UNIVERSITY of WISCONSIN
UWMILWAUKEE

College of Engineering and Applied Science
Department of Civil Engineering and Mechanics

Structural Engineering Laboratories

Load Tests on *JVI Spider Plate* Connectors Anchored in Concrete Slabs

Report on Test Results
October 12, 2006

by:

A. Fattah Shaikh, P.E., Ph.D.
Fellow, Distinguished Educator, and Titan: PCI
Fellow: ASCE, ACI
Emeritus Professor: University of Wisconsin-Milwaukee

and

Jeffrey Gehlhoff, M.S. (Candidate)
University of Wisconsin-Milwaukee

I. PREFACE

This report documents results of shear and pullout load tests on 44 JVI, Inc. Spider plates. The tests were carried out at the Metromont Corporation plant in Hiram, GA during July 17-21, 2006. This test program also included load tests of JVI's PSA Slotted Insert; the results of those tests will be summarized in a separate report.

The Spider plates were embedded in both 2" and 4" thick concrete slabs simulating sandwich wall panels and other precast concrete members. Slabs were cast on site at the Metromont Corporation plant during a normal day's production. The tests were carried out under monotonic pullout and shear loading conditions.

II. ACKNOWLEDGEMENTS

The writers are pleased to have participated in this program sponsored by JVI. It is an excellent example of cooperation between a precast producer—Metromont, connection materials manufacturer/supplier—JVI, and an education and research organization—University of Wisconsin- Milwaukee. We believe that such cooperation can produce highly authentic results for the benefit of the precast/prestressed concrete industry.

The JVI team included Mr. David Jablonsky, PE.—his expertise and energy were instrumental in establishing the test program and in developing many details included in this report. The other member of the JVI team intimately involved in this project was Mr. Charles Magnesio; his leadership in steering this test program is gratefully acknowledged. The writers also wish to thank Chuck and Dave for their "southern hospitality" over the duration of the test program.

The excellent and cordial cooperation of the Metromont Corporation's Hiram, GA plant staff played a vital role in the success of this program. A special thanks to Harry Gleich, PE – VP Engineering and John Wenkel – VP/General Manager for design testing input and plant usage and assistance.

Finally, the writers wish to recognize the guidance of Professor Al Ghorbanpoor, Director of the UWM Structural Engineering Laboratory and the invaluable cooperation of Mr. Rahim Reshadi, Supervising Technician of the Laboratory. Mr. Reshadi not only assisted with the pre-planning of the test program and calibration of the equipment but also helped with the set-up of the instrumentation and the test equipment at the test site.

III. TEST SPECIMENS

SLABS

All details of test specimens were developed by JVI in consultation with the writers. The fabrication of the test specimens was supervised by the JVI team, and actual testing was done in the presence of both the UWM and JVI teams. Slabs were cast during a normal production run using a Metromont 6000psi concrete mix design. Concrete cylinder strength tests were performed by Metromont quality control personnel, the results of which are shown in Tables A-1 and A-1a of the Appendix. A total of four slabs were cast, labeled A, B, C, and D. Slabs A and B were used for testing JVI PSA Inserts, results of which are summarized in a separate report. Slabs C and D were used for Spider plate testing, as summarized in this report. Production drawings of slabs C and D are shown in Figures A-1 and A-2 of the Appendix.

Slab C had overall dimensions of 8'-11" x 10'-5". Thickness of the slab varied between 4" and 2". The 2" portion of the slab was designed to simulate the interior wythe of a sandwich wall panel. The entire slab was nominally reinforced with 6x6 -W2.5/W2.5 wire mesh, with bottom clear covers of 3/4" in the 2" slab portion and 2 3/4" in the 4" slab portion. Twelve Spider plates, hereafter referred to as 1C through 12C respectively, were cast into the 2" slab portion. Two plates, 13C and 14C, were cast into the 4" slab portion. Wire mesh approximately 1' x 1' square in the vicinity of all plates was cut and removed. Further details of each plate setup in slab C are described below and summarized in Table A-2 of the Appendix.

Slab D had overall dimensions of 13'-3" x 14'-6", with uniform slab thickness of 4". The slab was nominally reinforced with 4x4 – W4/W4 wire mesh with bottom clear cover of 1 1/2". Wire mesh material certifications can be found in Figures A-3 and A-4 of the Appendix. Thirty Spider plates, hereafter referred to as 1D through 30D respectively, were cast in the slab. Several JVI 6035 PSA inserts were cast in strategic locations to serve as alignment mechanisms for the testing equipment. These inserts were not load tested. Further details of each plate setup in slab D are described below and summarized in Tables A-3 and A-4 of the Appendix.

SPIDER PLATES

Production drawings of all hardware and connection details for Spider plates used in these tests can be found in Figures A-7 through A-10 of the Appendix. A brief summary of Spider plate variables are shown in Tables 1 and 2; a more robust summary and explanation of details is shown in Tables A-2 through A-4 of the Appendix and the text following those tables.

Table 1: Summary of Spider Plate Details for Slab C.

Test #	Spider Plate (SP) Type (JVI Part Number)	Load Applied	Slab	Edge Test (Y or N)	Additional Rebar (Y or N)	Field Plate (FP) Location on SP
1C, 2C, 3C	66SLCT, No Studs	Pullout	2"	N	N	Centered on & Normal to SP, FP width parallel to leg sides
4C, 5C, 6C	66SLCT, No Studs	Lateral Shear	2"	N	N	Centered on & Normal to SP, FP width parallel to leg sides
7C, 8C, 9C	66SLCT, No Studs	Parallel Edge Shear	2"	Y	Y (u-bar)	FP end @ center of SP, FP overhangs SP Cup end
10C, 11C, 12C	66SLCT, No Studs	Perpendicular Edge Shear	2"	Y	Y (u-bar)	FP end @ center of SP, FP overhangs SP Cup end
13C	66DLCT	Parallel Edge Shear	4"	Y	Y (str. bar)	FP end @ center of SP, FP overhangs SP Cup end
14C	66DLCT	Perpendicular Edge Shear	4"	Y	Y (str. bar)	FP end @ center of SP, FP overhangs SP Cup end

Table 2: Summary of Spider Plate Details for Slab D.

Test #	Spider Plate (SP) Type (JVI Part Number)	Load Applied	Slab	Edge Test (Y or N)	Additional Rebar (Y or N)	Field Plate (FP) Location on SP
1D, 2D, 3D	66SLCT, Short Studs	Pullout	4"	N	N	Centered on & Normal to SP, FP width parallel to leg sides
4D, 5D, 6D	66SLCT, Short Studs	Lateral Shear	4"	N	N	Centered on & Normal to SP, FP width parallel to leg sides
7D	66SLCT, Short Studs	Pullout	4"	N	N	Edge of SP, FP width parallel to leg sides
8D, 9D, 10D	66DLCT	Lateral Shear	4"	N	N	Centered on & N to SP, FP width parallel to leg sides
11D	66DLCT	Pullout	4"	N	N	Edge of SP, FP width parallel to leg sides
12D, 13D, 14D	66DLCT	Pullout	4"	N	N	Centered on & Normal to SP, FP width parallel to leg sides
15D	66SLCT, Short Studs	Parallel Edge Shear	4"	Y	Y (u-bar)	FP end @ center of SP, FP overhangs SP Cup end
16D, 17D	66SLCT, Short Studs	Parallel Edge Shear	4"	Y	Y (u-bar)	FP end @ center of SP, FP overhangs SP Cup end
18D, 19D, 20D	66SLCT, Short Studs	Perpendicular Edge Shear	4"	Y	Y (u-bar)	FP end @ center of SP, FP overhangs SP Cup end
21D, 22D, 23D	66DLCT	Parallel Edge Shear	4"	Y	Y (u-bar)	FP end @ center of SP, FP overhangs SP Cup end
24D, 25D, 26D	66DLCT	Perpendicular Edge Shear	4"	Y	Y (u-bar)	FP end @ center of SP, FP overhangs SP Cup end
27D, 28D	66DLCT	Parallel Edge Shear	4"	Y	Y (str. bar)	FP end @ center of SP, FP overhangs SP Cup end
29D, 30D	66DLCT	Perpendicular Edge Shear	4"	Y	Y (str. bar)	FP end @ center of SP, FP overhangs SP Cup end

IV. TEST SETUP

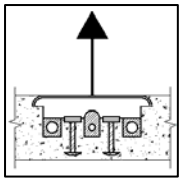
Test setup for each type of load test is illustrated in Figures A-12 through A-22 of the Appendix.

For all tests, the load was applied with an Enerpac P-391 (10 ksi) hand pump coupled with an Enerpac 30 kip cylinder with 4” stroke, combined hereafter referred to as the "load jack". The load jack was calibrated at the UWM laboratory against a Tinius Olsen 300 kN universal testing machine. Calibration and cylinder pressure-load conversion chart is shown in Figure A-23 of the Appendix.

For tests where displacement measurements were taken, a 0.001” dial gage was used with a steel clamp stand.

Test setups for specific load test types are described below:

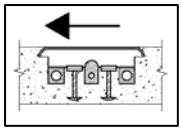
PULLOUT TESTS



For pullout tests a threaded rod was attached to the field plate with a rod nut. The rod extended vertically through the center gap between two welded steel channels, the load cylinder, and several 1/2” steel plates. A rod nut was then placed at the top end of the rod and hand tightened against the steel plates. Load was applied by the load cylinder by extending vertically and compressing between the steel plates and the steel channels, applying a tension load to the rod that is transferred to the field plate and Spider plate. The load cylinder was braced against the channels, which rested on wood blocks on both ends. The wood blocks transferred the reaction load back to the concrete slab a sufficient distance from the Spider plate test, and the slab was braced against the ground from below where necessary. Pullout test setup is shown in Figures A-12 through A-15 of the Appendix.

Where applicable, displacement was measured in the vertical direction, with the dial gage extension placed on a steel extension clamped to the field plate within 1 1/2” of the center of the Spider plate face.

LATERAL SHEAR TESTS

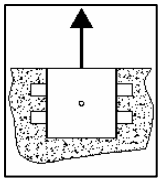


For lateral shear tests, load was transferred to a load plate with a welded double-channel steel load beam. The load plate was welded to the field plate, which was welded to the Spider plate. Welded steel blocks between the load beam channels were spaced at 6" edge to edge. The beam was lowered onto the load plate, with the load plate positioned in the 6" space. This arrangement applied a rotational fixity to the field plate to simulate field conditions. Eccentricity varied, and was measured as the distance from top of slab to the bottom of the load plate.

The load was applied horizontally (load parallel to the top of slab) by the load jack to one end of the load beam. The jack was braced against a bracing tubular steel beam, which ran perpendicular to the load path and was tied down to the slab with a rod and nut assembly. The rod protruded through to the bottom of the slab via 1 1/4" diameter PVC knockouts cast into the slab. Lateral shear test setup is shown in Figures A-16 through A-18 of the Appendix.

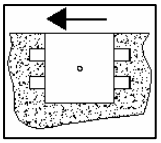
Where applicable, horizontal displacement was measured at the load beam end opposite to the load jack end.

PERPENDICULAR EDGE SHEAR TESTS



For perpendicular edge shear tests, setup was similar to pullout tests, with the setup rotated to the horizontal plane instead of the vertical plane. The field plate face was engaged on the Spider plate face and welded on both long sides. A threaded rod was attached to the field plate with a rod nut. The rod extended horizontally through the center gap between two welded steel channels, the load cylinder, and several 1/2" steel plates. A rod nut was then placed at the end of the rod and hand tightened against the steel plates. Load was applied by the load cylinder by extending horizontally and compressing between the steel plates and the steel channels, applying a tension load to the rod that is transferred to the field plate and Spider plate. The load cylinder was braced against the channels, and the channels transferred the reaction load back to the slab edge via wood blocks a sufficient distance away from the test area. Test setup is shown in Figures A-19 and A-20 of the Appendix.

PARALLEL EDGE SHEAR TESTS



For parallel edge shear tests, Spider plates were tested in pairs. This setup was devised in the field to eliminate the need for an external reaction mechanism. Load cylinder was set up on the centroidal line between the load plates of respective Spider plates. A 6" x 6" wood block orientated with it's longitudinal axis parallel with the slab edge transferred the load from one end of the load cylinder to one load plate. The other end of the load cylinder was engaged on several steel plates that transferred the load directly to the other load plate. Load was therefore transferred equally to the adjacent Spider plates. Spider plates that were designated for parallel edge shear but did not have a similarly designated plate adjacent to it were not tested.

Displacement was measured before and after the tests, and effectively measured the rotation of the field plate and load plate with respect to the slab edge. For each Spider plate's load plate, distance between slab edge and the load plate edge was measured on both adjacent sides of the field plate. Test setup is shown in Figures A-20 and A-21 of the Appendix.

V. TEST RESULTS

Test results are given in Tables 3 through 6, and load-displacement plots are given in Figures 1 through 6. It should be noted that not all load-displacement plots show the full behavior of the Spider plates through failure. For a significant number of tests, displacement dial gages had to be removed after concrete cracked to prevent damage to the gages during failure.

A significant observation during testing was the propagation of global slab cracks (cracks not caused by local cracking due to Spider plate behavior). The global slab cracks resulted primarily from three causes:

1) Large size and relative small thickness of test slabs, particularly slab C, caused cracking while slabs were hoisted from lift points.

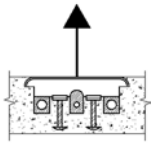
2) Slab D was lifted while being removed from the plant's production facility such that slab dead load was not distributed uniformly to all lift points.

3) Self-contained nature of test setups, whereby the slab itself provided load reaction may have caused some cracking unrelated to Spider plate behavior.

Where cracking propagated to the vicinity of a Spider plate prior to that plate being tested, it is noted in the summary tables and was marked in red marker on the slabs for identification in photographs.

Table 3: JVI Spider Plate Pullout Load Test Results

July 2006

	Test #	Specimen Designation[1] W-X-Y-Z	Slab[2] Thickness	Weld Orientation[3] U-V	Pre-existing Crack	Cracking		Peak Load (lb)	Failure Mechanism	Comments				
						Load (lb)	Displace-ment (in)			Concrete	Age (days)	Spider Plate	Field Plate / Weld	Misc.
 **Pullout**	1C	Sn-A-N-C	2"	II-C	N	3251	0.057	6037	concrete	blowout weld side	12			plate not set level in concrete - higher side is side that concrete failed
	2C	Sn-A-N-C	2"	II-C	N	3715	0.097	6501	concrete	blowout weld side	12			plate not set level in concrete - higher side is side that concrete failed
	3C	Sn-A-N-C	2"	II-C	Y	3251	0.119	5573	concrete	large crack parallel to weld both sides	12			failure crack from this test propagated to corner of SP 11C
	1D	Ss-A-N-I	4"	T-C	N	11145	0.294	13003	concrete	blowout both sides (sides perpendicular to weld)	12	small rupture in plate directly below FP	weld cracked on one end	
	2D	Ss-A-N-I	4"	T-C	N	10217	0.240	13932	concrete	blowout both sides (sides perpendicular to weld)	12			
	3D	Ss-A-N-C	4"	T-C	N	7895	0.189	13003	concrete	blowout both sides (sides perpendicular to weld)	12			
	7D	Ss-A-N-I	4"	T-E	Y	6037	0.236	10217	concrete	large spalling both sides perpendicular to weld	13			
	12D	Dn-A-N-C	4"	T-C	Y	12539	0.303	13003	concrete	blowout one side	13			
	13D	Dn-A-N-C	4"	T-C	N	11145	0.250	13003	concrete	blowout one side	13			
	14D	Dn-A-N-C	4"	T-C	N	10217	0.274	13003	concrete	blowout one side	13			
	11D	Dn-A-N-C	4"	II-E	N	9752	0.059	9752	concrete	blowout weld side	13		small weld crack	small weld crack

NOTES: 1/ Specimen designation nomenclature:

W: **Ss** = shallow plate (66SLCT) with studs
Sn = shallow plate (66SLCT) no studs
Dn = deep plate (66DLCT) no studs

X: **A** = away from slab edge
N = near slab edge

Y: **N** = no additional reinforcement
S = extra reinforcement - straight bar
U = extra reinforcement - u-bar

Z: **C** = wire mesh removed around plate
I = wire mesh intact around plate

2/ Concrete strength: 6558 psi for tests 1C-3C and 1D-3D; 6802 psi for tests 7D and 11D-14D

3/ Weld orientation nomenclature:

U: **II** = field plate width parallel to SP leg sides (see Figure A)
T = field plate width perpendicular to SP leg sides (see Figure B)

V: **C** = field plate centered on SP face
E = field plate 2" from center of SP face

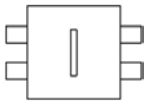


Figure A: parallel

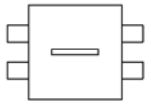
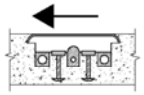


Figure B: perpendicular

Table 4: JVI Spider Plate Lateral Shear Load Test Results

July 2006

	Test #	Specimen Designation[1] W-X-Y-Z	Slab[2] Thickness	Weld Orientation[3] U-V	Pre-existing Crack	Cracking		Peak Load (lb)	Failure Mechanism	Comments				
						Load (lb)	Displace-ment (in)			Concrete	Age (days)	Spider Plate	Field Plate / Weld	Misc.
 **Lateral Shear - Eccentricity[4] = 1.5"**	4C	Sn-A-N-C	2"	II-C	Y	8823	0.116	14860*	concrete	cracks all directions	14			test stopped due to slab bending - result incomplete
	5C	Sn-A-N-C	2"	II-C	Y	4644	0.284	8359*	concrete	cracked both sides parallel to weld	14			test stopped due to resisting beam rotation due to slab thickness - result incomplete
	6C	Sn-A-N-C	2"	II-C	Y	3251	0.253	10681*	concrete	cracked both sides parallel to weld	14			test stopped due to slab bending - result incomplete
	4D	Ss-A-N-I	4"	T-C	N	13932	0.133	19969	concrete	cracked	14	bowed opposite load side	bent	
	5D	Ss-A-N-I	4"	T-C	N	**	**	16718	weld	OK	14	bowed load side	bent; weld tear load side	
	6D	Ss-A-N-I	4"	T-C	Y	**	**	19969	weld	OK	14	bowed load side	bent; weld tear load side	
	8D	Dn-A-N-C	4"	T-C	N	**	**	19969	weld	OK	14	bowed load side	bent; weld tear load side	
	9D	Dn-A-N-C	4"	T-C	Y	**	**	18576	weld	OK	14	bowed load side	bent; weld tear load side	
	10D	Dn-A-N-C	4"	T-C	Y	16254	0.192	19969	field plate	very small crack load side	14	bowed load side	bent, yielded	

NOTES: 1/ Specimen designation nomenclature:

W: **Ss** = shallow plate (66SLCT) with studs
Sn = shallow plate (66SLCT) no studs
Dn = deep plate (66DLCT) no studs

X: **A** = away from slab edge
N = near slab edge

Y: **N** = no additional reinforcement
S = extra reinforcement - straight bar
U = extra reinforcement - u-bar

Z: **C** = wire mesh removed around plate
I = wire mesh intact around plate

2/ Concrete strength: 7046 psi for all tests

3/ Weld orientation nomenclature:

U: **II** = field plate width parallel to SP leg sides (see Figure A)
T = field plate width perpendicular to SP leg sides (see Figure B)

V: **C** = field plate centered on SP face
E = field plate 2" from center of SP face

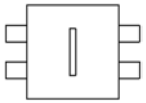


Figure A: parallel

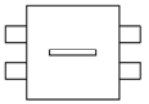


Figure B: perpendicular

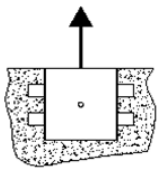
4/ Eccentricity defined as distance from top of spider plate to bottom of load plate.

*/ Test was stopped before failure due to slab bending - result incomplete.

**/ No observable concrete cracking occurred during test.

Table 5: JVI Spider Plate Perpendicular Edge Shear Load Test Results

July 2006

	Test #	Specimen Designation[1] W-X-Y-Z	Slab[2] Thickness	Pre-existing Crack	Cracking		Peak Load (lb)	Failure Mechanism	Comments				
					Load (lb)	Displace-ment (in)			Concrete	Age (days)	Spider Plate	Field Plate / Weld	Misc.
 **Perpendicular Edge Shear**	10C	Sn-N-U-C	2"	N	7430	not measured	12074	concrete	cracks ~45deg. From back corners to slab edge	13			
	11C	Sn-N-U-C	2"	Y	6501		15789	concrete	crack ~45 deg. From back corner to slab edge one side of plate only	13			plate embedded deeper in slab
	12C	Sn-N-U-C	2"	N	6501		17647	concrete	spalling at back legs; cracks on slab edge face	13			
	14C	Dn-N-S-C	4"	N	7895		10217	concrete	cracks ~45deg. From back corners to slab edge	13			
	29D	Dn-N-S-I	4"	N	12074		15789	concrete	cracked ~45deg. One side, parallel to edge other side; cracked to back of bar	13			
	30D	Dn-N-S-I	4"	N	12074		14860	concrete	cracks ~45deg. From back corners to slab edge	14			
	18D	Ss-N-U-I	4"	Y	6966		23220	concrete	cracks ~45deg. From back corners to slab edge	13			
	19D	Ss-N-U-I	4"	N	6966		20433	concrete	cracks ~45deg. From back corners to slab edge	13			small face cracks at 1500 psi; big cracks at 3800 psi
	20D	Ss-N-U-I	4"	N	10681		22291	concrete	cracks ~45deg. From back corners to slab edge	13			
	24D	Dn-N-U-I	4"	N	18576		23684	concrete	blowout ~45deg. both sides	14			
	25D	Dn-N-U-I	4"	N	17647		24148	concrete	blowout ~45deg. both sides	14			plate embedded at angle: sitting deeper in slab at the edge of slab - angle ~0.1deg. relative to top of slab plane
	26D	Dn-N-U-I	4"	N	16254		25077	concrete	cracks ~45deg. From back corners to slab edge	14			

NOTES: 1/ Specimen designation nomenclature:

W: **Ss** = shallow plate (66SLCT) with studs
Sn = shallow plate (66SLCT) no studs
Dn = deep plate (66DLCT) no studs

X: **A** = away from slab edge
N = near slab edge

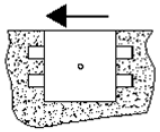
Y: **N** = no additional reinforcement
S = extra reinforcement - straight bar
U = extra reinforcement - u-bar

Z: **C** = wire mesh removed around plate
I = wire mesh intact around plate

2/ Concrete strength: 7046 psi for tests 30D and 24D-26D; 6802 psi for all other tests

Table 6: JVI Spider Plate Parallel Edge Shear Load Test Results

July 2006

	Test #	Specimen Designation[1] W-X-Y-Z	Slab[2] Thickness	Pre-existing Crack	Cracking		Peak Load (lb)	Failure Mechanism	Comments[3]				
					Load (lb)	Displace-ment (in)			Concrete	Age (days)	Spider Plate	Field Plate / Weld	Misc.
 **Parallel Edge Shear**	7C	Sn-N-U-C	2"	N	9288	not measured	12074	strap bending	OK	13	OK	FP change in distance from panel edge: load side -1/16", opposite side 1/16"	testing stopped before failure due to excessive FP bending; tested in series with 8C - results dependent
	8C	Sn-N-U-C	2"	N	9288		12074	strap bending	cracked top and edge of slab	13	OK	FP change in distance from panel edge: load side 1/8", opposite side -1/4"	testing stopped before failure due to excessive FP bending; tested in series with 7C - results dependent
	27D	Dn-N-S-I	4"	N	*		11145	strap bending	OK	13	OK	FP change in distance from panel edge: load side -1/16", opposite side -1/16"	testing stopped before failure due to excessive FP bending; tested in series with 28D - results dependent
	28D	Dn-N-S-I	4"	N	*		11145	strap bending	OK	13	OK	FP change in distance from panel edge: load side 1/8", opposite side -1/16"	testing stopped before failure due to excessive FP bending; tested in series with 27D - results dependent
	15D	Ss-N-U-I	4"	N	*		13003	strap bending	OK	13	OK	FP change in distance from panel edge: load side 3/8", opposite side -1/4"	testing stopped before failure due to excessive FP bending; tested in series with 16D - results dependent
	16D	Ss-N-U-I	4"	N	*		13003	strap bending	OK	13	OK	FP change in distance from panel edge: load side 1/4", opposite side -1/4"	testing stopped before failure due to excessive FP bending; tested in series with 15D - results dependent
	17D	Ss-N-U-I	4"	N	*		11145	strap bending	OK	13	OK	FP change in distance from panel edge: load side ?", opposite side -5/16"	testing stopped before failure due to excessive FP bending; braced against both 15D and 16D
	21D	Dn-N-U-C	4"	N	*		10217	strap bending	OK	13	OK	FP change in distance from panel edge: load side 0", opposite side -1/8"	testing stopped before failure due to excessive FP bending; braced against 22D
	22D	Dn-N-U-I	4"	N	*		13932	strap bending	OK	13	OK	FP change in distance from panel edge: load side 1/16", opposite side -1/16"	testing stopped before failure due to excessive FP bending; braced against 21D

NOTES: 1/ Specimen designation nomenclature:

W: **Ss** = shallow plate (66SLCT) with studs
Sn = shallow plate (66SLCT) no studs
Dn = deep plate (66DLCT) no studs

X: **A** = away from slab edge
N = near slab edge

Y: **N** = no additional reinforcement
S = extra reinforcement - straight bar
U = extra reinforcement - u-bar

Z: **C** = wire mesh removed around plate
I = wire mesh intact around plate

2/ Concrete strength: 6802 psi for all tests

3/ Spider plates 9C, 13C, and 23D were not tested due to setup limitation that required an adjacent Spider plate set up for parallel shear.

*/ No observable concrete cracking occurred during test.

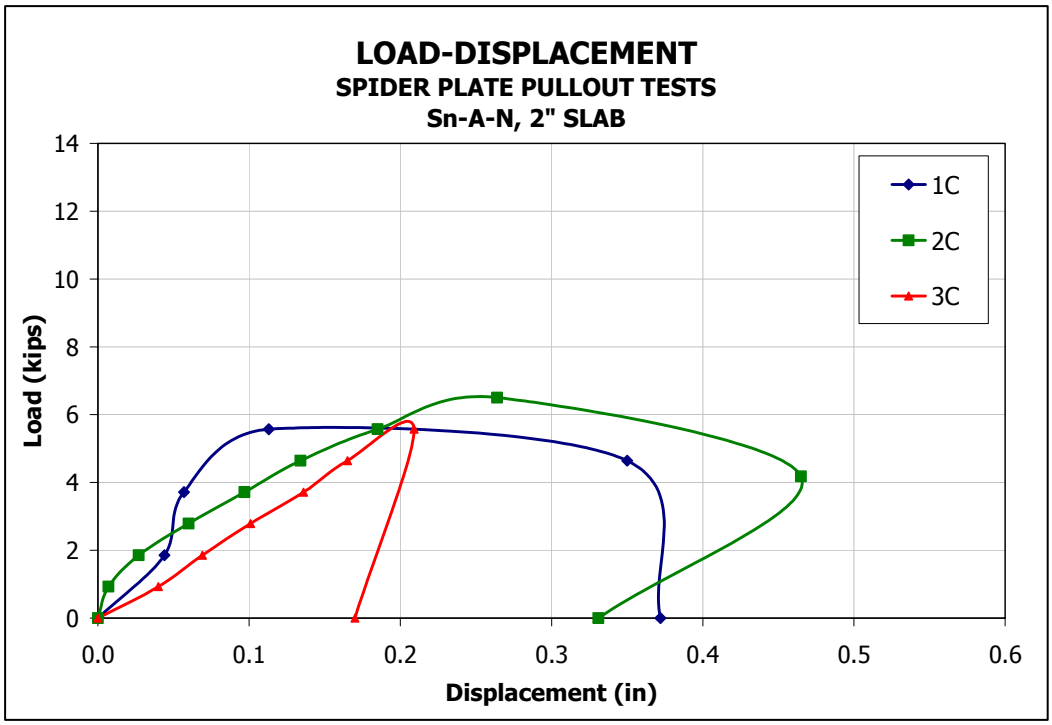


Figure 1: Load-displacement of tests 1C – 3C.
NOTE: Final displacement reading taken after load was released.

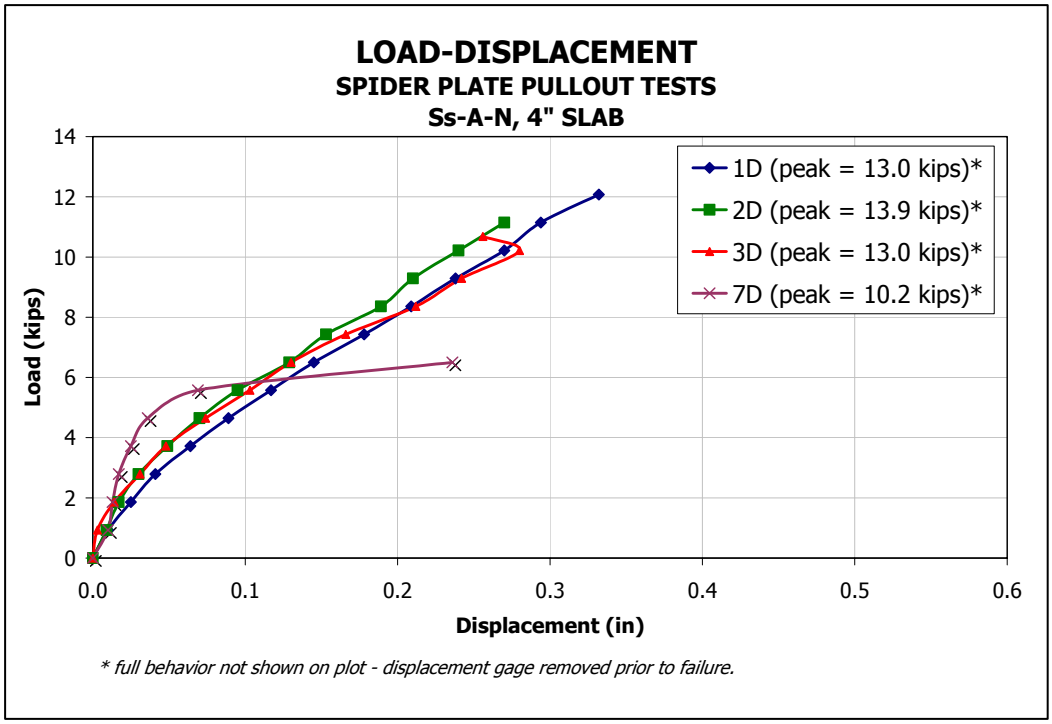


Figure 2: Load-displacement of tests 1D – 3D, 7D.

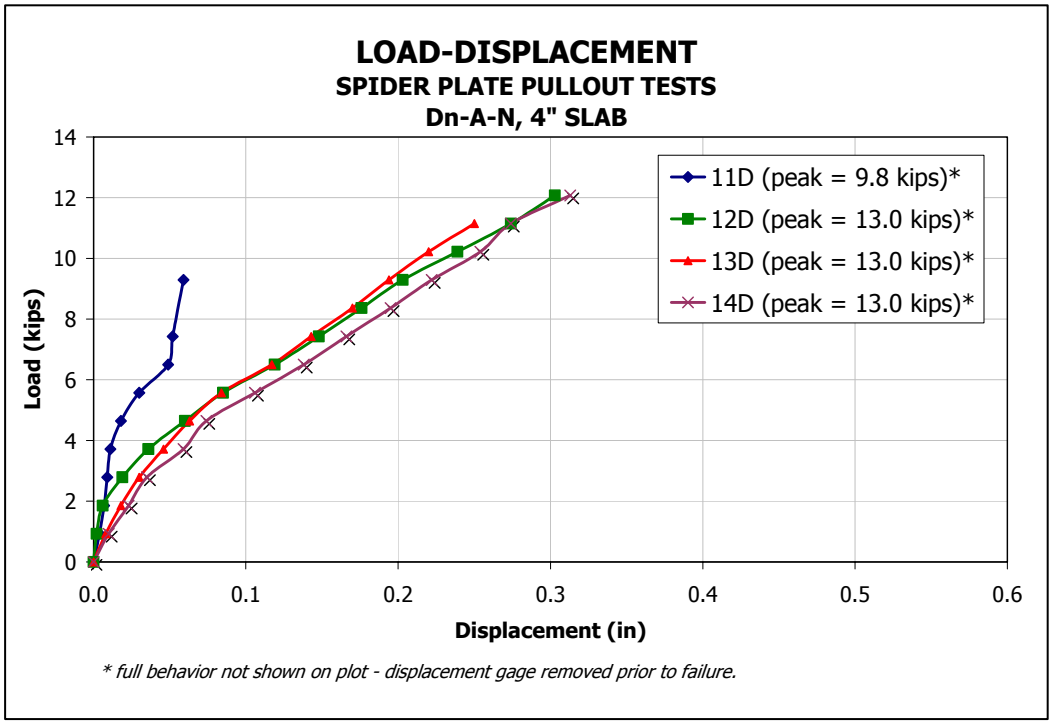


Figure 3: Load-displacement of tests 11D – 14D.

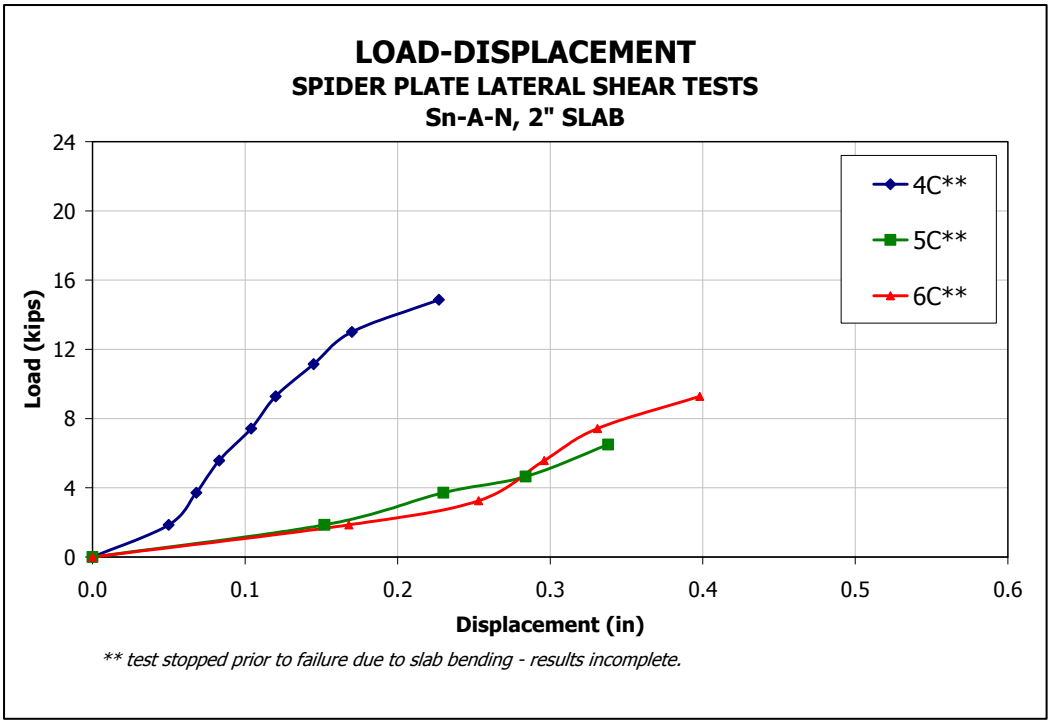


Figure 4: Load-displacement of tests 4C – 6C.
NOTE: Displacement was caused primarily by field plate bending.

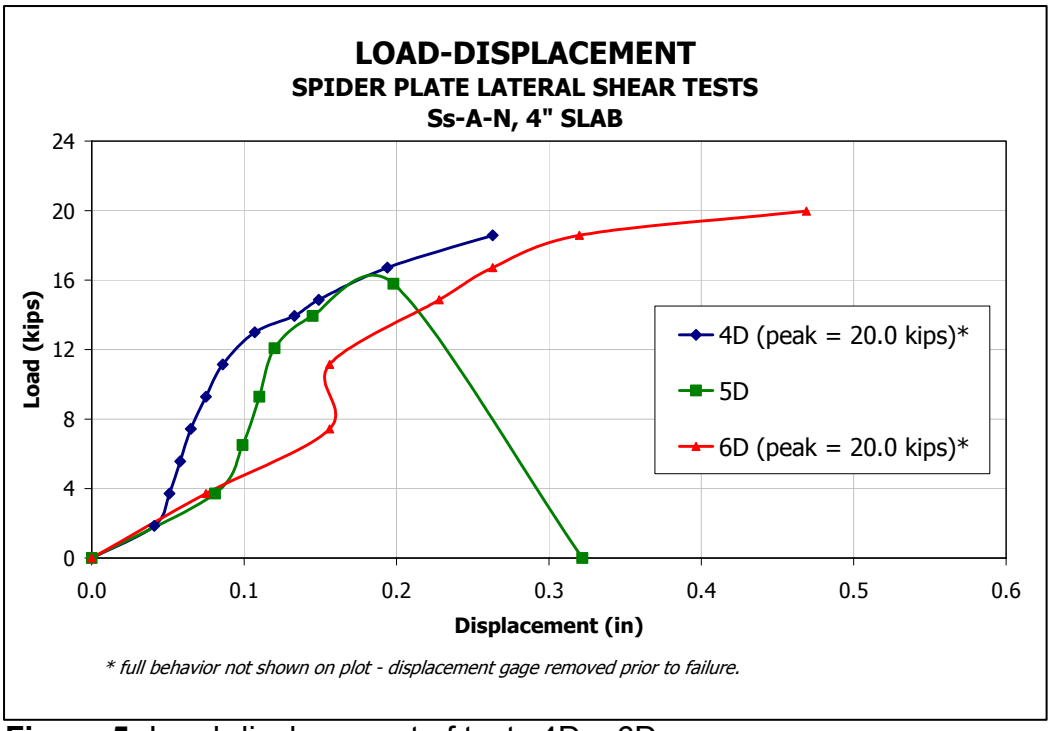


Figure 5: Load-displacement of tests 4D – 6D.
NOTE: Displacement was caused primarily by field plate bending; final displacement reading for test 5D was taken after load was released.

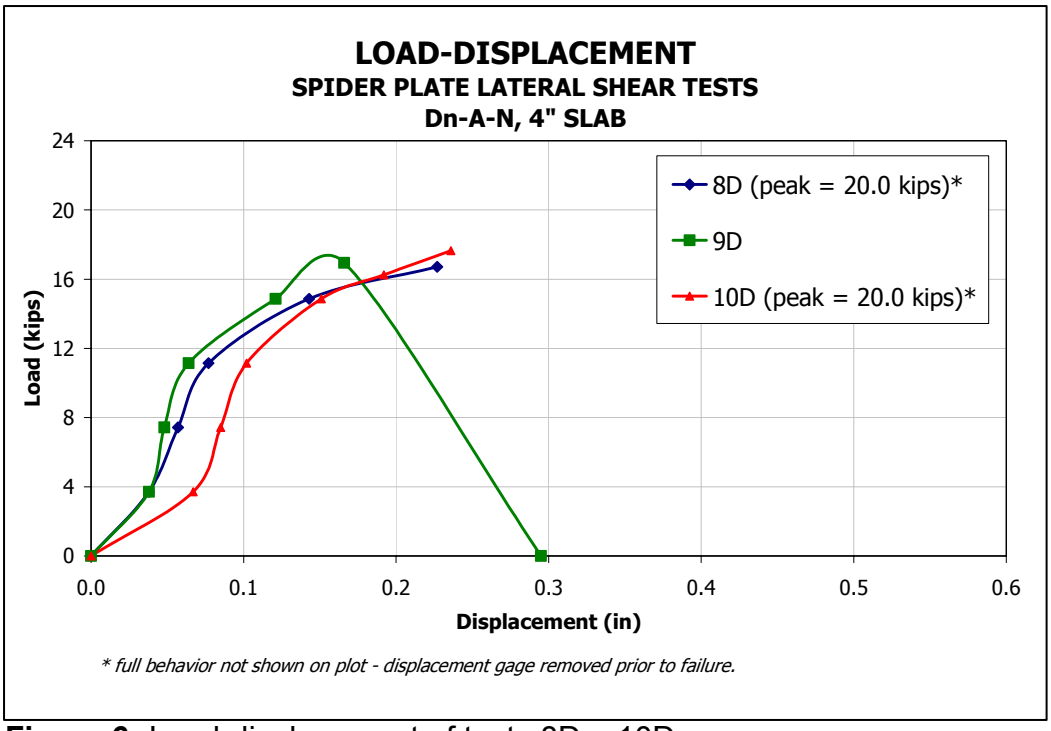


Figure 6: Load-displacement of tests 8D – 10D.
NOTE: Displacement was caused primarily by field plate bending; final displacement reading for test 9D was taken after load was released.

VI. APPENDIX

Table A-1: Concrete strength test results[1].

Test Panel(s)	Production Date[2]	Cylinder	Cylinder Break Date	Age (days)	Load (lb)	Ram Area (in^2)	Concrete Strength (psi)
A,B,C,D	7/6/2006	# 1	7/7/2006	1	45,500	12.5602	3,623
		# 2	7/7/2006	1	45,000	12.5602	3,583
		Average	**7/7/2006**	**1**			**3,603**
A,B,C,D	7/6/2006	# 3	7/17/2006	11	80,500	12.5602	6,409
		# 4	7/17/2006	11	78,100	12.5602	6,218
		Average	**7/17/2006**	**11**			**6,314**
A,B,C,D	7/6/2006	# 5	7/20/2006	14	88,500	12.5602	7,046
		# 6	7/20/2006	14	88,500	12.5602	7,046
		Average	**7/20/2006**	**14**			**7,046**

Table A-1a: Interpolated results for test dates.

Cylinder Break Date	Age (days)	Concrete Strength (psi)
7/17/2006	11	6,314
7/18/2006	12	6,558
7/19/2006	13	6,802
7/20/2006	14	7,046

NOTES: 1/ Tests performed by Metromont quality control personel.

2/ Metromont mix design #703250, design f'c = 6,000 psi @ 28 days

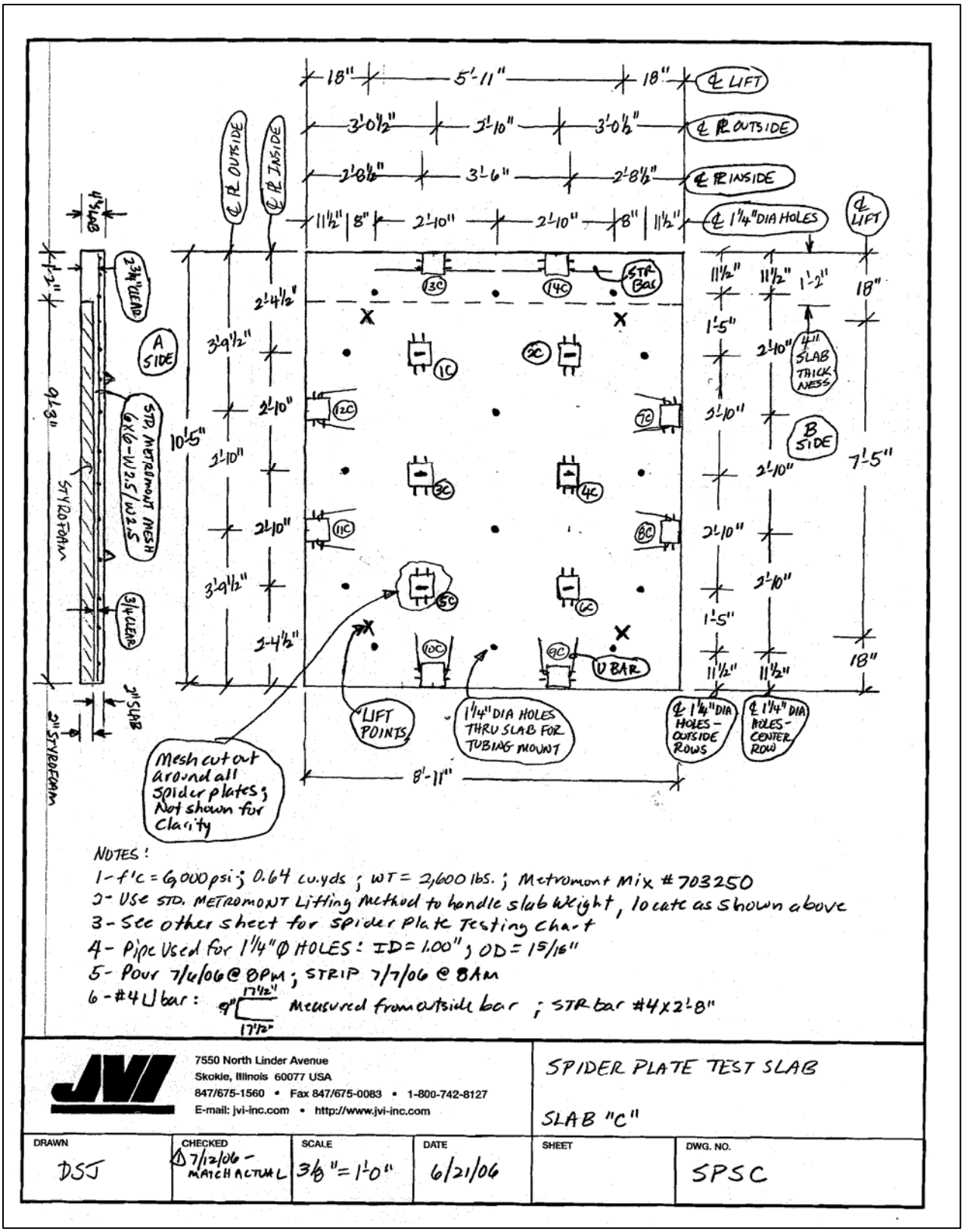


Figure A-1: Production drawing for slab C.

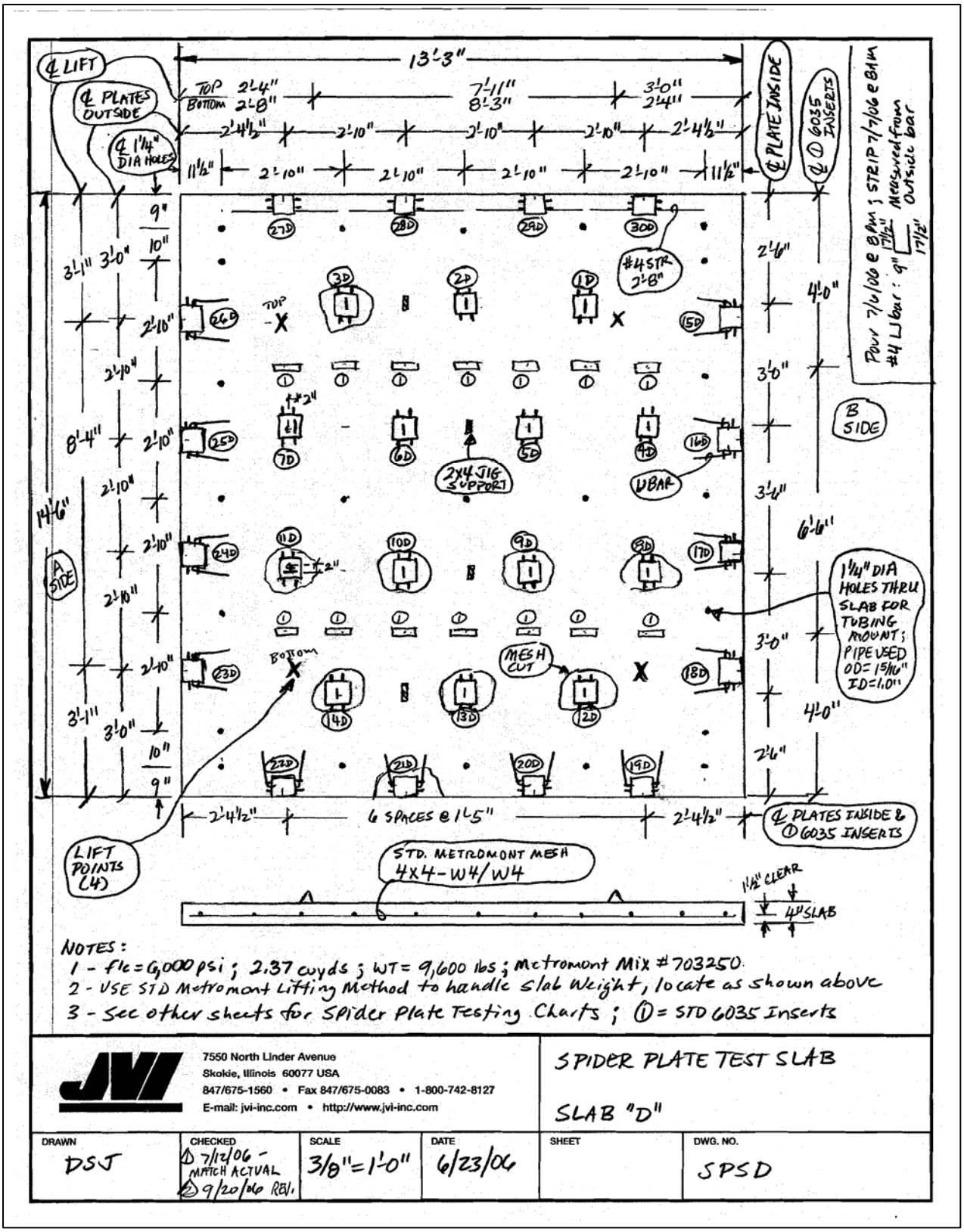


Figure A-2: Production drawing for slab D.

Test #	Location in Slab	Specimen Designation	Slab	Spider Plate (SP) Type - Description	Additional Rebar @ SP	Field Plate Size	Field Plate (FP) Location on SP	Field Plate Mark #	Field Plate Weld	Load Applied	Mesh Cut Around SPL	Setting Method
1C	Away from edge	Sn-A-N-C	2"	1 - 66SLCT, No Studs, J Finish	NA	3" wide x 3/8" thick	Centered on & N to SP, FP width parallel to leg sides	SPL-1	1/4" fillet x 3" on one side only	N to SP face	Yes	Wood Jig
2C	Away from edge	Sn-A-N-C	2"	1 - 66SLCT, No Studs, J Finish	NA	3" wide x 3/8" thick	Centered on & N to SP, FP width parallel to leg sides	SPL-1	1/4" fillet x 3" on one side only	N to SP face	Yes	Wood Jig
3C	Away from edge	Sn-A-N-C	2"	1 - 66SLCT, No Studs, J Finish	NA	3" wide x 3/8" thick	Centered on & N to SP, FP width parallel to leg sides	SPL-1	1/4" fillet x 3" on one side only	N to SP face	Yes	Wood Jig
4C	Away from Edge	Sn-A-N-C	2"	1 - 66SLCT, No Studs, J Finish	NA	3" wide x 3/8" thick	Centered on & N to SP, FP width parallel to leg sides	SPL-2	1/4" fillet x 3" on one side only	Along width of FP @ 1.5" ecc	Yes	Wood Jig
5C	Away from Edge	Sn-A-N-C	2"	1 - 66SLCT, No Studs, J Finish	NA	3" wide x 3/8" thick	Centered on & N to SP, FP width parallel to leg sides	SPL-2	1/4" fillet x 3" on one side only	Along width of FP @ 1.5" ecc	Yes	Wood Jig
6C	Away from Edge	Sn-A-N-C	2"	1 - 66SLCT, No Studs, J Finish	NA	3" wide x 3/8" thick	Centered on & N to SP, FP width parallel to leg sides	SPL-2	1/4" fillet x 3" on one side only	Along width of FP @ 1.5" ecc	Yes	Wood Jig
7C	Near Edge	Sn-N-U-C	2"	1 - 66SLCT, No Studs, J Finish	U Bar thru SP tunnel and over back legs	3" wide x 3/8" thick	FP end @ center of SP, FP overhangs SP Cup end	SPL-3	1/4" fillet x 3" on both sides	Along width of FP @ 4.5" ecc	Yes	Wood Jig
8C	Near Edge	Sn-N-U-C	2"	1 - 66SLCT, No Studs, J Finish	U Bar thru SP tunnel and over back legs	3" wide x 3/8" thick	FP end @ center of SP, FP overhangs SP Cup end	SPL-3	1/4" fillet x 3" on both sides	Along width of FP @ 4.5" ecc	Yes	Wood Jig
9C	Near Edge	Sn-N-U-C	2"	1 - 66SLCT, No Studs, J Finish	U Bar thru SP tunnel and over back legs	3" wide x 3/8" thick	FP end @ center of SP, FP overhangs SP Cup end	SPL-3	1/4" fillet x 3" on both sides	Along width of FP @ 4.5" ecc	Yes	Hand Set Wet
10C	Near Edge	Sn-N-U-C	2"	1 - 66SLCT, No Studs, J Finish	U Bar thru SP tunnel and over back legs	3" wide x 3/8" thick	FP end @ center of SP, FP overhangs SP Cup end	SPL-1	1/4" fillet x 3" on both sides	N to FP end, Parallel to SP face	Yes	Hand Set Wet
11C	Near Edge	Sn-N-U-C	2"	1 - 66SLCT, No Studs, J Finish	U Bar thru SP tunnel and over back legs	3" wide x 3/8" thick	FP end @ center of SP, FP overhangs SP Cup end	SPL-1	1/4" fillet x 3" on both sides	N to FP end, Parallel to SP face	Yes	Wood Jig
12C	Near Edge	Sn-N-U-C	2"	1 - 66SLCT, No Studs, J Finish	U Bar thru SP tunnel and over back legs	3" wide x 3/8" thick	FP end @ center of SP, FP overhangs SP Cup end	SPL-1	1/4" fillet x 3" on both sides	N to FP end, Parallel to SP face	Yes	Wood Jig
13C	Near Edge	Dn-N-S-C	4"	3 - 66DLCT, No Studs, J Finish	STR bar thru SP vertical Leg holes away from edge	3" wide x 3/8" thick	FP end @ center of SP, FP overhangs SP Cup end	SPL-3	1/4" fillet x 3" on both sides	Along width of FP @ 4.5" ecc	Yes	Hand Set Wet
14C	Near Edge	Dn-N-S-C	4"	3 - 66DLCT, No Studs, J Finish	STR bar thru SP vertical Leg holes away from edge	3" wide x 3/8" thick	FP end @ center of SP, FP overhangs SP Cup end	SPL-1	1/4" fillet x 3" on both sides	N to FP end, Parallel to SP face	Yes	Hand Set Wet

Table A-2: Spider Plate schedule for slab C.

Test #	Location in Slab	Specimen Designation	Slab	Spider Plate (SP) Type - Description	Additional Rebar @ SP	Field Plate Size	Field Plate (FP) Location on SP	Field Plate Mark #	Field Plate Weld	Load Applied	Mesh Cut Around SPL	Setting Method
1D	Away from edge	Ss-A-N-I	4"	2 - 66SLCT, Short Studs, J Finish	NA	3" wide x 3/8" thick	Centered on & N to SP, FP width perp. to leg sides	SPL-1	1/4" fillet x 3" on one side only	N to SP face	No	Wood Jig
2D	Away from edge	Ss-A-N-I	4"	2 - 66SLCT, Short Studs, J Finish	NA	3" wide x 3/8" thick	Centered on & N to SP, FP width perp. to leg sides	SPL-1	1/4" fillet x 3" on one side only	N to SP face	No	Wood Jig
3D	Away from edge	Ss-A-N-C	4"	2 - 66SLCT, Short Studs, J Finish	NA	3" wide x 3/8" thick	Centered on & N to SP, FP width perp. to leg sides	SPL-1	1/4" fillet x 3" on one side only	N to SP face	Yes	Wood Jig
4D	Away from Edge	Ss-A-N-I	4"	2 - 66SLCT, Short Studs, J Finish	NA	3" wide x 3/8" thick	Centered on & N to SP, FP width perp. to leg sides	SPL-2	1/4" fillet x 3" on one side only	Along width of FP @ 1.5" ecc	No	Wood Jig
5D	Away from Edge	Ss-A-N-I	4"	2 - 66SLCT, Short Studs, J Finish	NA	3" wide x 3/8" thick	Centered on & N to SP, FP width perp. to leg sides	SPL-2	1/4" fillet x 3" on one side only	Along width of FP @ 1.5" ecc	No	Wood Jig
6D	Away from Edge	Ss-A-N-I	4"	2 - 66SLCT, Short Studs, J Finish	NA	3" wide x 3/8" thick	Centered on & N to SP, FP width perp. to leg sides	SPL-2	1/4" fillet x 3" on one side only	Along width of FP @ 1.5" ecc	No	Wood Jig
7D	Away from Edge	Ss-A-N-I	4"	2 - 66SLCT, Short Studs, J Finish	NA	3" wide x 3/8" thick	Edge of SP, FP width perp. to leg sides	SPL-1	1/4" fillet x 3" on one side only	N to SP face	No	Wood Jig
8D	Away from Edge	Dn-A-N-C	4"	3 - 66DLCT, No Studs, J Finish	NA	3" wide x 3/8" thick	Centered on & N to SP, FP width perp. to leg sides	SPL-2	1/4" fillet x 3" on one side only	Along width of FP @ 1.5" ecc	Yes	Wood Jig
9D	Away from Edge	Dn-A-N-C	4"	3 - 66DLCT, No Studs, J Finish	NA	3" wide x 3/8" thick	Centered on & N to SP, FP width perp. to leg sides	SPL-2	1/4" fillet x 3" on one side only	Along width of FP @ 1.5" ecc	Yes	Wood Jig
10D	Away from Edge	Dn-A-N-C	4"	3 - 66DLCT, No Studs, J Finish	NA	3" wide x 3/8" thick	Centered on & N to SP, FP width perp. to leg sides	SPL-2	1/4" fillet x 3" on one side only	Along width of FP @ 1.5" ecc	Yes	Wood Jig
11D	Away from Edge	Dn-A-N-C	4"	3 - 66DLCT, No Studs, J Finish	NA	3" wide x 3/8" thick	Edge of SP, FP width parallel to leg sides	SPL-1	1/4" fillet x 3" on one side only	N to SP face	Yes	Wood Jig
12D	Away from Edge	Dn-A-N-C	4"	3 - 66DLCT, No Studs, J Finish	NA	3" wide x 3/8" thick	Centered on & N to SP, FP width perp. to leg sides	SPL-1	1/4" fillet x 3" on one side only	N to SP face	Yes	Wood Jig
13D	Away from Edge	Dn-A-N-C	4"	3 - 66DLCT, No Studs, J Finish	NA	3" wide x 3/8" thick	Centered on & N to SP, FP width perp. to leg sides	SPL-1	1/4" fillet x 3" on one side only	N to SP face	Yes	Wood Jig
14D	Away from Edge	Dn-A-N-C	4"	3 - 66DLCT, No Studs, J Finish	NA	3" wide x 3/8" thick	Centered on & N to SP, FP width perp. to leg sides	SPL-1	1/4" fillet x 3" on one side only	N to SP face	Yes	Wood Jig
15D	Near Edge	Ss-N-U-I	4"	2 - 66SLCT, Short Studs, J Finish	U Bar thru SP tunnel and over back legs	3" wide x 3/8" thick	FP end @ center of SP, FP overhangs SP Cup end	SPL-3	1/4" fillet x 3" on both sides	Along width of FP @ 4.5" ecc	No	Hand Set Wet

Table A-3: Partial Spider Plate schedule for slab D.

Test #	Location in Slab	Specimen Designation	Slab	Spider Plate (SP) Type - Description	Additional Rebar @ SP	Field Plate Size	Field Plate (FP) Location on SP	Field Plate Mark #	Field Plate Weld	Load Applied	Mesh Cut Around SPL	Setting Method
16D	Near Edge	Ss-N-U-I	4"	2 - 66SLCT, Short Studs, J Finish	U Bar thru SP tunnel and over back legs	3" wide x 3/8" thick	FP end @ center of SP, FP overhangs SP Cup end	SPL-3	1/4" fillet x 3" on both sides	Along width of FP @ 4.5" ecc	No	Hand Set Wet
17D	Near Edge	Ss-N-U-I	4"	2 - 66SLCT, Short Studs, J Finish	U Bar thru SP tunnel and over back legs	3" wide x 3/8" thick	FP end @ center of SP, FP overhangs SP Cup end	SPL-3	1/4" fillet x 3" on both sides	Along width of FP @ 4.5" ecc	No	Hand Set Wet
18D	Near Edge	Ss-N-U-I	4"	2 - 66SLCT, Short Studs, J Finish	U Bar thru SP tunnel and over back legs	3" wide x 3/8" thick	FP end @ center of SP, FP overhangs SP Cup end	SPL-1	1/4" fillet x 3" on both sides	N to FP end, Parallel to SP face	No	Hand Set Wet
19D	Near Edge	Ss-N-U-I	4"	2 - 66SLCT, Short Studs, J Finish	U Bar thru SP tunnel and over back legs	3" wide x 3/8" thick	FP end @ center of SP, FP overhangs SP Cup end	SPL-1	1/4" fillet x 3" on both sides	N to FP end, Parallel to SP face	No	Hand Set Wet
20D	Near Edge	Ss-N-U-I	4"	2 - 66SLCT, Short Studs, J Finish	U Bar thru SP tunnel and over back legs	3" wide x 3/8" thick	FP end @ center of SP, FP overhangs SP Cup end	SPL-1	1/4" fillet x 3" on both sides	N to FP end, Parallel to SP face	No	Hand Set Wet
21D	Near Edge	Dn-N-U-C	4"	3 - 66DLCT, No Studs, J Finish	U Bar thru SP tunnel and over back legs	3" wide x 3/8" thick	FP end @ center of SP, FP overhangs SP Cup end	SPL-3	1/4" fillet x 3" on both sides	Along width of FP @ 4.5" ecc	Yes	Hand Set Wet
22D	Near Edge	Dn-N-U-I	4"	3 - 66DLCT, No Studs, J Finish	U Bar thru SP tunnel and over back legs	3" wide x 3/8" thick	FP end @ center of SP, FP overhangs SP Cup end	SPL-3	1/4" fillet x 3" on both sides	Along width of FP @ 2" ecc	No	Hand Set Wet
23D	Near Edge	Dn-N-U-I	4"	3 - 66DLCT, No Studs, J Finish	U Bar thru SP tunnel and over back legs	3" wide x 3/8" thick	FP end @ center of SP, FP overhangs SP Cup end	SPL-3	1/4" fillet x 3" on both sides	Along width of FP @ 4.5" ecc	No	Hand Set Wet
24D	Near Edge	Dn-N-U-I	4"	3 - 66DLCT, No Studs, J Finish	U Bar thru SP tunnel and over back legs	3" wide x 3/8" thick	FP end @ center of SP, FP overhangs SP Cup end	SPL-1	1/4" fillet x 3" on both sides	N to FP end, Parallel to SP face	No	Hand Set Wet
25D	Near Edge	Dn-N-U-I	4"	3 - 66DLCT, No Studs, J Finish	U Bar thru SP tunnel and over back legs	3" wide x 3/8" thick	FP end @ center of SP, FP overhangs SP Cup end	SPL-1	1/4" fillet x 3" on both sides	N to FP end, Parallel to SP face	No	Hand Set Wet
26D	Near Edge	Dn-N-U-I	4"	3 - 66DLCT, No Studs, J Finish	U Bar thru SP tunnel and over back legs	3" wide x 3/8" thick	FP end @ center of SP, FP overhangs SP Cup end	SPL-1	1/4" fillet x 3" on both sides	N to FP end, Parallel to SP face	No	Hand Set Wet
27D	Near Edge	Dn-N-S-I	4"	3 - 66DLCT, No Studs, J Finish	STR bar thru SP vertical Leg holes away from edge	3" wide x 3/8" thick	FP end @ center of SP, FP overhangs SP Cup end	SPL-3	1/4" fillet x 3" on both sides	Along width of FP @ 4.5" ecc	No	Hand Set Wet
28D	Near Edge	Dn-N-S-I	4"	3 - 66DLCT, No Studs, J Finish	STR bar thru SP vertical Leg holes away from edge	3" wide x 3/8" thick	FP end @ center of SP, FP overhangs SP Cup end	SPL-3	1/4" fillet x 3" on both sides	Along width of FP @ 4.5" ecc	No	Hand Set Wet
29D	Near Edge	Dn-N-S-I	4"	3 - 66DLCT, No Studs, J Finish	STR bar thru SP vertical Leg holes away from edge	3" wide x 3/8" thick	FP end @ center of SP, FP overhangs SP Cup end	SPL-1	1/4" fillet x 3" on both sides	N to FP end, Parallel to SP face	No	Hand Set Wet
30D	Near Edge	Dn-N-S-I	4"	3 - 66DLCT, No Studs, J Finish	STR bar thru SP vertical Leg holes away from edge	3" wide x 3/8" thick	FP end @ center of SP, FP overhangs SP Cup end	SPL-1	1/4" fillet x 3" on both sides	N to FP end, Parallel to SP face	No	Hand Set Wet

Table A-4: Partial Spider Plate schedule for slab D.

A detailed description of the summaries found in Tables A-2 through A-4 follows:

Spider plates 1C through 6C were of nominal dimensions 6”w x 6”l x 1 1/2” deep plates (JVI part number 66SLCT) with no additional studs attached. Plates were cast into the 2” thick portion of slab C, with wire mesh cut and removed around the plates and no additional reinforcement attached. Plates were preset in position with a wood jig prior to slabs being poured. Steel field plates 3”w x 3/8”t were attached, after concrete had cured, at the center of the face of the Spider plates with a 1/4” x 3” long fillet weld on one side. The width of the field plate was oriented parallel to the leg sides of the Spider plates. All welding was performed by an AWS certified welder according to the welding procedure specification of Figure A-11 of the Appendix. Plates 1C through 3C were designated for pullout tests, and plates 4C through 6C were designated for lateral shear tests.

Spider plates 7C through 12C were 66SLCT with no additional studs attached, and were cast at the edges of the 2” thick portion of slab C. Wire mesh was cut and removed around the plates. Each plate had an additional #4 u-bent rebar placed through the plate tunnels with each leg resting on top of the back legs of the plates (back legs are legs farthest from slab edge). Plates 7C, 8C, 11C, and 12C were preset in position with a wood jig prior to slabs being poured. Plates 9C and 10C were set in position by hand after the slabs were poured. Steel field plates 3”w x 3/8”t were attached to the plates, with the face of the field plate resting on the face of the Spider plate. The end of the field plates were positioned at the center of the Spider plates, with the length of the field plates extending past the slab edge. Field plates were welded to Spider plates, after concrete had cured, with a 1/4” x 3” fillet weld on both edges in contact with the Spider plate. Plates 7C through 9C were designated for shear tests with the load parallel to the slab edge. Plates 10C through 12C were designated for shear tests with the load perpendicular to the slab edge.

Spider plates 13C and 14C were of nominal dimensions 6”w x 6”l x 2 1/2” deep plates (JVI part number 66DLCT) with no additional studs attached. Plates were cast into the 4” thick portion of slab C, with wire mesh cut and removed around the plates. Each plate had an additional #4 straight rebar 2’-8” long placed through the rebar holes on the back extended legs of the Spider plate (back legs are legs furthest from slab edge). Both plates were set in position by hand after the slabs were poured. Steel field plates 3”w x 3/8”t were attached to the plates, with the face of the field plate resting on the face of the Spider plate. The end of the field plates were positioned at the center of the Spider plates, with the length of the field plates extending past the slab edge. Field plates were welded to Spider plates, after concrete had cured, with a 1/4” x 3” fillet weld on both edges in contact with the Spider plate. Plate 13C was designated for shear test with the load parallel to the slab edge. Plate 14C was designated for shear test with the load perpendicular to the slab edge.

Spider plates 1D - 7D were 66SLCT with short studs attached. Plates were cast into slab D away from the slab edge. Wire mesh was cut and removed around the plate 3D, but was left intact for 1D, 2D, and 4D - 7D. No additional reinforcement was attached to the plates. Plates were preset in position with a wood jig prior to slabs being poured. Steel field plates 3”w x 3/8”t were attached at the center of the face of Spider plates 1D – 6D, and 2” from the center of Spider plate 7D. All field plates were welded with a 1/4” x 3” long fillet weld on one side, after concrete had cured. The width of the field plate was oriented perpendicular to the leg sides of the Spider plates. Plates 1D – 3D and 7D were designated for pullout tests, and plates 4D - 6D were designated for lateral shear tests.

Spider plates 8D - 14D were 66DLCT with no additional studs attached. Plates were cast into slab D away from the slab edge, with wire mesh cut and removed around the plates and no additional reinforcement attached. Plates were preset in position with a wood jig prior to slabs being poured. Steel field plates 3”w x 3/8”t were attached at the center of the face of the Spider plates 8D – 10D and 12D – 14D, and 2” from the center of Spider plate 11D. All field plates were welded with a 1/4” x 3” long fillet weld on one side, after concrete had cured. The width of the field plate was oriented parallel to the leg sides of the Spider plate 11D and perpendicular for plates 8D – 10D and 12D – 14D. Plates 11D – 14D were designated for pullout tests, and plates 8D - 10D were designated for lateral shear tests.

Spider plates 15D – 20D were 66SLCT with short studs attached, and were cast at the edges of slab D. Wire mesh was left intact around the plates. Each plate had an additional #4 u-bent rebar placed through the plate tunnels with each leg resting on top of the back legs of the plates (back legs are legs furthest from slab edge). Plates were set in position by hand after the slabs were poured. Steel field plates 3”w x 3/8”t were attached to the plates, with the face of the field plate resting on the face of the Spider plate. The end of the field plates were positioned at the center of the Spider plates, with the length of the field plates extending past the slab edge. Field plates were welded to Spider plates, after concrete had cured, with a 1/4” x 3” fillet weld on both edges in contact with the Spider plate. Plates 15D – 17D were designated for shear tests with the load parallel to the slab edge. Plates 18D – 20D were designated for shear tests with the load perpendicular to the slab edge.

Spider plates 21D – 26D were 66DLCT with no additional studs attached, and were cast at the edges of slab D. Wire mesh was left intact around plates 22D – 26D, and was cut and removed around plate 21D. Each plate had an additional #4 u-bent rebar placed through the plate tunnels with each leg resting on top of the back legs of the plates (back legs are legs furthest from slab edge). Plates were set in position by hand after the slabs were poured. Steel field plates 3”w x 3/8”t were attached to the plates, with the face of the field plate resting on the face of the Spider plates. The end of the field plates were positioned at the

center of the Spider plates, with the length of the field plates extending past the slab edge. Field plates were welded to Spider plates, after concrete had cured, with a 1/4" x 3" fillet weld on both edges in contact with the Spider plate. Plates 21D – 23D were designated for shear tests with the load parallel to the slab edge. Plates 24D – 26D were designated for shear tests with the load perpendicular to the slab edge.

Spider plates 27D – 30D were 66DLCT with no additional studs attached, and were cast at the edges of slab D. Wire mesh was left intact around the plates. Each plate had an additional #4 straight rebar 2'-8" long placed through the rebar holes on the back extended legs of the Spider plate (back legs are legs furthest from slab edge). Plates were set in position by hand after the slabs were poured. Steel field plates 3"w x 3/8"t were attached to the plates, with the face of the field plate resting on the face of the Spider plates. The end of the field plates were positioned at the center of the Spider plates, with the length of the field plates extending past the slab edge. Field plates were welded to Spider plates, after concrete had cured, with a 1/4" x 3" fillet weld on both edges in contact with the Spider plate. Plates 27D and 28D were designated for shear tests with the load parallel to the slab edge. Plates 29D and 30D were designated for shear tests with the load perpendicular to the slab edge.

INSTEEL WIRE PRODUCTS **DISCRETE JOB#** 198977

Mount Airy, North Carolina

This is to certify that the manufacturing processes for the reinforcement material described below occurred in the United States of America and was made in accordance with and conforms to the following specifications:

ASTM-A 82 Tensile & Bend Tests **Conf. Number:** 219886

ASTM-A 185 Weld Shear Test **Lot Number:** 20050919

Sales Order Number:

Item Number: **532-103467**

Product Style: 6X6-W2.5/W2.5-96"(2+2)X 11'10" (2+2) W2.5/W2.5

TENSILE TESTS

WIRE SIZES		Test No.	Pounds/Foot "Deformed Wire Only"		WIRE DIA. (Inches)	Actual Area (Sq. In.)	Tensile Pounds/ Sq. In.	ROA %	Yield Strength P.S.I.
Longitudinal	Transverse		Actual	Nominal					
W2.5	XXXXXX	1			0.178	0.02488	81755	65%	
W2.5	XXXXXX	2			0.178	0.02488	82437	65%	
XXXXXX	W2.5	1			0.177	0.02461	106624	63%	
XXXXXX	W2.5	2			0.177	0.02461	106946	63%	

ALL WIRES LISTED ABOVE MEET A.S.T.M. A-82 OR A-496 BEND TEST REQUIREMENTS

WELD SHEAR TESTS

WIRE SIZES: W2.5 / W2.5

Test Number	1	2	3	4
Break Load (Lbs. Of Force)	2238	2192	2257	2315

MINIMUM BREAK LOAD REQUIRED 875 **LBS. OF FORCE**

RAW MATERIALS – HEAT NUMBER INFORMATION

Longitudinal Wires	Heat No's:
Code: W2455	256982

Transverse Wires	Heat No's:
Code: W23732	J5-4483

Date: 9/22/2005

Quality Assurance
Insteel Wire Products K Simmons

Figure A-3: Wire mesh certification for slab C.

INSTEEL WIRE PRODUCTS **DISCRETE JOB#** 198309

Mount Airy, North Carolina

This is to certify that the manufacturing processes for the reinforcement material described below occurred in the United States of America and was made in accordance with and conforms to the following specifications:

ASTM-A 82 Tensile & Bend Tests
ASTM-A 185 Weld Shear Test

Conf. Number: 219071
Lot Number: 20050910
Sales Order Number:

Item Number: **533-103250**

Product Style: 4X4-W4/W4-96" (2+2) X 11'10" (1+1) W4/W4

TENSILE TESTS

WIRE SIZES		Test No.	Pounds/Foot "Deformed Wire Only"		WIRE DIA. (Inches)	Actual Area (Sq. In.)	Tensile Pounds/ Sq. In.	ROA %	Yield Strength P.S.I.
Longitudinal	Transverse		Actual	Nominal					
W4	XXXXXX	1			0.224	0.03941	104356	61%	
W4	XXXXXX	2			0.224	0.03941	103946	61%	
XXXXXX	W4	1			0.227	0.04047	103889	63%	
XXXXXX	W4	2			0.227	0.04047	104117	63%	

ALL WIRES LISTED ABOVE MEET A.S.T.M. A-82 OR A-496 BEND TEST REQUIREMENTS

WELD SHEAR TESTS

WIRE SIZES: W4 / W4

Test Number	1	2	3	4
Break Load (Lbs. Of Force)	3934	3781	3887	3775

MINIMUM BREAK LOAD REQUIRED 1400 **LBS. OF FORCE**

RAW MATERIALS – HEAT NUMBER INFORMATION

Longitudinal Wires	Heat No's:
Code: W23932	J5-4456

Transverse Wires	Heat No's:
Code: W23932	J5-4442

Date: 9/15/2005

Quality Assurance
Insteel Wire Products D Baker

Figure A-4: Wire mesh certification for slab D.

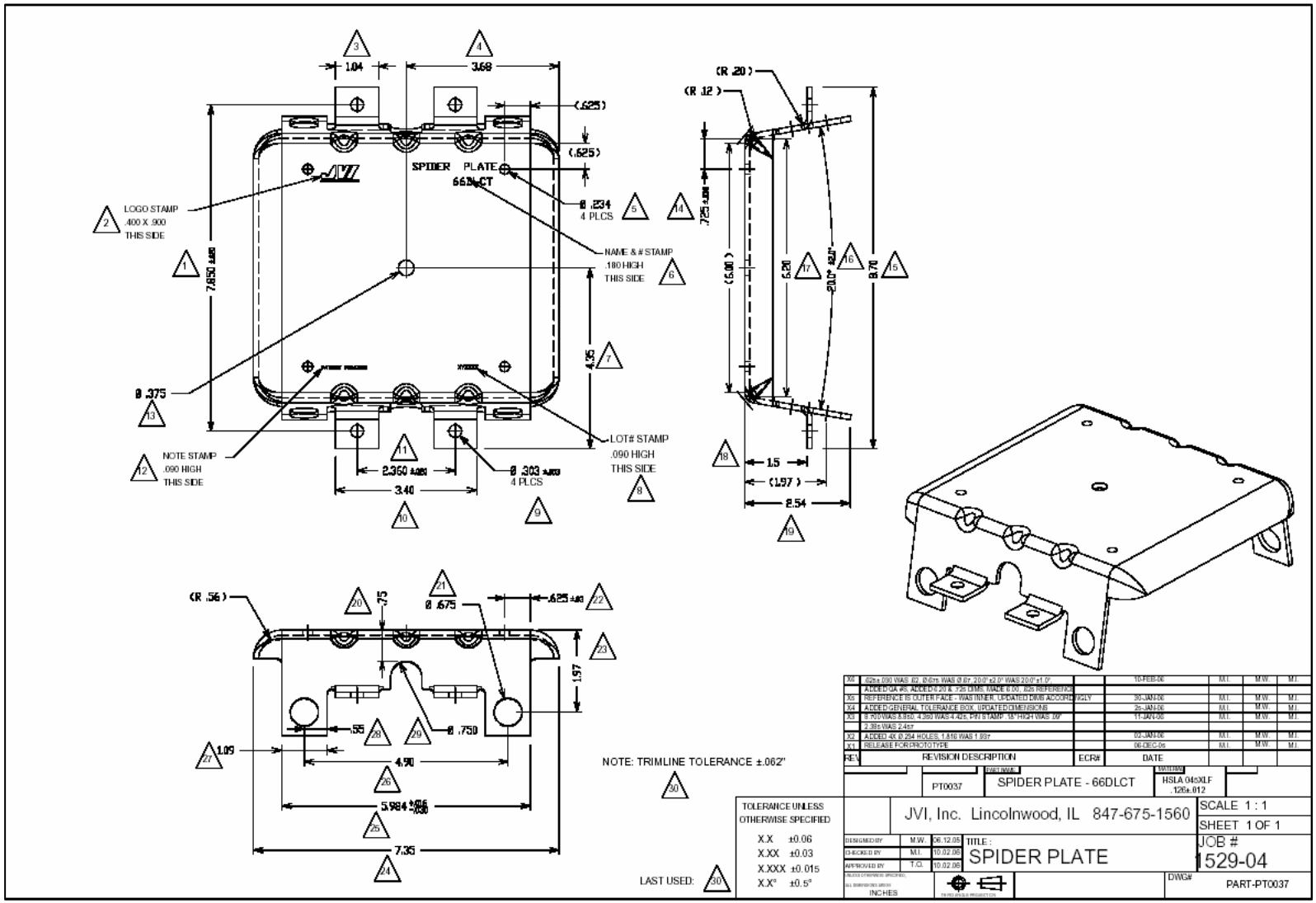


Figure A-5: Spider plate 66DLCT detail.

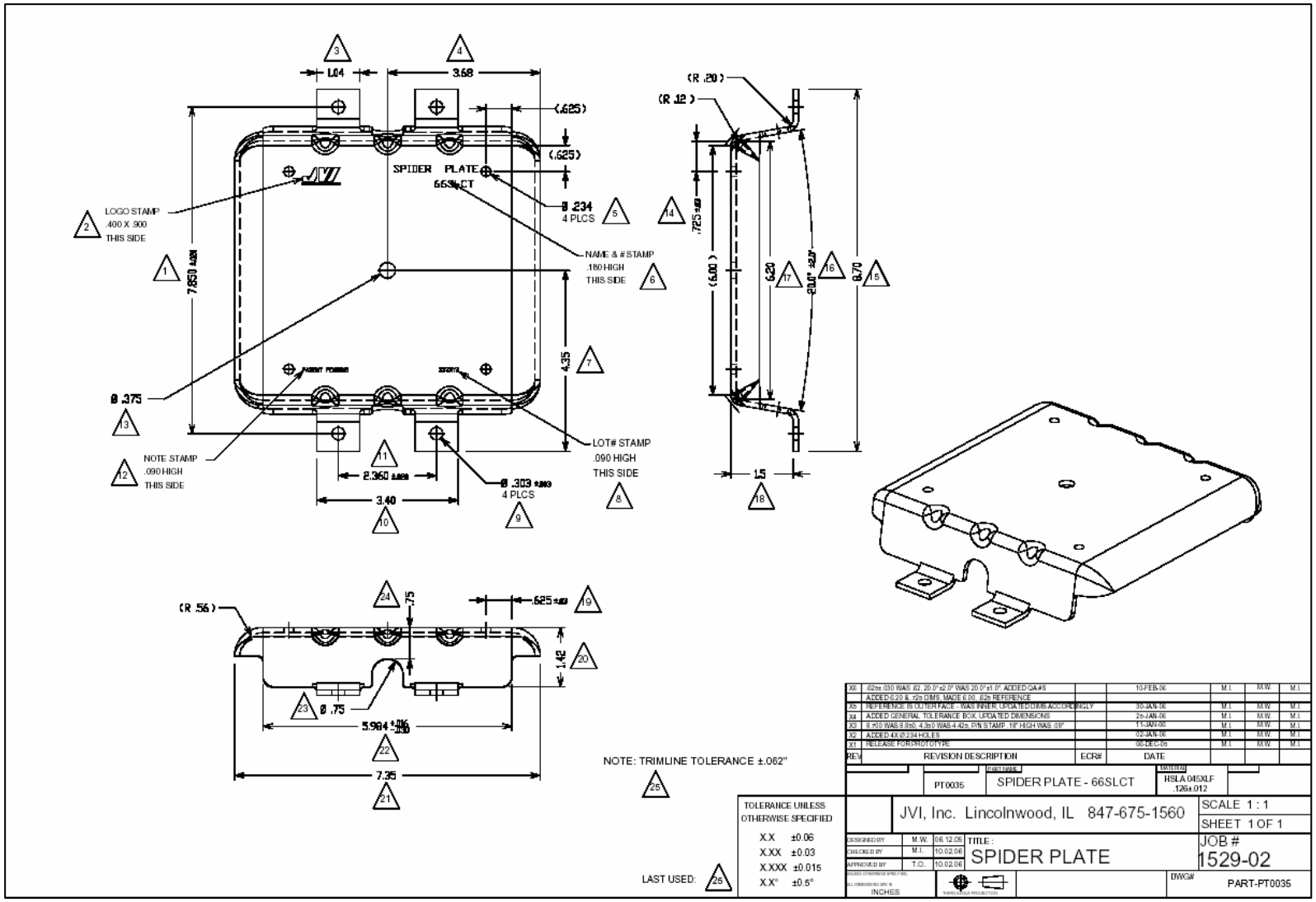


Figure A-6: Spider plate 66SLCT detail.

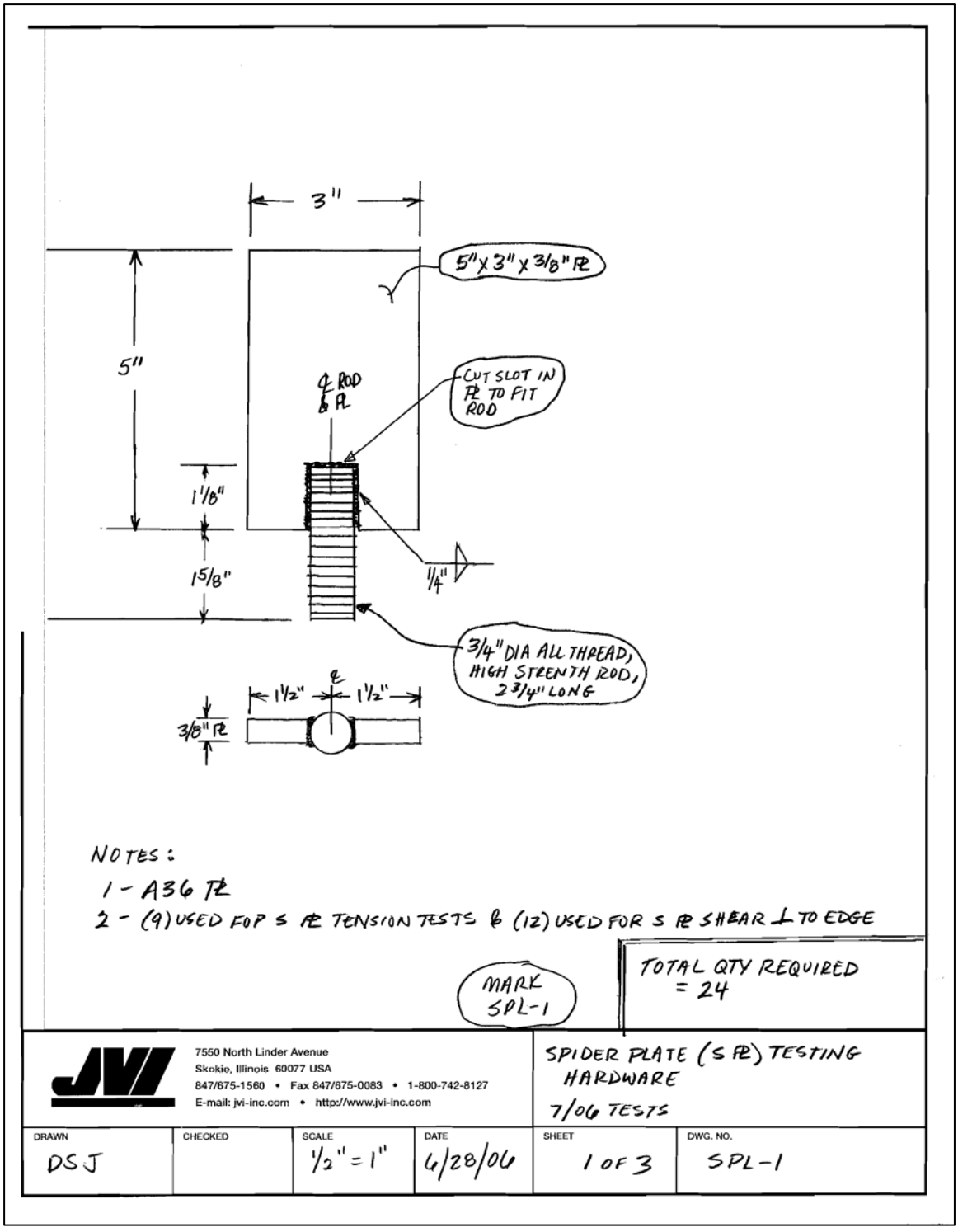


Figure A-7: Production detail for SPL-1 field plate.

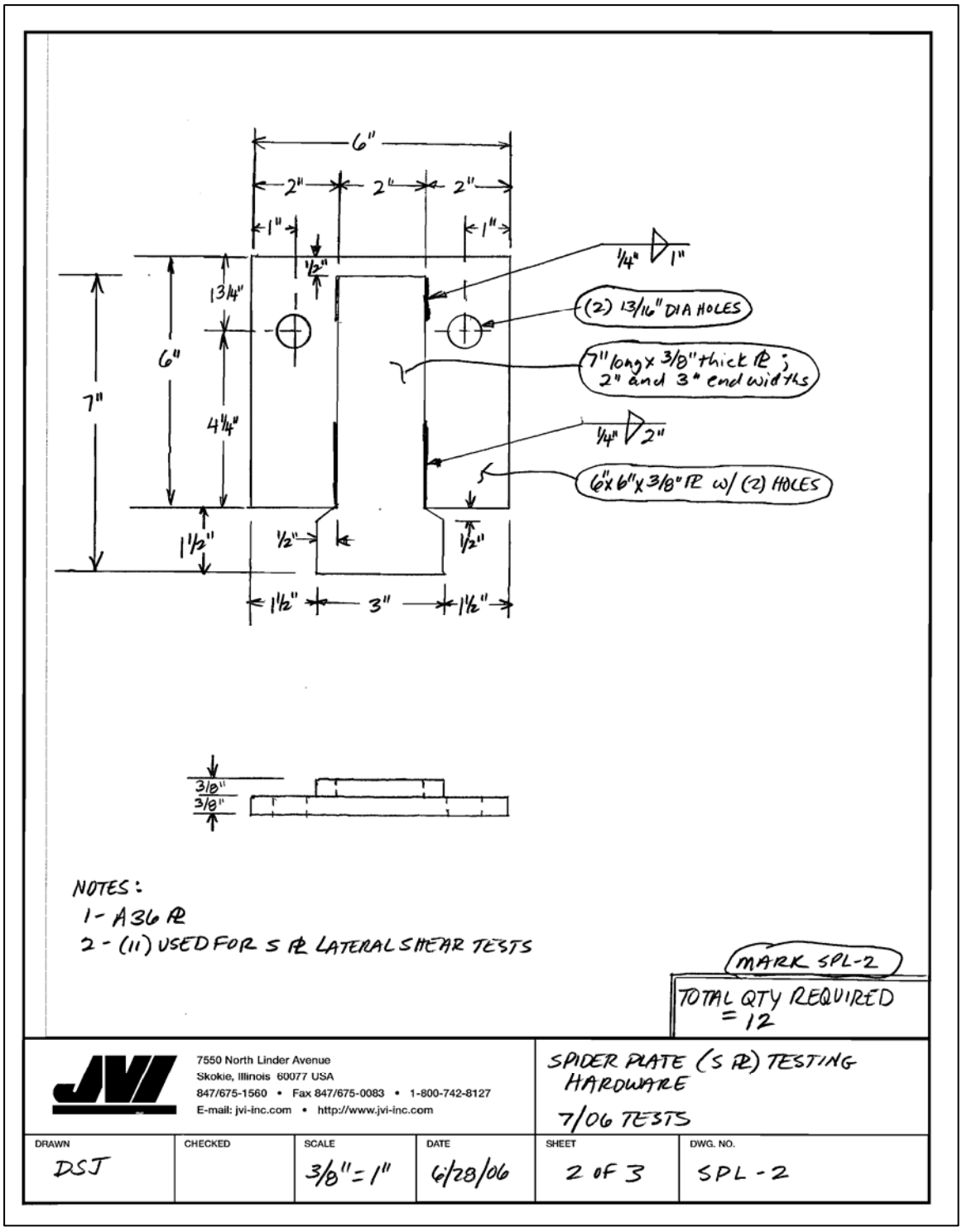


Figure A-8: Production detail for SPL-2 field plate and load plate.

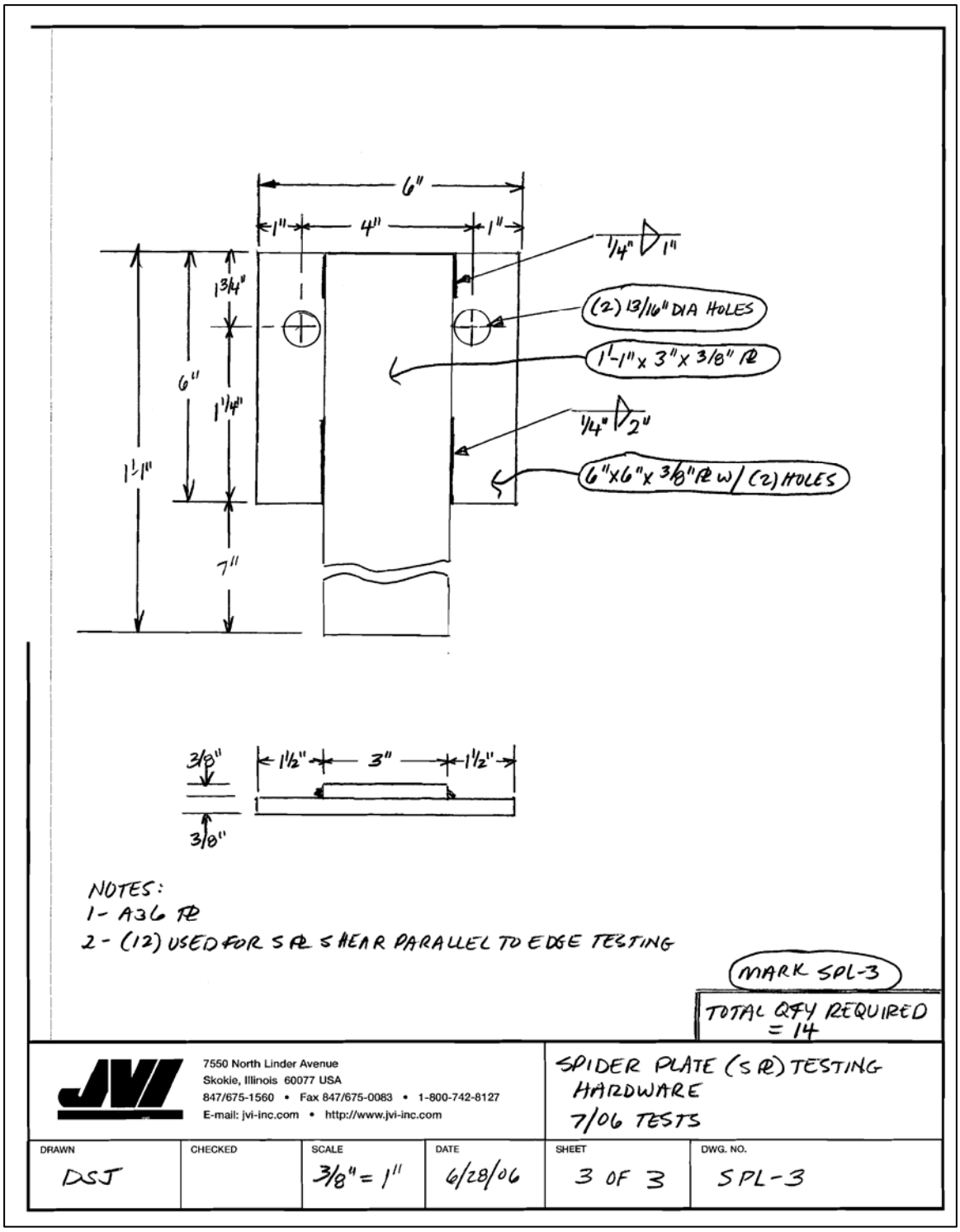


Figure A-9: Production detail for SPL-3 field plate and load plate.

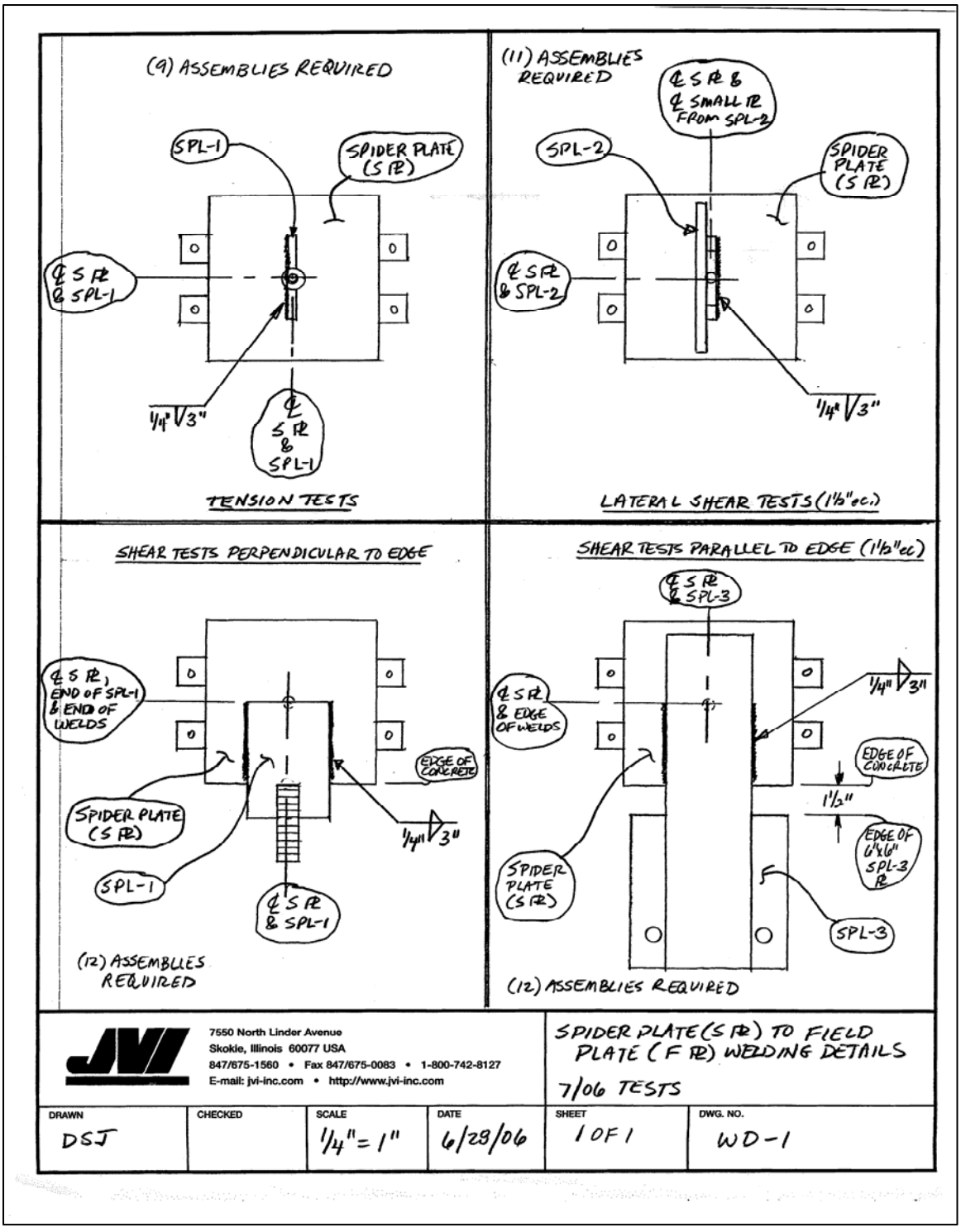
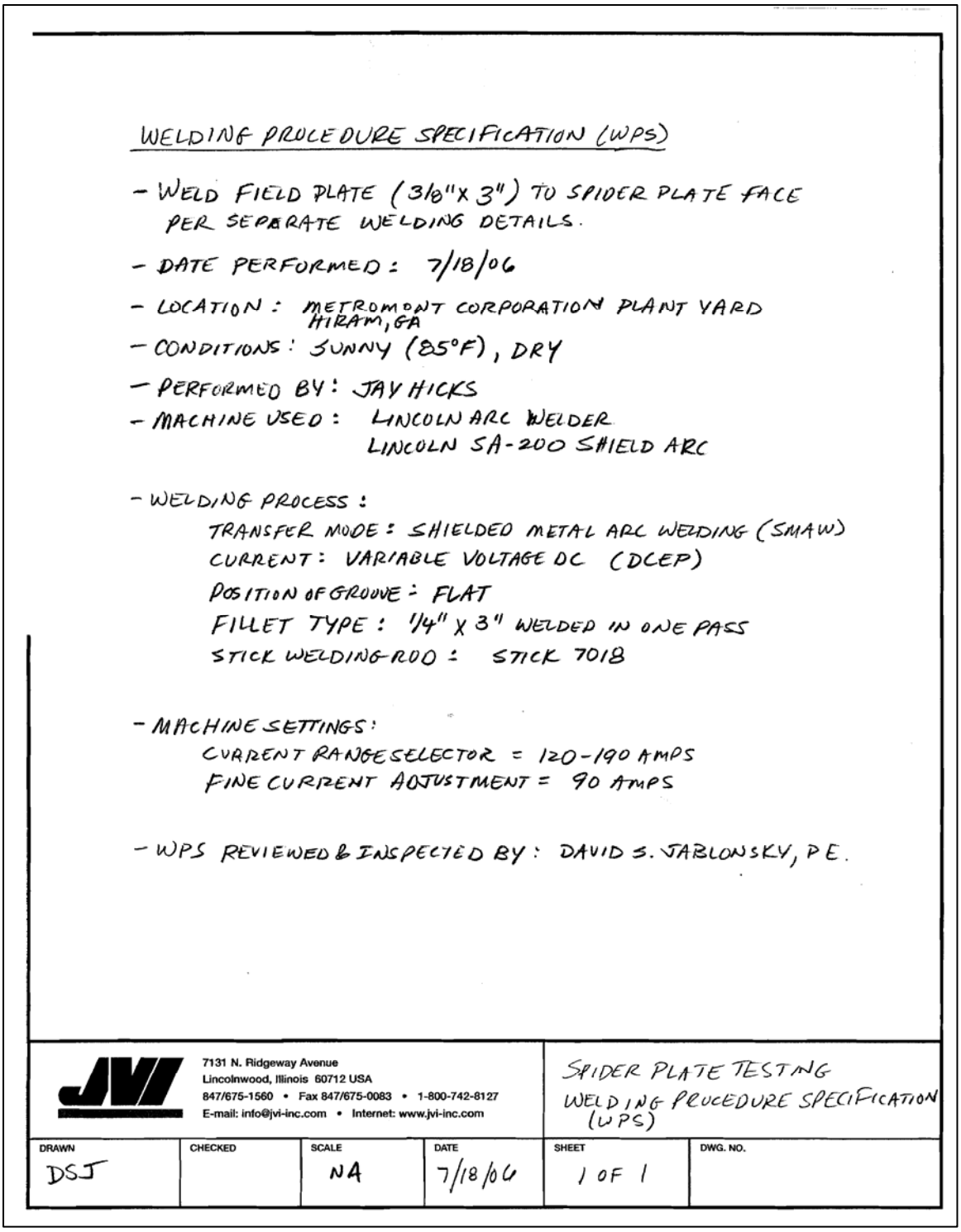


Figure A-10: Field plate to Spider plate connection details.
NOTE: Orientation of field plate welded on Spider plate shown on Tension Tests and Lateral Shear Test details will vary depending on test performed. See Tables 3 and 4 for orientation of specific tests.



WELDING PROCEDURE SPECIFICATION (WPS)

- WELD FIELD PLATE (3/8" X 3") TO SPIDER PLATE FACE PER SEPARATE WELDING DETAILS.
- DATE PERFORMED: 7/18/06
- LOCATION: METROMONT CORPORATION PLANT YARD HIRAM, GA
- CONDITIONS: SUNNY (85°F), DRY
- PERFORMED BY: JAY HICKS
- MACHINE USED: LINCOLN ARC WELDER LINCOLN SA-200 SHIELD ARC
- WELDING PROCESS:
  - TRANSFER MODE: SHIELDED METAL ARC WELDING (SMAW)
  - CURRENT: VARIABLE VOLTAGE DC (DCEP)
  - POSITION OF GROOVE: FLAT
  - FILLET TYPE: 1/4" X 3" WELDED IN ONE PASS
  - STICK WELDING ROD: STICK 7018
- MACHINE SETTINGS:
  - CURRENT RANGE SELECTOR = 120-190 AMPS
  - FINE CURRENT ADJUSTMENT = 90 AMPS
- WPS REVIEWED & INSPECTED BY: DAVID S. JABLONSKY, P.E.

JVI
7131 N. Ridgeway Avenue
Lincolnwood, Illinois 60712 USA
847/675-1560 • Fax 847/675-0083 • 1-800-742-8127
E-mail: info@jvi-inc.com • Internet: www.jvi-inc.com

SPIDER PLATE TESTING
WELDING PROCEDURE SPECIFICATION (WPS)

DRAWN	CHECKED	SCALE	DATE	SHEET	DWG. NO.
DSJ		NA	7/18/06	1 OF 1	

Figure A-11: Welding Procedure Specification.

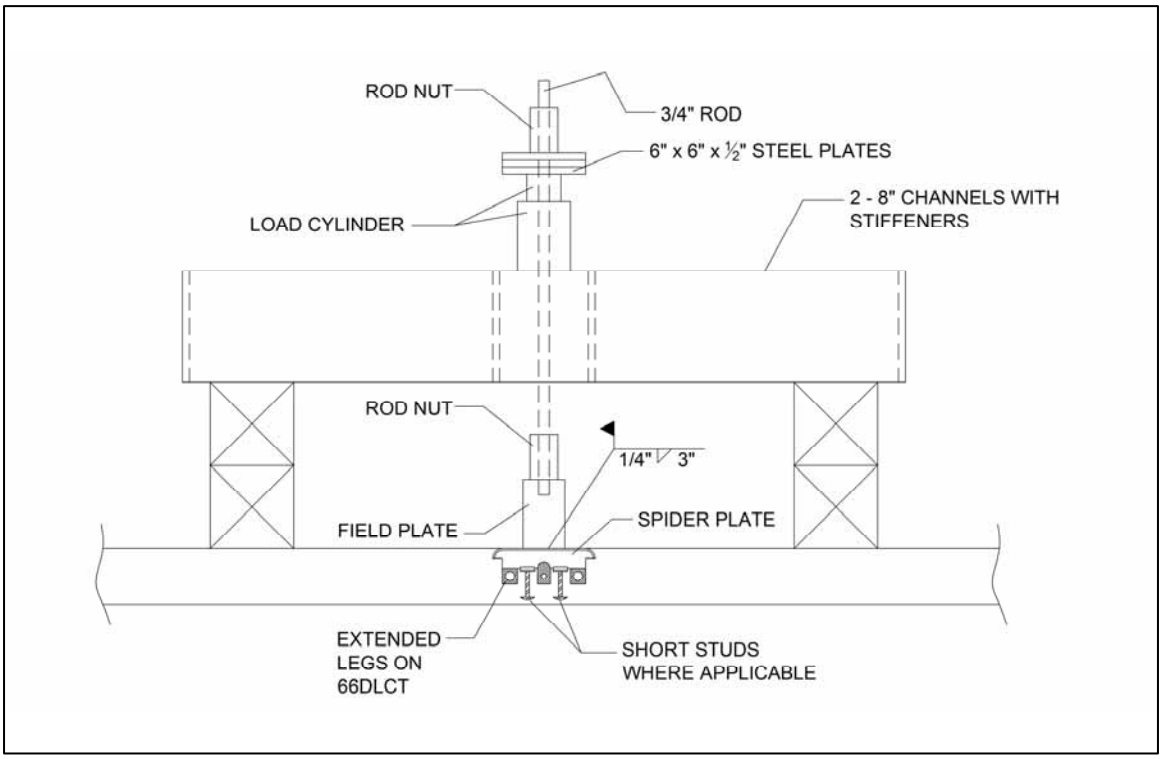


Figure A-12: Schematic (section profile) of pullout test setup.

Figure A-13: Photo (front profile) of pullout test setup.
Note: JVI PSA insert is being tested here, but general setup is the same for Spider plate.

Figure A-14: Photo (side profile) of pullout test setup.
Note: JVI PSA insert is being tested here, but general setup is the same for Spider plate.

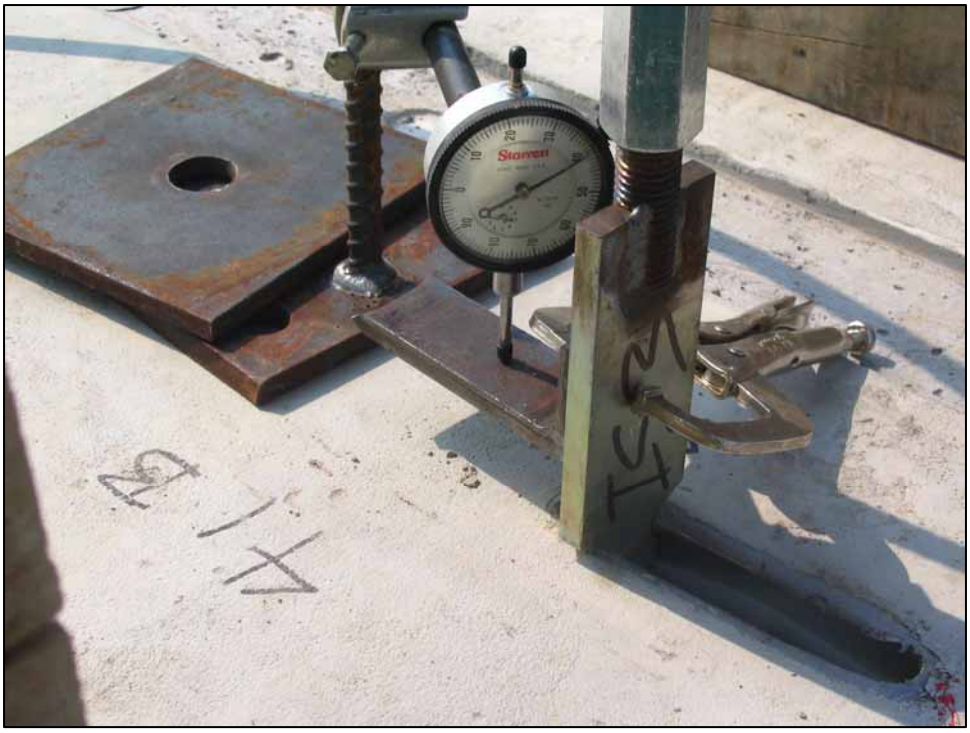


Figure A-15: Close-up photo of dial gage setup for pullout test.
Note: JVI PSA insert is being tested here, but general setup is the same for Spider plate.

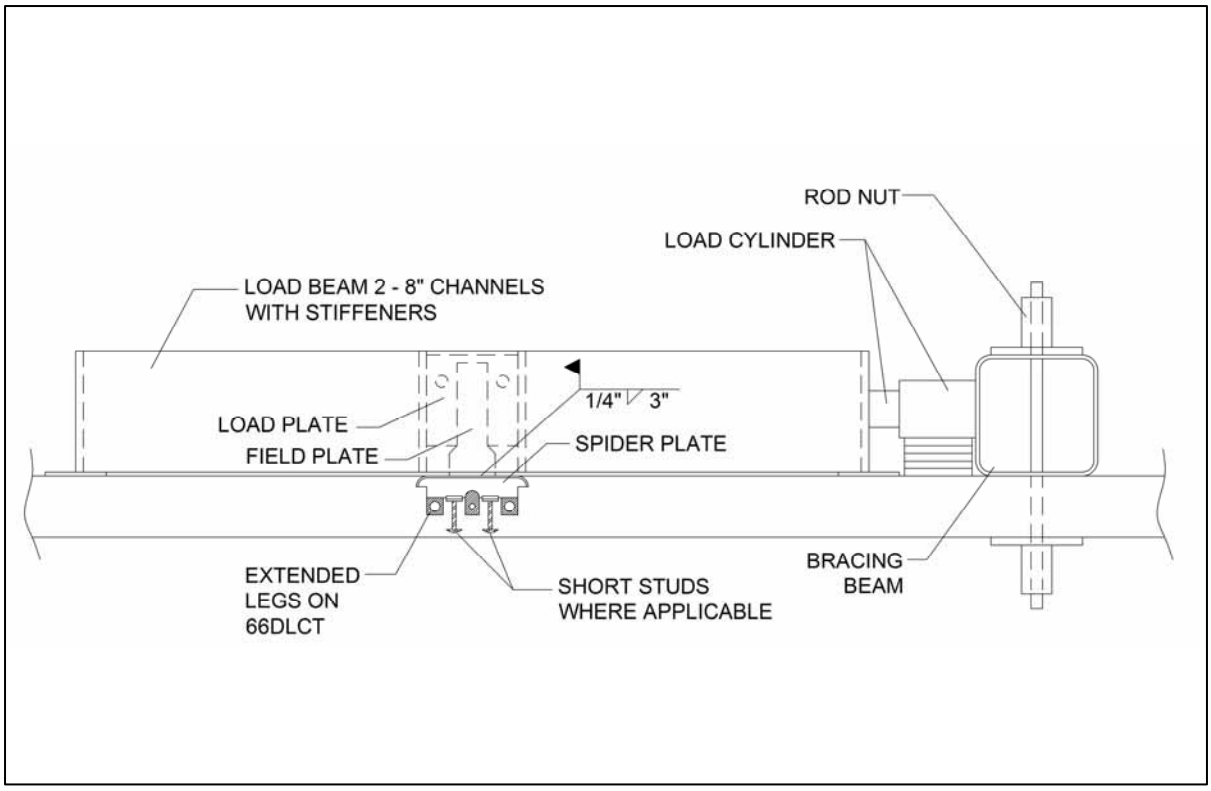


Figure A-16: Schematic (section profile) of lateral shear test setup.

Figure A-17: Photo of lateral shear test setup.
Note: JVI PSA insert is being tested here, but general setup is the same for Spider plate.

Figure A-18: Close-up photo of lateral shear test setup.
Note: JVI PSA insert is being tested here, but general setup is the same for Spider plate.

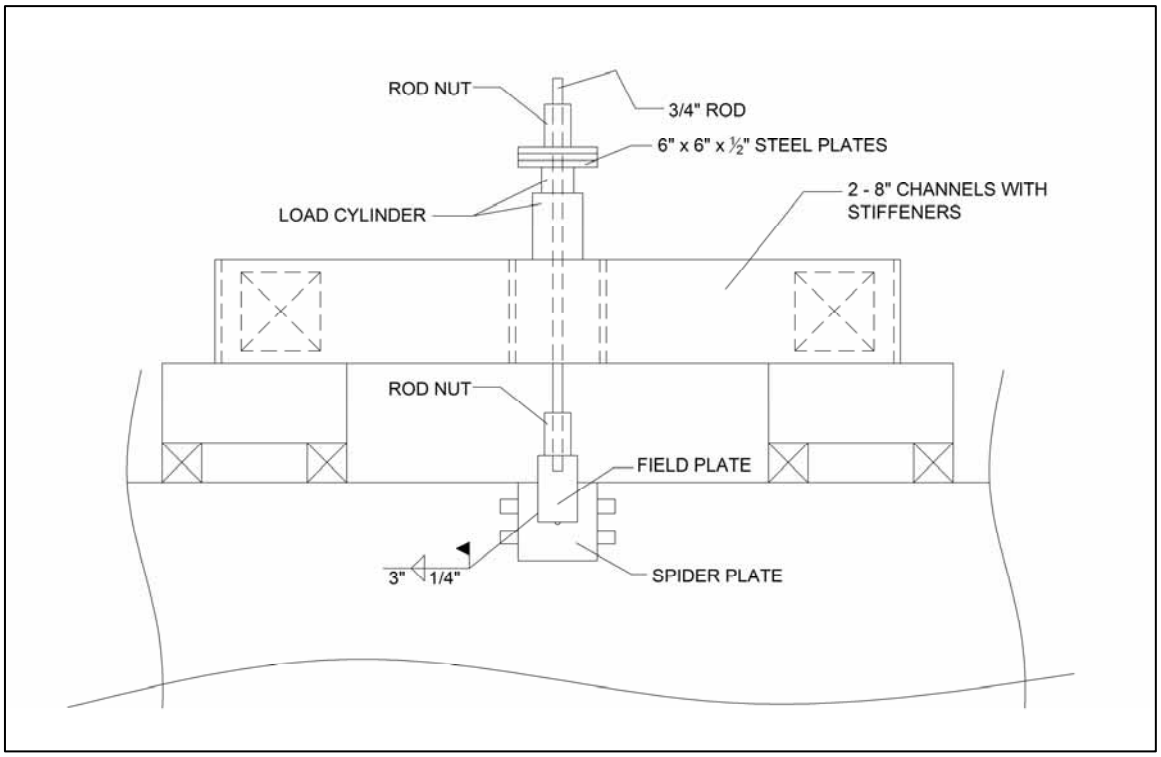


Figure A-19: Schematic (plan view) of perpendicular edge shear test setup.

Figure A-20: Photo of perpendicular edge shear test setup.

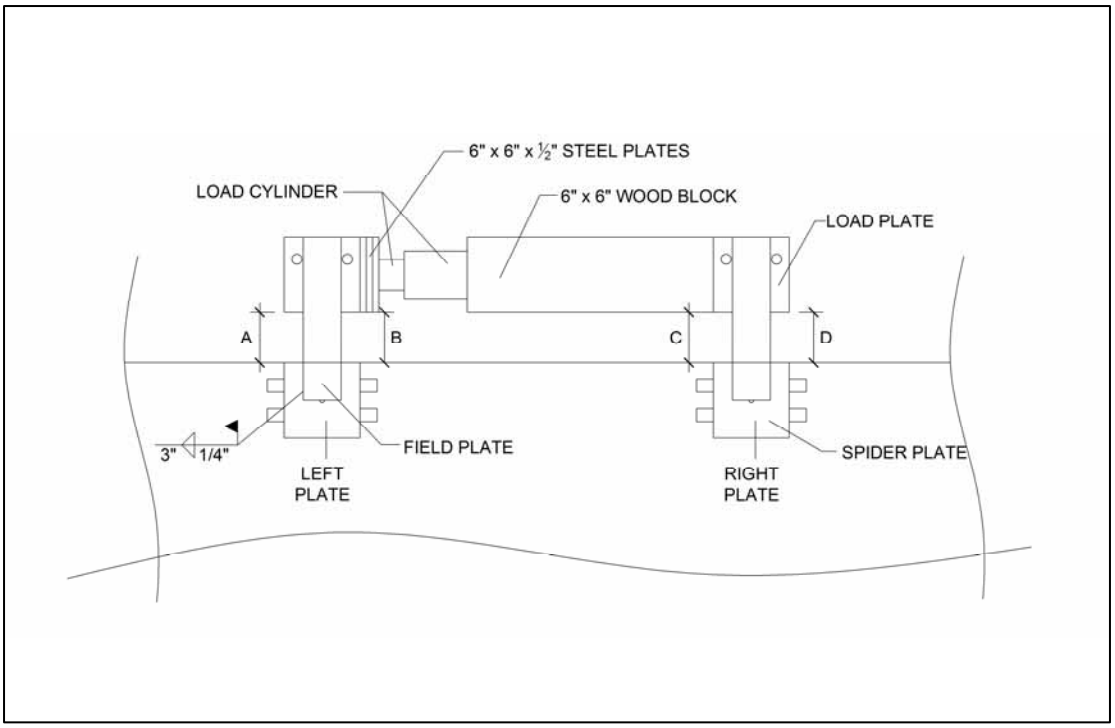


Figure A-21: Schematic (plan view) of parallel edge shear test setup.

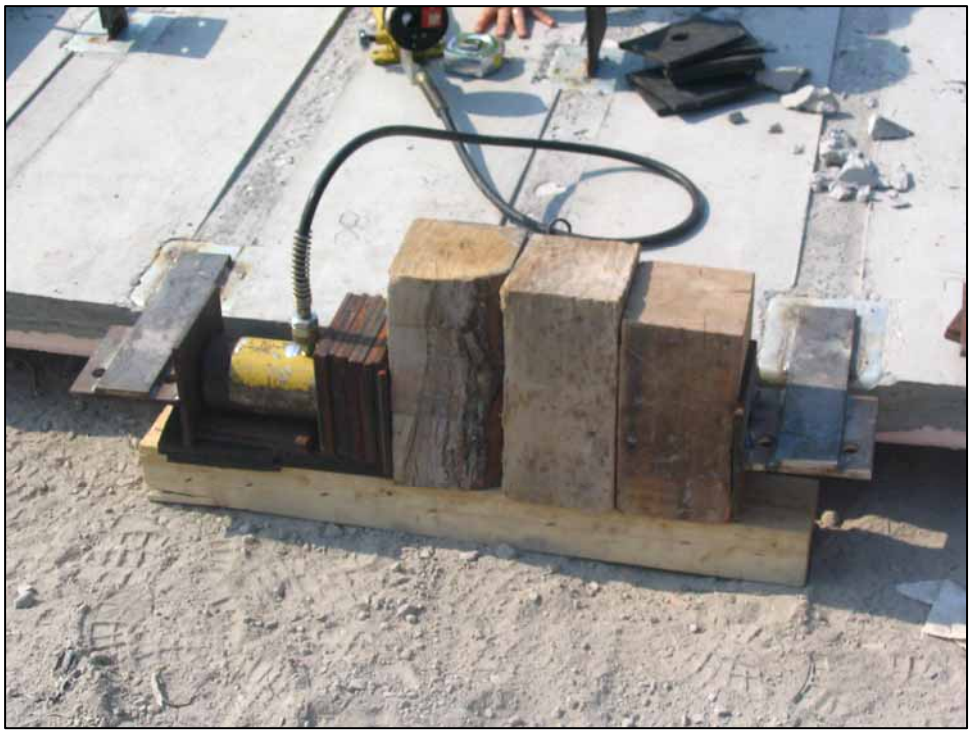
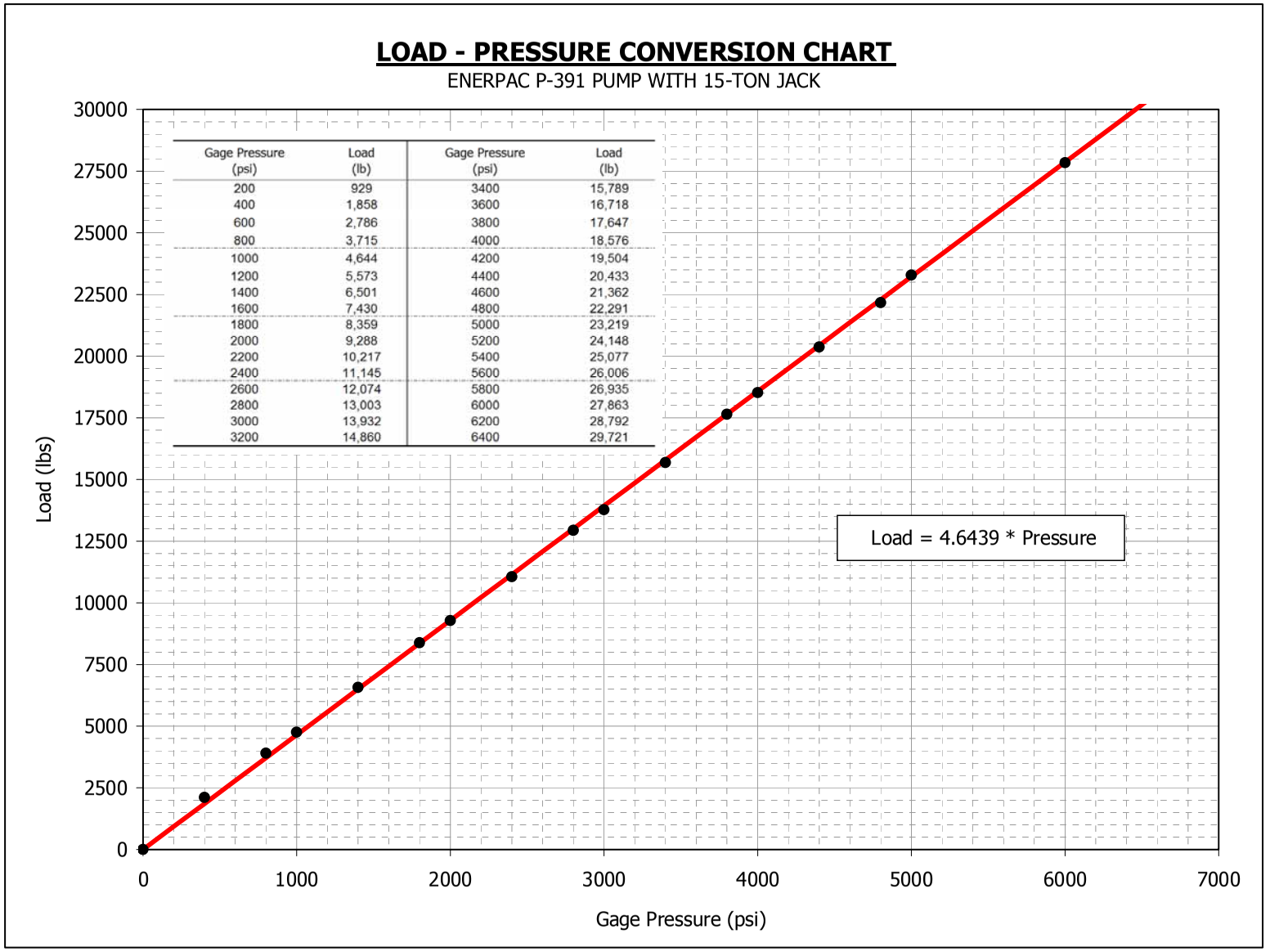


Figure A-22: Photo of parallel edge shear test setup.



Gage Pressure (psi)	Load (lb)	Gage Pressure (psi)	Load (lb)
200	929	3400	15,789
400	1,858	3600	16,718
600	2,786	3800	17,647
800	3,715	4000	18,576
1000	4,644	4200	19,504
1200	5,573	4400	20,433
1400	6,501	4600	21,362
1600	7,430	4800	22,291
1800	8,359	5000	23,219
2000	9,288	5200	24,148
2200	10,217	5400	25,077
2400	11,145	5600	26,006
2600	12,074	5800	26,935
2800	13,003	6000	27,863
3000	13,932	6200	28,792
3200	14,860	6400	29,721

Figure A-23: Calibration and cylinder pressure-load conversion chart.