Test Report for NMB Splice System
- For Sound Barrier Wall Foundation Connection -

By: Will Potter
6/15/07

Overview:
The testing of the NMB Splice System was brought forth by the Florida Department of Transportation to investigate the sensitivity of the grout material installation. The intent is not to test the NMB Splice System, only the grouting process.

Specimen Construction:
Six 9U-X NMB Splice Sleeves were constructed, grouted, and then subjected to a tensile test. The specimens were assembled and grouted in accordance to the proposed testing scheme (see attachment). The grout was mixed as per specifications with 1 gallon of water to 1 bag of SS Mortar. The reinforcing bar was a number 9, Grade 60. The assembling and casting setup is shown in figure 1. The specimens are labeled numerically 1 to 6. Specimens 1 to 3 represent the poor grout scenario, in that they were not rodded. Specimens 4 to 6 correspond to the proper grouting technique, with specimen 6 being agitated further by moving the reinforcing bar.

Figure 1: NMB Splice Sleeve setup

Tensile Testing:
A tension test was performed on the six specimens 12 days after casting at the State Materials Office in Gainesville, FL. The test was conducted based on ASTM A615. The setup is shown in figure 2. The objective of testing was to acquire the load at which

failure occurs and compare the results between the two installation procedures. The results from the failure test are given in table 1 with further details given in the attachment.

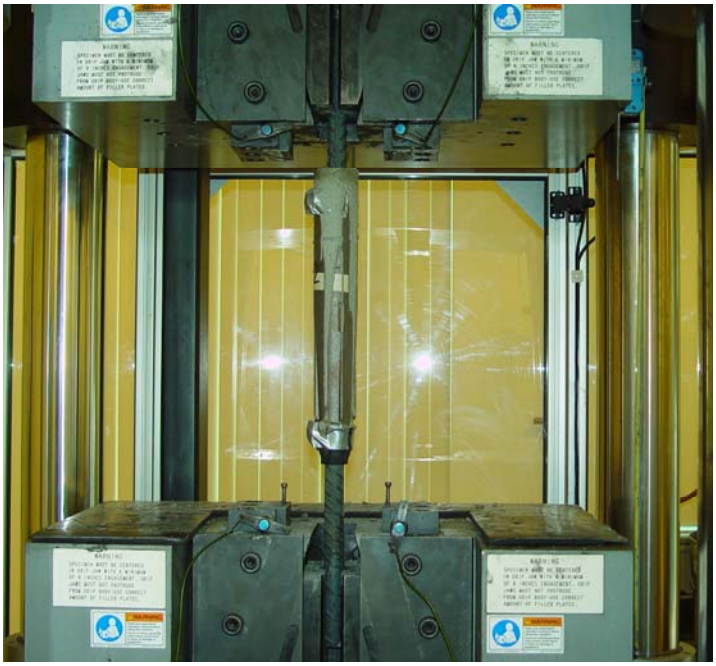


Figure 2: Test Setup

Table 1: Test Results

Specimen	Ultimate Load (kips)	Type of Failure	Location (depth)
1	106.42	Splice Device	½
2	111.17	Bar	--
3	107.02	Splice Device	½
4	107.54	Splice Device	¼ from top
5	107.72	Splice Device	½
6	106.99	Splice Device	½

Analysis of Results:

The results in table 1 depict consistency based on the small variance in ultimate load. With the type of failures that occurred, a comparison of the grout installation cannot be established, due to the fact that the grout was not the controlling factor. It is shown that five of the specimens failed within the splice sleeve with one specimen failing within the reinforcing bar. It is also observed that specimen 4 failed in the upper region of the device (bar insertion end) as opposed to mid-depth as the other four. A plausible explanation for the devices failing rather than the reinforcing bar is that the clear distance between the top of the device and the grips of the testing machine was small,

approximately 4 to 5 inches. This short distance prevented the reinforcing bar from failing, except in specimen 2. It is believed that if this clear distance was increased the bar would have a better opportunity to fail. The reason for the failure in specimen 4 is not yet determined. The failed specimens can be seen in figure 3.

The manufacturers of the device specify 160 percent (96 kips for a #9 bar –Grade 60) of bar yield and the results from testing show well above that value with the minimum being 177 percent. The splice system's performance is more than adequate.

Figure 3: Failed Test Specimens

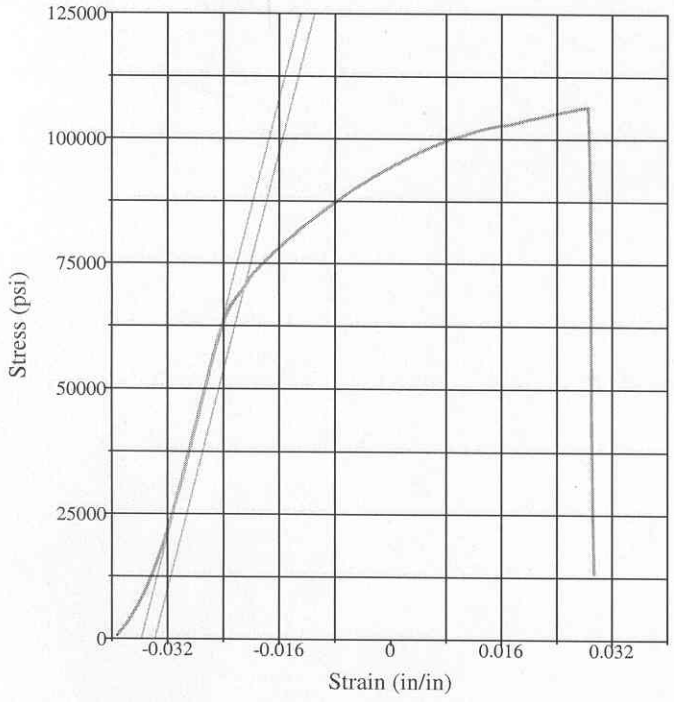
A compression test was completed at the same time of the tension test on grout cubes that were cast concurrently with the splice devices. The results of this test are given in table 2. The grout cubes were cast in accordance to ASTM C 942. The samples remained in the covered grout molds until the day of testing without any additional moisture.

Table 2: Compressive Test Results

Specimen #	12-day Compressive Strength (psi)
1	16,373
2	16,730
3	16,690

Conclusion:
The test results clearly indicate that the grouting procedures for the NMB Splice Sleeves have a low sensitivity. It is apparent that with the grout being fluid it is not that critical for the specimens to be rodded. As long as there is a sufficient amount of grout used and the placement of the reinforcing bars is adequate there will not be an issue with the splice system.

An issue that may need to be investigated is the placement of the reinforcing bar. How will the device perform if the bar is oriented to one side of the system? With the current setup, the bar is located as close to center as possible. The setup in the field may not guarantee this situation.

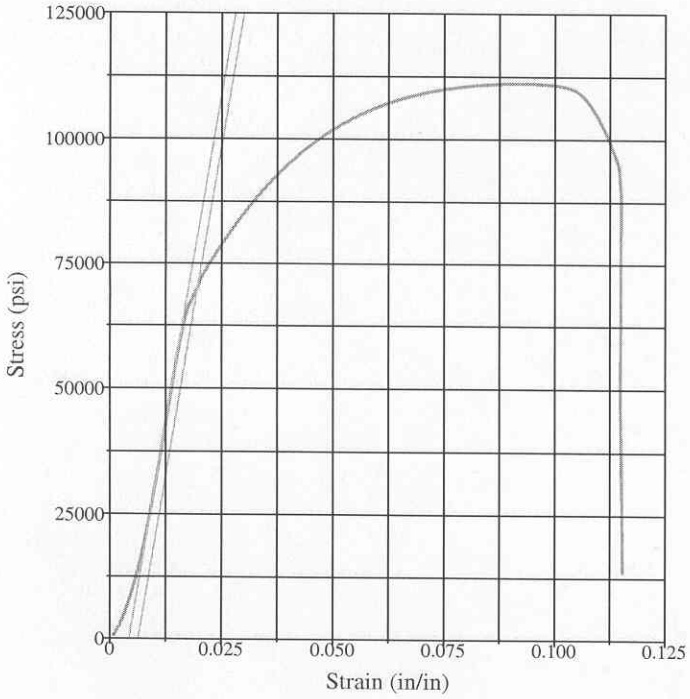


Test Results

Specimen Gage Length:	**24.7500** in
Area:	**1.0000** in²
Yield Load:	**106420** lbf
Yield Strength:	**106420** psi
Total Load:	**106420** lbf
Tensile Strength:	**106420** psi
Load at Offset:	**70280** lbf
Stress at Offset:	**70280** psi
Young's Modulus:	**5470000** psi

Test Summary

Counter:	**2765**
Elapsed Time:	**00:01:48**
LIMS Number:	**Test Sample**
Project Number:	*
Sample Number:	*
Size:	**9**
Grade:	**60**
Elongation:	**0**
Cold Bend:	**OK @ 180**
Condition of Sample:	**Satisfactory**
Operator:	**MC**
Comments:	**Test Sample #1**
Heat Number:	*
Procedure Name:	**ASTM A615 - Grade 60 - 3 zones - no exten**
Start Date:	**6/12/2007**
Start Time:	**9:32:32 AM**
End Date:	**6/12/2007**
End Time:	**9:34:20 AM**
Workstation:	**FLORIDA-DOT**
Tested By:	**tech**

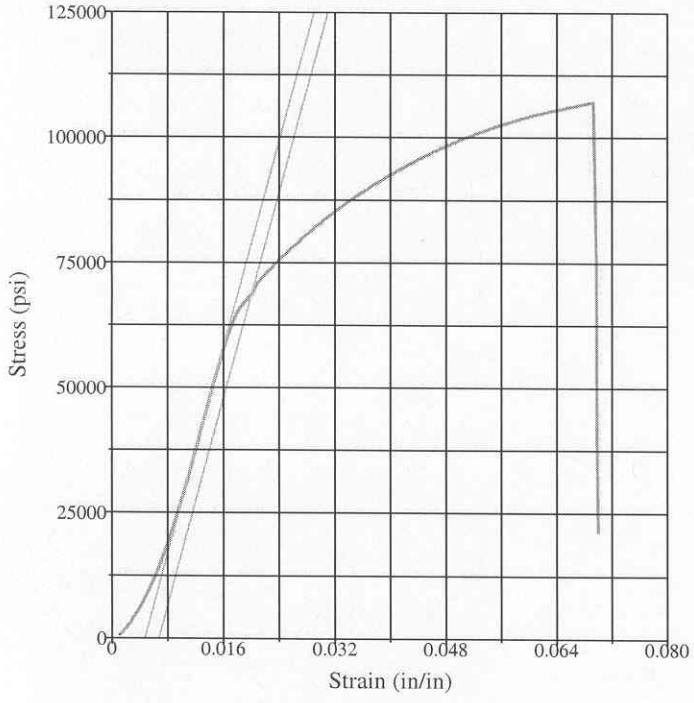


Test Results

Specimen Gage Length:	**24.7500** in
Area:	**1.0000** in²
Yield Load:	**111170** lbf
Yield Strength:	**111170** psi
Total Load:	**111170** lbf
Tensile Strength:	**111170** psi
Load at Offset:	**69910** lbf
Stress at Offset:	**69910** psi
Young's Modulus:	**5270000** psi

Test Summary

Counter:	**2766**
Elapsed Time:	**00:02:09**
LIMS Number:	**Test Sample #2**
Project Number:	*
Sample Number:	*
Size:	**9**
Grade:	**60**
Elongation:	**0**
Cold Bend:	*
Condition of Sample:	**Satisfactory**
Operator:	**MC**
Comments:	**Test Sample #2**
Heat Number:	
Procedure Name:	**ASTM A615 - Grade 60 - 3 zones - no exten**
Start Date:	**6/12/2007**
Start Time:	**9:41:18 AM**
End Date:	**6/12/2007**
End Time:	**9:43:27 AM**
Workstation:	**FLORIDA-DOT**
Tested By:	**tech**

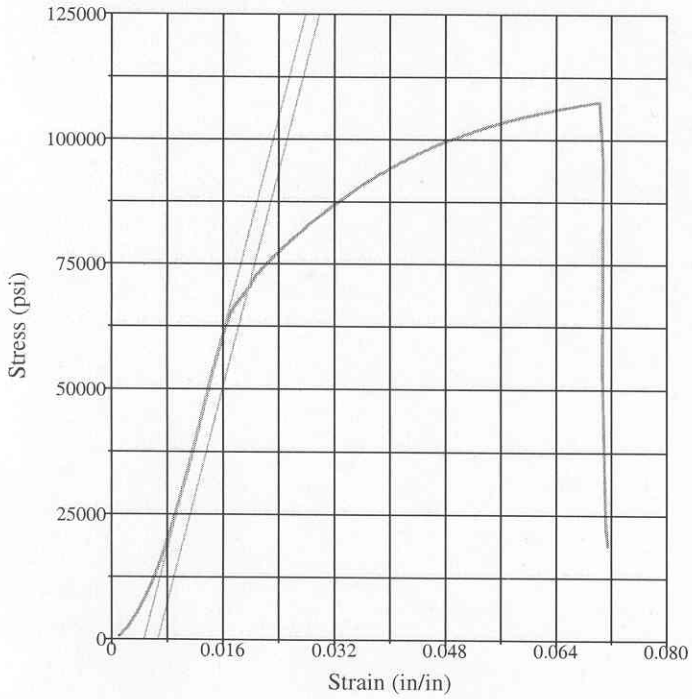


Test Results

Specimen Gage Length:	**24.7500** in
Area:	**1.0000** in²
Yield Load:	**107020** lbf
Yield Strength:	**107020** psi
Total Load:	**107020** lbf
Tensile Strength:	**107020** psi
Load at Offset:	**68790** lbf
Stress at Offset:	**68790** psi
Young's Modulus:	**5150000** psi

Test Summary

Counter:	**2767**
Elapsed Time:	**00:01:49**
LIMS Number:	**Test Sample #3**
Project Number:	*
Sample Number:	*
Size:	**9**
Grade:	**60**
Elongation:	**0**
Cold Bend:	*
Condition of Sample:	**Satisfactory**
Operator:	**MC**
Comments:	**Test Sample #3**
Heat Number:	
Procedure Name:	**ASTM A615 - Grade 60 - 3 zones - no exten**
Start Date:	**6/12/2007**
Start Time:	**9:49:07 AM**
End Date:	**6/12/2007**
End Time:	**9:50:56 AM**
Workstation:	**FLORIDA-DOT**
Tested By:	**tech**

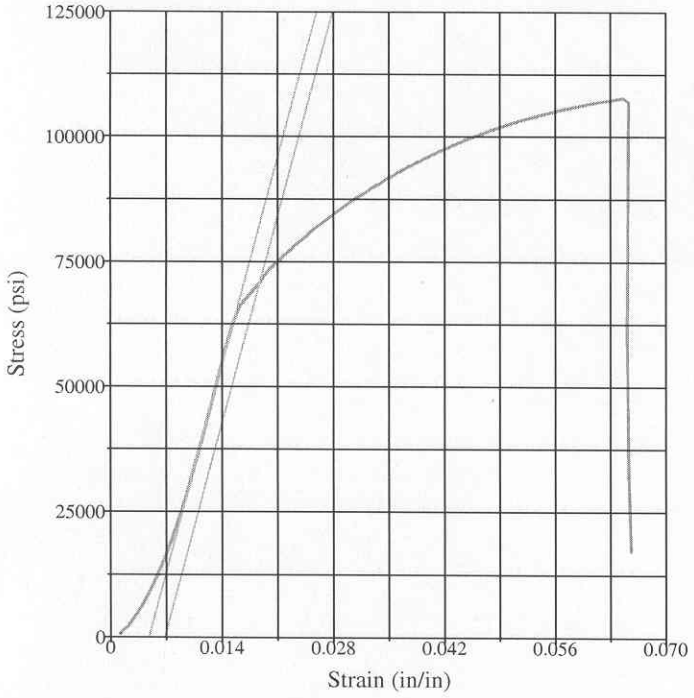


Test Results

Specimen Gage Length:	**24.7500** in
Area:	**1.0000** in²
Yield Load:	**107540** lbf
Yield Strength:	**107540** psi
Total Load:	**107540** lbf
Tensile Strength:	**107540** psi
Load at Offset:	**70110** lbf
Stress at Offset:	**70110** psi
Young's Modulus:	**5390000** psi

Test Summary

Counter:	**2768**
Elapsed Time:	**00:01:50**
LIMS Number:	**Test Sample #4**
Project Number:	*
Sample Number:	*
Size:	**9**
Grade:	**60**
Elongation:	**0**
Cold Bend:	*
Condition of Sample:	**Satisfactory**
Operator:	**MC**
Comments:	**Test Sample #4**
Heat Number:	
Procedure Name:	**ASTM A615 - Grade 60 - 3 zones - no exten**
Start Date:	**6/12/2007**
Start Time:	**9:55:29 AM**
End Date:	**6/12/2007**
End Time:	**9:57:19 AM**
Workstation:	**FLORIDA-DOT**
Tested By:	**tech**

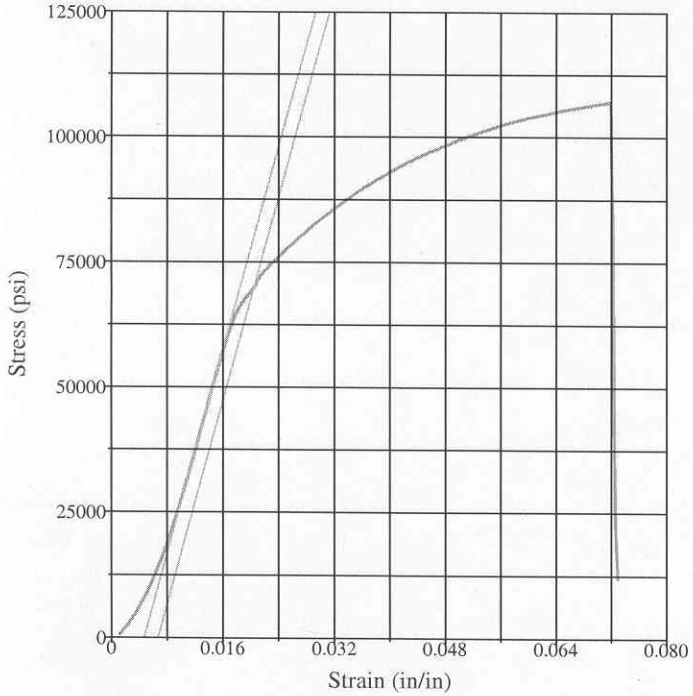


Test Results

Specimen Gage Length:	**24.7500** in
Area:	**1.0000** in²
Yield Load:	**107720** lbf
Yield Strength:	**107720** psi
Total Load:	**107720** lbf
Tensile Strength:	**107720** psi
Load at Offset:	**70820** lbf
Stress at Offset:	**70820** psi
Young's Modulus:	**5920000** psi

Test Summary

Counter:	**2769**
Elapsed Time:	**00:01:43**
LIMS Number:	**Test Sample #5**
Project Number:	*
Sample Number:	*
Size:	**9**
Grade:	**60**
Elongation:	**0**
Cold Bend:	*
Condition of Sample:	**Satisfactory**
Operator:	**MC**
Comments:	**Test Sample #5**
Heat Number:	
Procedure Name:	**ASTM A615 - Grade 60 - 3 zones - no exten**
Start Date:	**6/12/2007**
Start Time:	**10:10:34 AM**
End Date:	**6/12/2007**
End Time:	**10:12:17 AM**
Workstation:	**FLORIDA-DOT**
Tested By:	**tech**



Test Results

Specimen Gage Length:	**24.7500** in
Area:	**1.0000** in²
Yield Load:	**106990** lbf
Yield Strength:	**106990** psi
Total Load:	**106990** lbf
Tensile Strength:	**106990** psi
Load at Offset:	**69950** lbf
Stress at Offset:	**69950** psi
Young's Modulus:	**5090000** psi

Test Summary

Counter:	**2770**
Elapsed Time:	**00:01:53**
LIMS Number:	**Test Sample #6**
Project Number:	*
Sample Number:	*
Size:	**9**
Grade:	**60**
Elongation:	**0**
Cold Bend:	*
Condition of Sample:	**Satisfactory**
Operator:	**MC**
Comments:	**Test Sample #6**
Heat Number:	
Procedure Name:	**ASTM A615 - Grade 60 - 3 zones - no exten**
Start Date:	**6/12/2007**
Start Time:	**10:19:51 AM**
End Date:	**6/12/2007**
End Time:	**10:21:44 AM**
Workstation:	**FLORIDA-DOT**
Tested By:	**tech**

DATE: 06/12/07		**Tested by:** ABDU	
LIMS #	**Mat'l:** SS Mortar	**LIMS #**	**Mat'l:**
______ DAY BREAK	16373 psi	______ DAY BREAK	psi
	16730 psi		psi
	16690 psi		psi
AVG.	psi	**AVG.**	psi

LIMS #	**Mat'l:**	**LIMS #**	**Mat'l:**
______ DAY BREAK	psi	______ DAY BREAK	psi
	psi		psi
	psi		psi
AVG.	psi	**AVG.**	psi

LIMS #	**Mat'l:**	**LIMS #**	**Mat'l:**
______ DAY BREAK	psi	______ DAY BREAK	psi
	psi		psi
	psi		psi
AVG.	psi	**AVG.**	psi

LIMS #	**Mat'l:**	**LIMS #**	**Mat'l:**
______ DAY BREAK	psi	______ DAY BREAK	psi
	psi		psi
	psi		psi
AVG.	psi	**AVG.**	psi

LIMS #	**Mat'l:**	**LIMS #**	**Mat'l:**
______ DAY BREAK	psi	______ DAY BREAK	psi
	psi		psi
	psi		psi
AVG.	psi	**AVG.**	psi

IMS #	**Mat'l:**	**LIMS #**	**Mat'l:**
______ DAY BREAK	psi	______ DAY BREAK	psi
	psi		psi
	psi		psi
AVG.	psi	**AVG.**	psi

Proposed Testing of NMB Splice System – For Sound Barrier Wall Foundation Connection

By: Steven Nolan

Date: 5/8/07

Purpose:

The purpose of this test is to determine the sensitive of the grout placement for the splice system using the PRE-grout installation method. A lack of confidence with the consistent diligent placement and rodding of the grout material warrants the Department to investigate the effects of a poorly installed grout material which may compromise the strength of the completed soundwall post system proposed by Mack Industries. This testing will not discredit the validity of any previous product approval testing, but only to identify the sensitivity to poor installation practice.

Scope:

A total of six 9U-X NMB splice samples are to be constructed, cured and then subject to tensile testing. Two separate installation procedures will be investigated. Both installation methods will use the PRE-grout installation method but without the splice sleeves cast into concrete. A 18" long #9 bar shall be inserted into the narrow end of the splice, secured with the rubber seal and supported in the vertical position with the wide end opening at the top. The grout shall be mixed to the manufacturers proportions (1 gallon water/1 bag of grout) and simply poured from a bucket into the splice from the top filling the splice completely.

Installation 1 – No rodding:

The first three samples (1a, 1b, 1c) shall not be rodded or vibrated to consolidate the grout material. The top 18" long #9 bar shall be inserted directly into the splice and supported until initial set of the grout material.

Installation 2 – Limited Rodding:

The last three samples (2a, 2b, 2c) shall be rodded with a 1/8" diameter wire 10 times for a depth at least ¾ of the splice sleeve, after completely filing the splice with grout. The top #9 bar shall then be inserted directly into the splice and supported until initial set of the grout material.

Tensile Testing:

After curing for a minimum of 7 days all six samples shall be tested to determine the effective tensile strength of the spliced connection. The test results for each installation method shall be identified and reported separately.

GENERAL NOTES FOR PRE-GROUT (PRE) INSTALLATION

PRE-Grout Installations: This procedure is used when the sleeves are oriented below the joint without PVC tubing to pump SS Mortar® inside. It may be useful in situations requiring a "blind" architectural connection with no exposed tubes that require patching.

FIG.-40-1

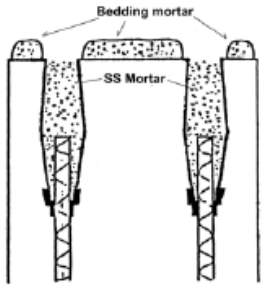


FIG.40-2