Assist. State Structures Design Engineer</p>	<p><b>Water Hammer on Voided Piles</b></p>	

**Design Conference 08**

**Construction Feedback**

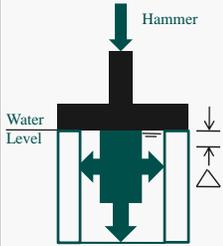


## Water Hammer on Voided Piles

Cause: Plugged Vent Hole

### Plugging Mechanisms:

- Soil column pushed upward inside pile
- Vent holes driven below mudline.



**Lessons Learned**

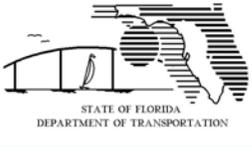
Thomas A. Andres P.E.  
Assist. State Structures  
Design Engineer



**Crack**

**Design Conference 08**

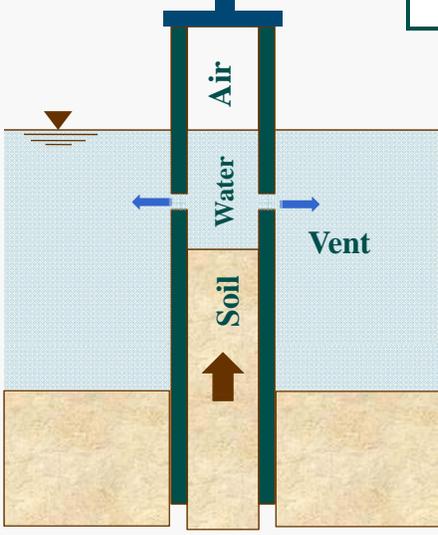
**Construction Feedback**



### Water Hammer

**Progression**

1. Soil column moves up inside void
2. Vent hole maintains outside water level



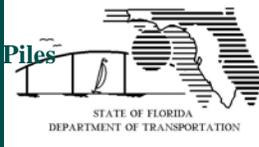
**Plugging Mechanism – Rising Soil Column**

**Lessons Learned**

Thomas A. Andres P.E.  
Assist. State Structures  
Design Engineer

**Design Conference 08**

**Construction Feedback**



**Piles**  
STATE OF FLORIDA  
DEPARTMENT OF TRANSPORTATION

**Water Hammer**

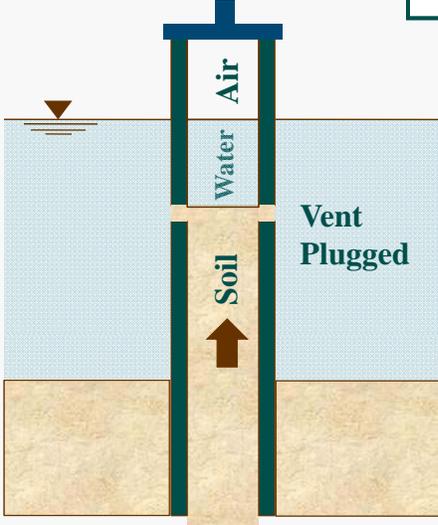
**Progression**

**3. Soil plugs vent holes.**

*Lessons Learned*

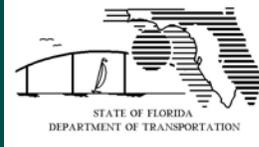
Thomas A. Andres P.E.  
Assist. State Structures  
Design Engineer



**Plugging Mechanism – Rising Soil Column**

**Design Conference 08**

**Construction Feedback**



**Piles**  
STATE OF FLORIDA  
DEPARTMENT OF TRANSPORTATION

**Water Hammer**

**Progression**

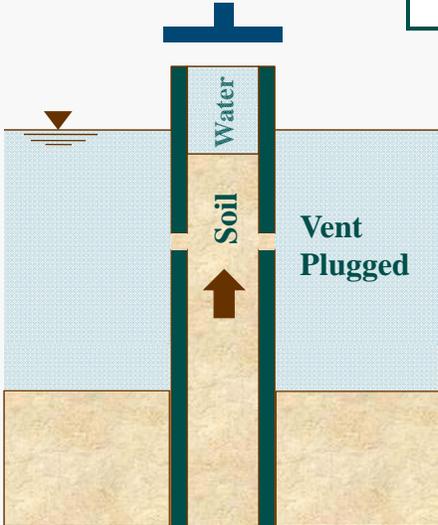
**4. Water column is trapped and rises**

**5. Top-of-water column reaches hammer elevation. Water hammer begins.**

*Lessons Learned*

Thomas A. Andres P.E.  
Assist. State Structures  
Design Engineer



**Plugging Mechanism – Rising Soil Column**

Design Conference 08

## Construction Feedback



STATE OF FLORIDA  
DEPARTMENT OF TRANSPORTATION

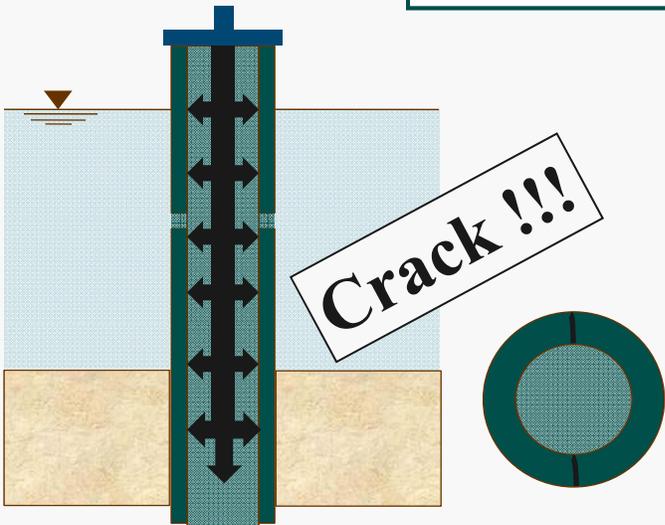
**Water Hammer**

**Progression**

6. Full length crack relieves the very large pressures.

**Lessons Learned**

Thomas A. Andres P.E.  
Assist. State Structures  
Design Engineer



**Plugging Mechanism – Rising Soil Column**

Design Conference 08

## Construction Feedback



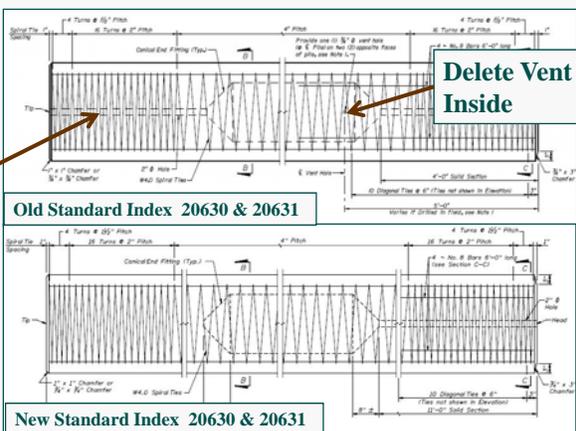
STATE OF FLORIDA  
DEPARTMENT OF TRANSPORTATION

### Water Hammer

Changes to 30" Voids Pile Standards

**Lessons Learned**

Thomas A. Andres P.E.  
Assist. State Structures  
Design Engineer



**Old Standard Index 20630 & 20631**

**New Standard Index 20630 & 20631**

Design  
Conference 08

## Construction Feedback



### Water Hammer

#### Possible Solutions

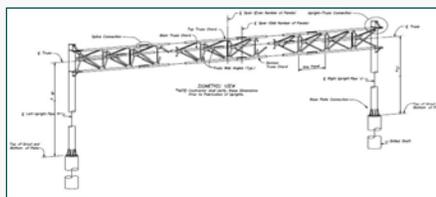
- Educate Inspectors and Contractors
- Increase the number and/or size of vent holes
- Expand 455 Specification
  - Contractor's Pile Installation Plan
    - Monitor water/soil level
    - Compressible gland
    - Vented helmet

#### Lessons Learned

Thomas A. Andres P.E.  
Assist. State Structures  
Design Engineer

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## Construction Feedback

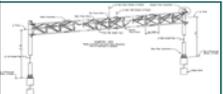


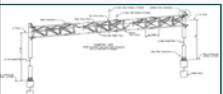
### Misc. Structures

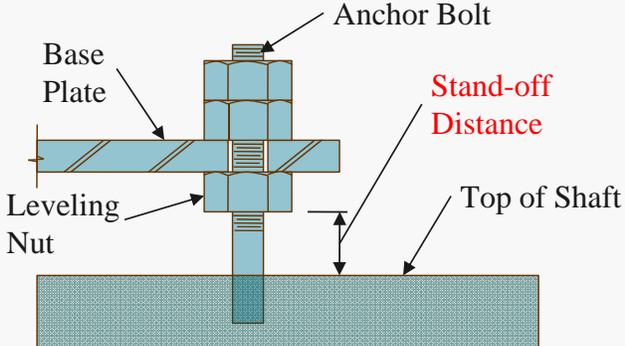
- drilled shaft quality issues
- nut stand-off distance

#### Lessons Learned

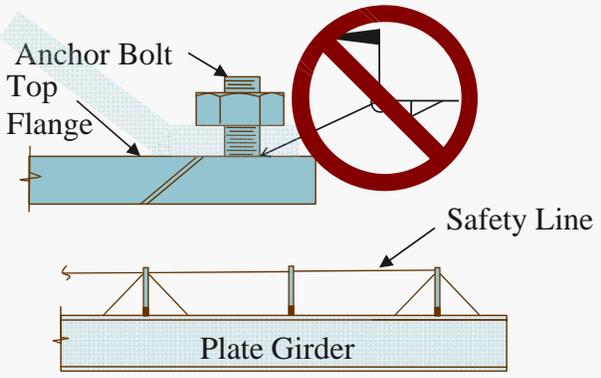
Thomas A. Andres P.E.  
Assist. State Structures  
Design Engineer

<p><b>Design Conference 08</b></p>	<p><b>Construction Feedback</b></p>	
		
<p><b>Lessons Learned</b></p> <p>Thomas A. Andres P.E. Assist. State Structures Design Engineer</p>	<p><b>Miscellaneous Structures</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Drilled Shaft Concreting Issues</li> </ul>	

<p><b>Design Conference 08</b></p>	<p><b>Construction Feedback</b></p>	
		
<p><b>Lessons Learned</b></p> <p>Thomas A. Andres P.E. Assist. State Structures Design Engineer</p>	<p><b>Drilled Shaft Concreting Issues</b></p> <p>New Specification:</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> No longer allows natural slurry (misc. structures)</li> <li><input type="checkbox"/> Allows polymer slurry</li> <li><input type="checkbox"/> Slump increased from 8" to 8 ½ "</li> <li><input type="checkbox"/> Clear distance between reinforcing increased to 6" clear.</li> </ul>	

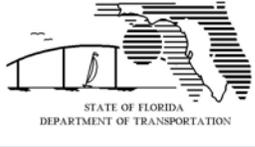
<b>Design Conference 08</b>	<b>Construction Feedback</b>	
<p><b>Lessons Learned</b></p> <p>Thomas A. Andres P.E. Assist. State Structures Design Engineer</p>	<h2 style="text-align: center;">Nut Stand-off distance</h2> <p style="text-align: center;">District 4 reports 27% of their installations exceed 1 bolt diameter</p> <div style="text-align: center; margin-top: 20px;">  </div>	

<b>Design Conference 08</b>	<b>Construction Feedback</b>	
<p><b>Lessons Learned</b></p> <p>Thomas A. Andres P.E. Assist. State Structures Design Engineer</p>	<h1 style="font-size: 2em;">Field Welding</h1>	

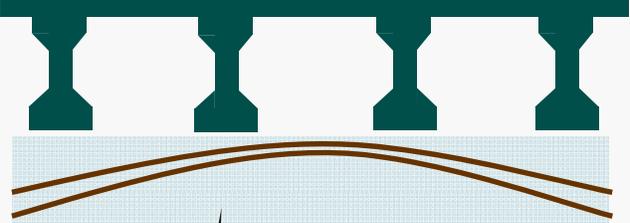
<p><b>Design Conference 08</b></p>	<p><b>Construction Feedback</b></p>	
<p><b>Lessons Learned</b></p> <p>Thomas A. Andres P.E. Assist. State Structures Design Engineer</p>	<p><b>No Field Welding!!!</b></p> <p>This includes form attachments and safety line brace attachments</p>  <p>Anchor Bolt Top Flange</p> <p>Safety Line</p> <p>Plate Girder</p>	

<p><b>Design Conference 08</b></p>	<p><b>Construction Feedback</b></p>	
<p><b>Lessons Learned</b></p> <p>Thomas A. Andres P.E. Assist. State Structures Design Engineer</p>	<p><b>Temporary load conditions that need to be considered in design</b></p>	

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## Temporary Load Conditions

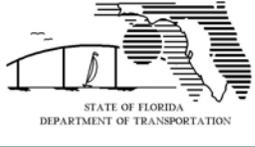


**Stress all or part of tendons prior to placing beam and pouring deck**

*Lessons Learned*

Thomas A. Andres P.E.  
Assist. State Structures  
Design Engineer

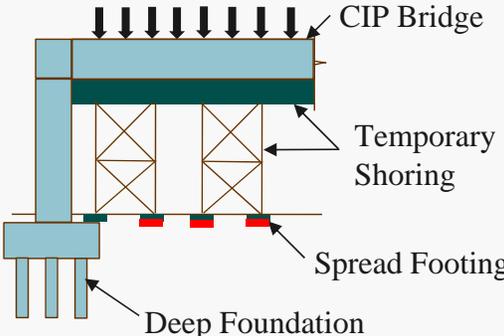
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## Settlement of Temporary Shoring

*Lessons Learned*

Thomas A. Andres P.E.  
Assist. State Structures  
Design Engineer

<p><b>Design Conference 08</b></p>	<p><b>Construction Feedback</b></p>	
<p><b>Lessons Learned</b></p> <p>Thomas A. Andres P.E. Assist. State Structures Design Engineer</p>	<h2>Settlement of Temporary Shoring</h2>  <p>The diagram illustrates a cross-section of a bridge under construction. At the top, a concrete slab is labeled 'CIP Bridge' and is supported by a network of 'Temporary Shoring'. This shoring is supported by 'Spread Footing' on the ground surface. Below the ground, 'Deep Foundation' piles are shown. Arrows indicate downward loads on the bridge deck.</p>	

<p><b>Design Conference 08</b></p>	<p><b>Construction Feedback</b></p>	
<p><b>Lessons Learned</b></p> <p>Thomas A. Andres P.E. Assist. State Structures Design Engineer</p>	<h2>Rehabilitation Projects</h2>	

<p><b>Design Conference 08</b></p>	<p><b>Construction Feedback</b></p>	
<p><i>Lessons Learned</i></p> <p>Thomas A. Andres P.E. Assist. State Structures Design Engineer</p>	<p><b>Bridge Rehabilitation Projects</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Lead Based Paint Note</li> <li><input type="checkbox"/> Proper project scope <ul style="list-style-type: none"> <li>• Need for field survey during design</li> </ul> </li> <li><input type="checkbox"/> Accurate Structural Steel Quantities</li> </ul>	

<p><b>Design Conference 08</b></p>	<p><b>Construction Feedback</b></p>	
<p><i>Lessons Learned</i></p> <p>Thomas A. Andres P.E. Assist. State Structures Design Engineer</p>	<p><b>The use of adhesive anchor systems</b></p>	

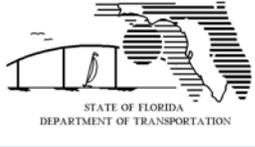
<p><b>Design Conference 08</b></p>	<p><b>Construction Feedback</b></p>	
<p>Photos: National Transportation Safety Board</p>	<p><b>Limitations on Adhesive Anchor Systems</b></p>	
		
	<p><input type="checkbox"/> "...discourages the use of Fast Set Epoxy (Sikadur AnchorFix-3) for adhesive anchor applications..."</p>	
<p><b>Lessons Learned</b></p> <p>Thomas A. Andres P.E. Assist. State Structures Design Engineer</p>	<p><input type="checkbox"/> "...discourages anchor systems utilizing adhesives ....for permanent sustained tension applications or overhead applications...."</p>	

<p><b>Design Conference 08</b></p>	<p><b>Construction Feedback</b></p>	
<p><b>Limitations on Adhesive Anchor Systems SDG 1.6.1.F</b></p>		
<p><input type="checkbox"/> Upwardly inclined installations are prohibited.</p>		
<p><input type="checkbox"/> Permanent factored tension load must never exceed 30% of the factored tension resistance.</p>		
<p><b>Lessons Learned</b></p> <p>Thomas A. Andres P.E. Assist. State Structures Design Engineer</p>		

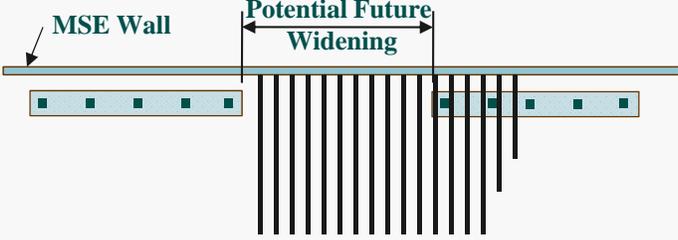
<p><b>Design Conference 08</b></p>	<p><b>Construction Feedback</b></p>	
<p><i>Lessons Learned</i></p> <p>Thomas A. Andres P.E. Assist. State Structures Design Engineer</p>	<p><b>Limitations on Adhesive Anchor Systems</b></p> <p>Structures that should not utilize adhesive anchor systems include:</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Mast arms</li> <li><input type="checkbox"/> Cantilever Sign Signal Structures</li> <li><input type="checkbox"/> Bridge mounted sign structures</li> <li><input type="checkbox"/> Erection tie-down stability stay</li> <li><input type="checkbox"/> P.T. bar anchorage</li> </ul>	

<p><b>Design Conference 08</b></p>	<p><b>Construction Feedback</b></p>	
<p><i>Lessons Learned</i></p> <p>Thomas A. Andres P.E. Assist. State Structures Design Engineer</p>	<p><b>Facilitate future bridge widenings (MSE wall volumes)</b></p>	

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### Facilitate future bridge widenings (MSE wall volumes)

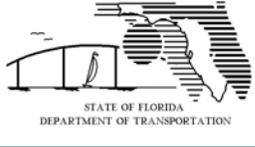


The diagram illustrates a cross-section of a bridge deck. On the left, a rectangular MSE wall is shown with four square reinforcement elements. A horizontal line represents the top of the bridge deck. To the right of this wall, a double-headed arrow labeled "Potential Future Widening" spans a section of the deck. Below this section, a series of vertical lines of varying lengths represent the reinforcement structure for the future widening.

**Lessons Learned**

Thomas A. Andres P.E.  
Assist. State Structures  
Design Engineer

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### Facilitate future bridge widenings (MSE wall volumes)



The diagram is similar to the one above, showing an MSE wall on the left and a "Potential Future Widening" area on the right. However, instead of vertical reinforcement lines, the area under the future widening contains a row of five circular "Corrugated Pipe Cans Filled w/ Sand". An arrow points from the text label to one of these cans.

**Lessons Learned**

Thomas A. Andres P.E.  
Assist. State Structures  
Design Engineer

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## Questions?

### *Lessons Learned*

Thomas A. Andres P.E.  
Assist. State Structures  
Design Engineer

