



Pull-Out Strength of fasteners in 1/2" FRP Angles

Tested by: Odd-Arne Hogset

Date: August 7, 2013

1. Scope

This test program was developed to determine pull-out strength of 1/4 - 20 x 1 1/2" self drilling screws (Dril-Flex part # AF876) and #12 - 14 x 1 1/2" self drilling screws (Fastenal part # 31819) in 4" x 1/2" FRP Angles.

2. Referenced Documents

ASTM D-6117 Standard Test Methods for Mechanical Fasteners in Plastic Lumber and Shapes.

3. Apparatus

Tinius Olsen Model 290 60,000lb tester, test fixture for pull-out strength of screws.

4. Test Specimens

10 pieces of 4" x 1/2" FRP Angles, all 8" long

5 fasteners of type 1/4 - 20 x 1 1/2" long self drilling screws (Dril-Flex part # AF876)

5 fasteners of type #12 - 14 x 1 1/2" long self drilling screws (Fastenal part # 31819)

5. Test Procedure

The screw was fastened to the center of the FRP sample as shown in Figure 1.



Figure 1. Fasteners and samples before testing (1/4 - 20 fastener left, #12 - 14 right).

The test fixture was attached to the screw and assembled in the Tinius Olsen tester (Figure 2). Load was applied at a speed of 0.10 "/min and a load-deflection curve and maximum load were recorded. The test was repeated for 5 specimens for both types of fasteners.





Figure 2. Pull-out strength test fixture and set-up.

6. Results

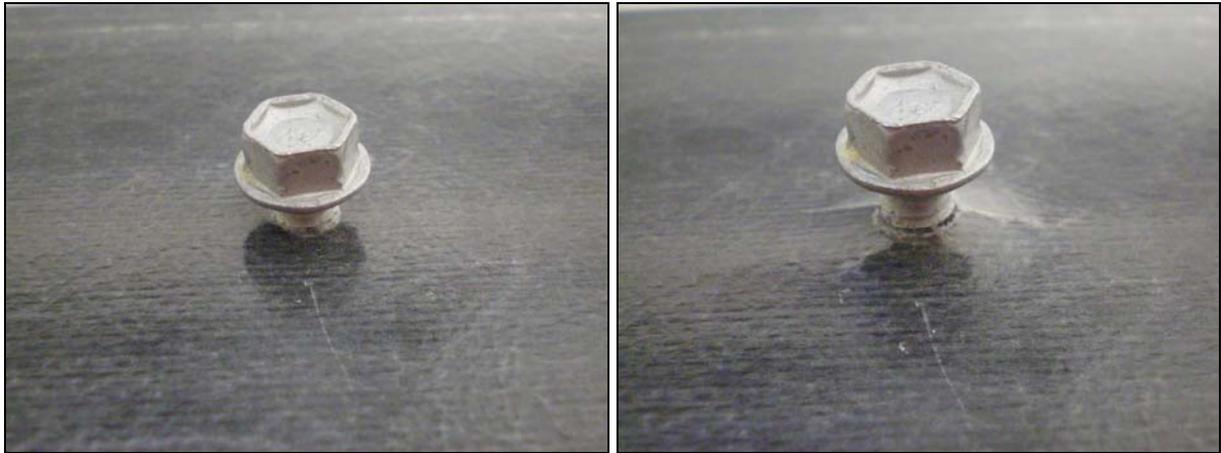
After testing, the samples showed two to four thin cracks extending about 1/4" out from the screw holes. There was also a slight separation (delamination) of the layers around the screw holes.

The average maximum pull-out strength was 2,260 lb for the 1/4 x 20 (Dril-Flex) fastener and 2,190 lb for the #12 - 14 (Fastenal) fastener. Detailed summaries and load/deflection curves are shown in Appendix B and C.

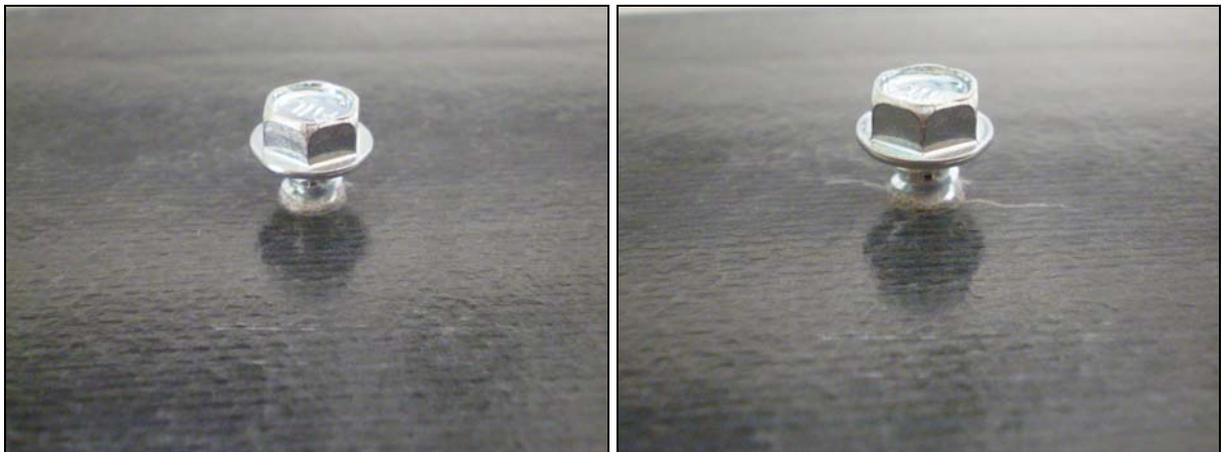
7. Conclusion

There are no noticeable difference in pull-out strength of the two types of fastener, 1/4 x 20 (Dril-Flex) and #12 - 14 (Fastenal).

Appendix A: Pictures of test samples.



1/4 - 20 x 1 1/2" fastener (Dril-Flex) before (left) and after test



#12 - 14 x 1 1/2" fastener (Fastenal) before (left) and after test

Appendix B: Test summary and load-deflection curves for 1/4 - 20 Fasteners (Dril-Flex).



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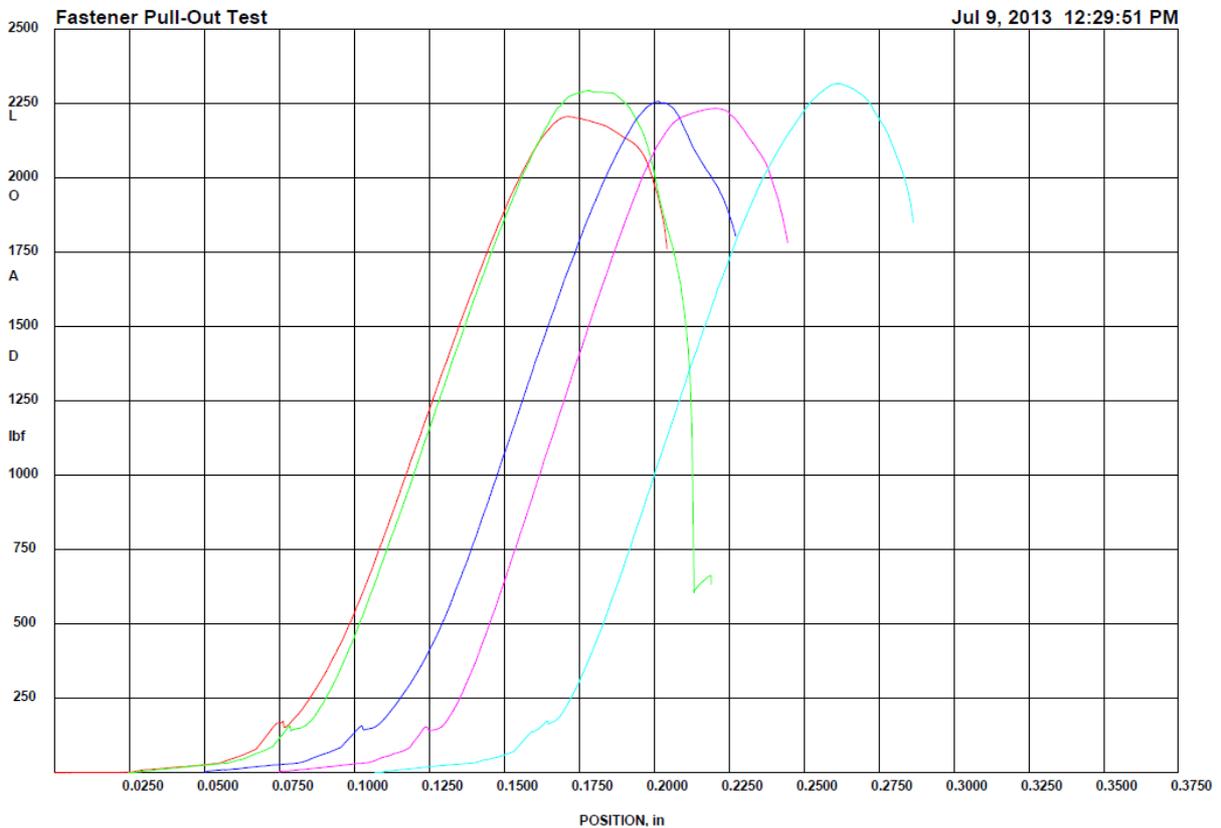


Fastener Pull-Out Test

Test Date:	07/09/2013	Test Setting:	Fastener Pull-Out
Part:	4" x 1/2" Angle	Test Speed, in/min:	0.10
Construction:	STD	Conditions:	81.4°F
Mix Number:	22-401 FR	Die Temp:	?
Color:	Gray	Production Speed:	?
Direction:	Z	Operator:	OH
Invoice Number:	Stock		
Production date:	?		

Test No.	Max Load lbf
1	2200
2	2290
3	2260
4	2230
5	2320
Average	2260
SD	44.4

Fastener type: Dril-Flex part # AF876, 1/4 - 20 x 1 1/2" self drilling screw



Appendix C: Test summary and load-deflection curves for #12 - 14 Fasteners (Fastenal).



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Fastener Pull-Out Test

Test Date:	07/09/2013	Test Setting:	Fastener Pull-Out
Part:	4" x 1/2" Angle	Test Speed, in/min:	0.10
Construction:	STD	Conditions:	84.5°F
Mix Number:	22-401 FR	Die Temp:	?
Color:	Gray	Production Speed:	?
Direction:	Z	Operator:	OH
Invoice Number:	Stock		
Production date:	?		

Test No.	Max Load lbf
1	2140
2	2100
3	2160
4	2310
5	2200
Average	2190
SD	79.7

Fastener type: Fastenal part # 31819, #12 - 14 x 1 1/2" self drilling screw

