FASTENER PULL-OUT CAPACITIES FOR HOBBS BUILDING SYSTEMS' "HOBBS WALL"

BY: DR. MAX L. PORTER, BRANDON O. VILAND

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IOWA STATE UNIVERSITY
AMES, IOWA

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ABSTRACT

The purpose of this research and testing was to determine the pull-out capacities of common fasteners used with the HOBBS Building Systems "HOBBS Wall" insulated concrete form system. The scope of the project included pullout capacity testing and analysis of four commonly used fasteners with this system. The furring assemblies to which the fasteners were secured were rigid Poly-Vinyl Chloride (PVC) with 2 ½ in. wide by ⅛ in. thick flanges.

The results of the pull-out testing yielded valuable conclusions about the effectiveness of fasteners used with the Poly-Vinyl Chloride furring assembly. Representative average pull-out capacities of 121 lbs for 1¼" x 6 coarse threaded screw, 166 lbs for 1⅝" x 6 coarse threaded screw, and 234 lbs for 3⅛" x 8 coarse threaded screw.

INTRODUCTION

The HOBBS Building Systems company was interested in investigating the pull-out capacity of commonly used fasteners associated with the wall furring assemblies. This report covers the testing of pull-out capacities of three fastener assemblies.

Full-Scale Fastener Pull-Out Test

The fastener pull-out test was conducted to determine the tension capacity of various screw type fasteners secured to the furring assembly. The test provided valuable insight into what fastener size and type would be most effective in securing to the furring.

Test Procedure

Upon completion of the flexural strength tests the fastener pull-out tests were conducted on the tested wall specimens. Conducting the pull-out capacity tests on the walls already tested for flexural capacity was determined to be adequate since the flexural tests did not affect the integrity of the PVC furring at all locations along the walls. The region of the wall from the support up to the loading locations was used for the pull-out tests.

A simple set-up was used for this test as the test required that we move the testing apparatus and loading ram after each trial. The apparatus used to pull the fasteners can be seen in the illustration of Figure 1.

Figure 1. Fastener Pulling Apparatus

Thick steel plates were used for the uprights and a thick plate with a hole in the middle was used to support the ram. The illustration of Figure 2 shows the apparatus used to test the fastener capacity. A threaded rod with a hook on the end was used to pull on the fastener testing apparatus by way of a rod run through both the steel loops.

Figure 2. Fastener Pull-Out Testing Set-up

The test was conducted numerous times using different screw types and enough times per screw type to come up with a representative average. The flanges of the furring

assembly vary in thickness from the web to the flange tip; thicker near the web. Therefore, as to best represent an average situation in the field; the tests were conducted with the fasteners secured at the mid-width of the flange.

Behavioral Results

The test proved valuable points as to whether screw length and thread characteristics will affect the pull-out capacity of the fastener and whether over-rotation of the fastener during installation will in fact increase the pull-out capacity.

The statement that over-rotating the screw will make it hold more securely was determined to be false. The idea behind this statement is that over-rotation will cause the material adjacent the screw to heat up and sort of fuse to the screw, thus, in a sense, gluing it into place. The simple geometry of a screw should be the first indication that this claim should not hold true; a screw acts as a drill and over rotation is just going to auger out the material that occupies the space between the threads and leave no material for the screw to secure to. This auguring characteristic was evident upon inspection of the hole left by the screw after pull-out; the screws that were just secured tightly left behind a mound of PVC material denoting that the extra material pulled up out of the hole was still intact whereas the screws that were over-rotated left a smoother surface behind leading you to believe the majority of the material had been removed prior to pull-out. After just a few trials it was quite apparent that over-rotation offers no benefit to the pull-out capacity of the screw, but rather decreases capacity.

Another finding is that coarse thread screws seemed to have a higher capacity than that of a similar fine threaded screw. Once again the idea is simple; a coarse threaded screw allows for more material between the threads and thus more material to

secure to. Very few tests were conducted on the fine threaded screws as the observation was made evident early on that the finer thread pattern decreases the capacity.

One finding that was quite interesting; of the coarse threaded screws, the longer fasteners had higher capacity than the shorter ones with very similar thread pattern. Since there is very nearly the same amount of furring assembly 'gripped' in each screw; and without a more in depth investigation, one may attribute this behavior to the fact that the longer screws propagate into the EPS foam and therefore engaging additional material to resist pull-out.

In a couple of the tests conducted the observation was made that the screw would initially give a little and then appeared to gain strength and obtain higher capacity. In this case one can presume that the leading thread slipped and then following threads caught the material and continued to hold; a sort of 'seating' of the screw.

Analysis of Fastener Pull-Out Test

There were a total of four screw types that were tested for pull-out capacity, although representative data was only valid for three of these; 1 ¼" x 6 coarse dry-wall screw, 1 ⅝ x 6 coarse construction screw, and 3 ⅛ x 8 coarse construction screw. The three fasteners can be seen in the following illustration, Figure 3. These three were considered to have 'representative' results since there was at least three successful tests conducted with the controls the same.

Figure 3. Tested Fasteners

For the 1 ¼" x 6 coarse dry-wall screw the test was conducted securing the screw without over-rotation at the mid-width of the furring assembly flange; resulting in an average pull-out capacity of 121 lbs. The 1 ⅝" x 6 coarse construction screw was also conducted by securing the screw without over-rotation at the mid-width of the furring assembly flange; this screw yielded an average pull-out capacity of 166 lbs. The final screw type, 3 ⅛" x 8 coarse construction screw, was tested just as the others were with the same controls; this screw had at average pull-out capacity of 234 lbs. The detailed results can be seen in the following Table 1 and a plot of the average values for the screw types tested can be seen in Figure 4. The column graph in Figure 4 provides a visual of how the average capacities were found to increase with the screw length. Additionally, Figure 5 is a column graph displaying the individual capacities reached for each of the screw types during each trial performed.

Table 1. Fastener Pull-Out Capacity Results

Fastener Number	Fastener Description	Trial No.	Load Initial (lb)	Load Max (lb)	Additional Notes	Max Average (lb)
1	(1 1/4)" x 6 Coarse Thread Dry-Wall Screw	1	101	119	tightened "snug", center of "flange"	121
		3	-	126	tightened "snug", center of "flange"	
		3	96	118	tightened "snug", center of "flange"	
3	(1 5/8)" x 6 Coarse Thread Const. Screw	1	-	123	tightened "snug", center of "flange"	166
		2	-	190	tightened "snug", center of "flange"	
		3	-	186	tightened "snug", center of "flange"	
4	(3 1/8)" x 8 Coarse Thread Const. Screw	1	-	238	tightened "snug", center of "flange"	234
		2	-	215	tightened "snug", center of "flange"	
		3	-	249	tightened "snug", center of "flange"	

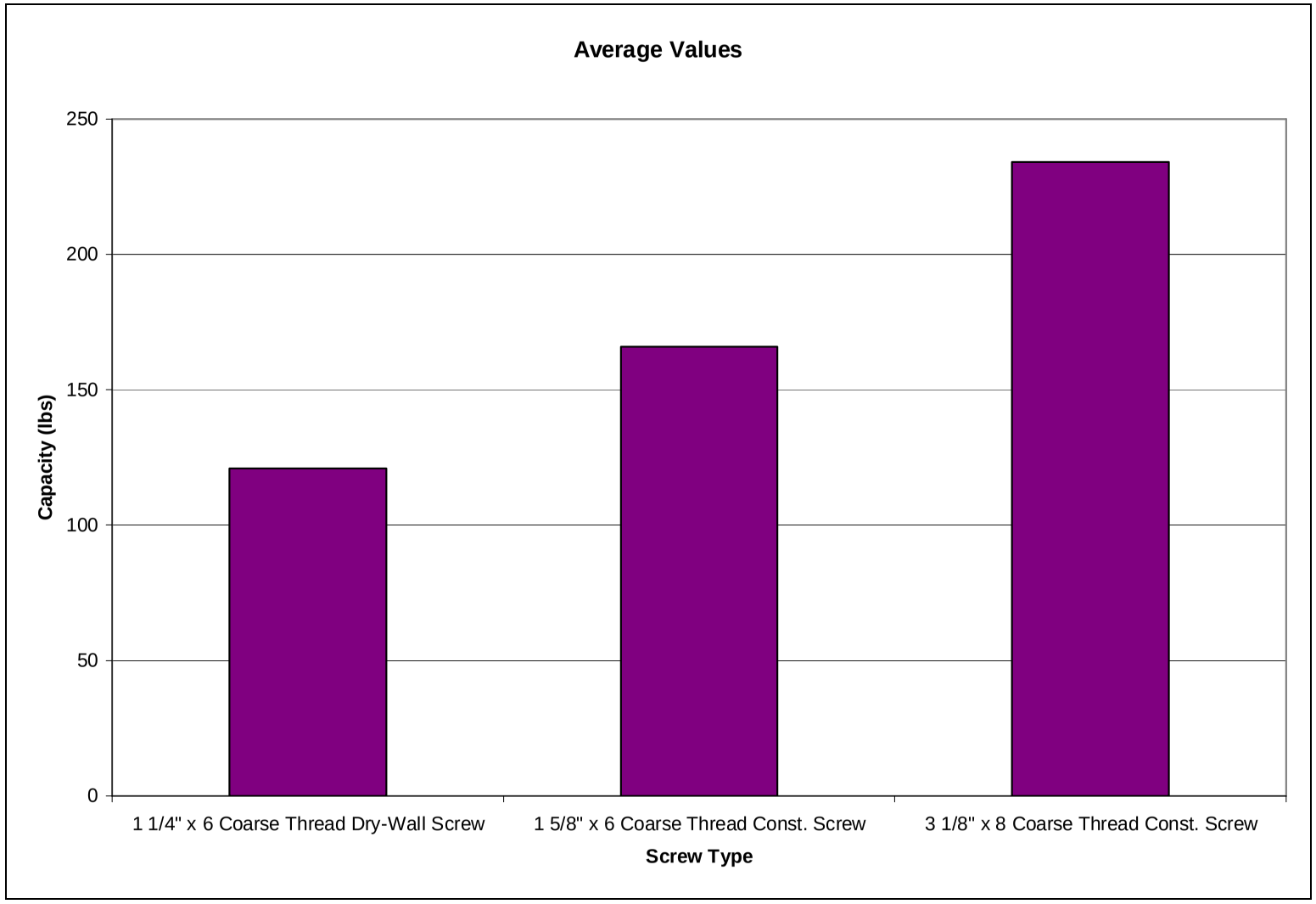

Figure 4. Average Pull-Out Capacity

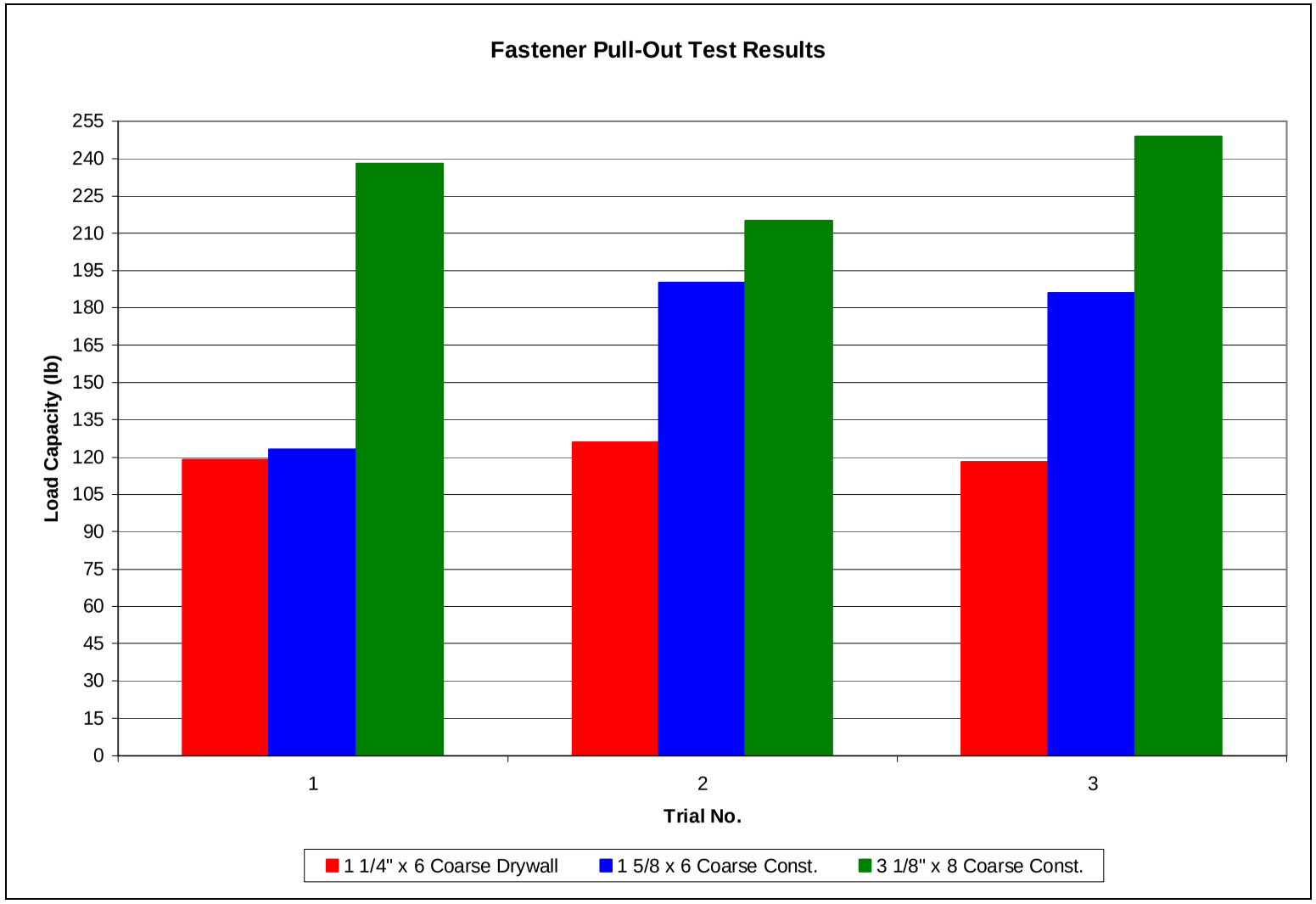

Figure 5. Fastener Pull-Out Test Results

SUMMARY AND CONCLUSIONS

The conducted tests offered insight into the pull-out capacity of various fasteners typically used to secure to the furring assemblies of the wall system. The pull-out capacity of the fasteners was based off the average of three tests for three different screw types.

The pull-out capacity tests revealed that coarse thread screws were capable of higher capacity against pullout than that of fine thread screws, and of the coarse thread screws the longer screws were capable of higher capacity than shorter screws of comparable thread pattern. For the coarse thread screws the highest capacity was reached with a 3 ⅛" x 8 construction screw, yielding an average of 234 lbs. Likely, a contractor on the job will use a shorter screw to fasten interior dry-wall or any type of exterior cladding to the ICF wall; more similar to the 1 ¼" x 6 coarse dry-wall or the 1 ⅝" x 6 coarse construction screws that were tested, which yielded average capacities of 121 lbs and 166 lbs, respectively.

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