

July 7, 2003

Mr. Jimmie Linn
Structural Northwest, LLC.
408 Union Street
Boise, ID 83702

Dear Mr. Linn:

Windborne missile impact tests were performed on one of Structural Northwest's Textured Wall Panels. The windborne missile impact tests were performed using the Wind Load Test Facility's air canon and a Decatur Electronics, Inc. Genesis-I radar gun. The tests were performed at the Wind Load Test Facility in Clemson, South Carolina. The purpose of the testing was to investigate the resistance of Structural Northwest's textured wall panels to Large Missiles as specified in the Florida Building Code, ASTM E 1996, and the SBCCI standard, SS TD 12. In addition, missile speeds were increased beyond those normally used for hurricane protection to investigate the resistance of panels to missiles that are more in line with those specified for tornado missile protection.

Background:

The largest missile specified in the Florida, ASTM and SBCCI standards is a 9 pound 2x4 piece of lumber. The missile is projected at the test object using an air canon and strikes the test object end on, perpendicular to the surface. For all buildings, other than essential facilities (hospitals and hurricane shelters), the missile impact speed specified for regions with the highest design wind speeds in the US is 50 feet per second (34 mph) in all three standards. ASTM E 1996 specifies a missile impact speed of 80 feet per second (55 mph) for essential facilities located in regions with the highest design wind speeds in the US. The test protocol requires that specimen resist impacts in the middle of the panel and in a corner of the panel. In order for a product to pass the test, the Florida Building Code's impact standard allows no penetration of the wall.

Structural Northwest's textured wall panel was constructed using a patented textured 1/2-inch thick exterior wall material backed up by a 0.040-inch thick corrugated steel panel with 3-inch deep corrugations. The nominal wall thickness is 3-1/2 inches. The single panel provided for debris impact tests was 36-inches wide by 96-inches tall.

Before testing began, several Southern Yellow Pine (SYP) 2x4 boards were weighed and cut to produce missiles with weights of 9 lbs. (+/- 0.1 lbs.). The Genesis-I radar gun was

calibrated with two tuning forks provided by Decatur Electronics, Inc. The wall panel was placed so that it was braced against a wood frame that spanned between two concrete columns and contained a cutout where the missiles impacted the specimen. The frame provided a rigid brace near the top of the specimen and provided at least as much restraint as that provided by a roof or floor diaphragm. Rigid supports ensure that the impact loading of the missile is properly transferred to the panel system.

Panel Tests:

Tests were conducted with multiple impacts of 9-pound 2x4s on the panel. The first impact on the textured wall panel was with a missile speed of 34 mph. The missile penetrated the textured surface but only generated a ½-inch depression in the steel panel. The second impact was at 22 mph and the impact resulted in penetration of the textured surface. It impacted one of the ridges in the steel panel and created about a ¼-inch indentation in the steel panel. Subsequent shots were made at increasingly higher missile speeds until a speed of 91 mph was reached with the 9-pound 2x4. As the missile speed increased, the indentations became increasingly larger but were still confined to a local area around the impact location. A final impact was made with a 15-pound 2x4 traveling at 100 mph (this missile size and speed is in line with the FEMA National Specification for Tornado Missile debris impacts). In all of these tests, the overall deflection of the steel panel was less than 2.5 inches. The final impact with the 15-pound 2x4 at 100 mph was a corner shot that did cause local buckling of the steel panel and a significant amount of local crumpling. However, the missiles never penetrated the steel panel in any of the shots. Since only one panel was available, it was not possible to assess the impact resistance afforded a shot that hits on the seam between two panels. Figure 1 illustrates the impact locations of the missiles and Figure 2 shows damage to the textured material caused by typical missile impacts.

Impact Tests of Structural Northwest Textured Wall Panel

Test Number: Single Panel			
Panel Type: Textured 1/2-inch thick panel with 0.040" thick corrugated steel panel backup			
Panel Layout: 3' x 8' Panel Strong Axis in 8' direction	Nailing Schedule and Location: NA		
Missile Impact: <input type="checkbox"/> None <input checked="" type="checkbox"/> 2x4 <input type="checkbox"/> Clay Tile	Pressure Test: <input checked="" type="checkbox"/> None <input type="checkbox"/> Monotonic to Failure ___ psf failure <input type="checkbox"/> Cyclic _____ Design Wind Speed _____ Number of Cycles to Failure		
Results of Missile Tests:			
Impact #	Missile Weight	Missile Speed	Damage Observation
1	9-lb	34 mph	Perforated textured surface, indented steel panel 1/2-inch
2	9-lb	22 mph	Perforated textured surface, indented steel panel 1/4-inch
3	9-lb	38 mph	Perforated textured surface, indented steel panel 1/2-inch
4	9-lb	49 mph	Perforated textured surface, indented steel panel 1 & 1/2-inch
5	9-lb	59 mph	Perforated textured surface, indented steel panel 1-inch
6	9-lb	76 mph	Perforated textured surface, indented steel panel 2 & 1/2-inch
7	9-lb	91 mph	Perforated textured surface, indented steel panel 1 & 3/4-inch
8	15-lb	100 mph	Perforated textured surface, indented steel panel 1/2-inch

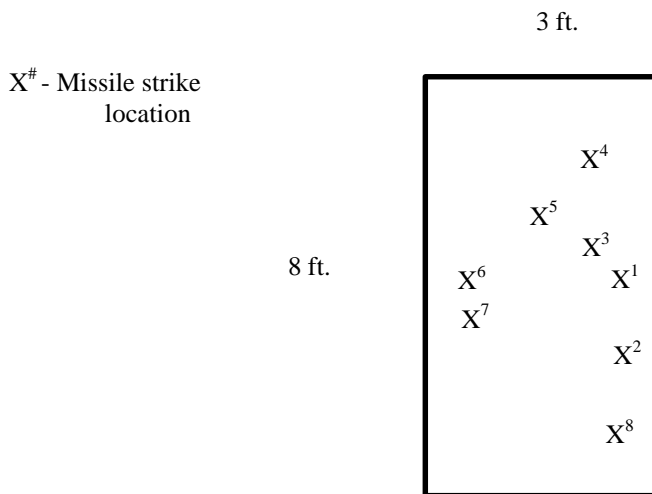


Figure 1. Location of 2x4 Lumber Missile Impacts



Figure 2. Photograph Showing Typical Missile Damage to Textured Surface Layer

Summary:

A single specimen of Structural Northwest's textured wall panel was impacted with 8 2x4 lumber missiles impacting end-on against the textured surface of the panel. The first seven shots were made using a 9-pound 2x4 missile and impact velocities were varied between 22 and 91 mph. In every case, the missile penetrated the textured surface material but was stopped by the steel backing panel. The wall even resisted the impact of a 15-pound 2x4 missile with an impact velocity of 100 mph without allowing penetration of the missile.

A CD Rom is being transmitted with this letter. The CD contains digital copies of pictures taken during the tests as well as digital footage of the impact tests.

If you should have any questions about the tests or results, please do not hesitate to call.

Sincerely yours,

Timothy A. Reinhold, Ph.D.
Associate Professor
Director, Wind Load Test Facility