SAFE ROOMS AND TORNADO PROTECTION

Several years ago, we received numerous inquiries from design professionals about the potential use of ArmorCore® Bullet Resistant Panels for the construction of “safe rooms” for protection during hurricanes and tornados.

Waco Composites, Ltd. contacted the Wind Engineering Research Center at Texas Tech University, a testing center that partners with the Federal Emergency Management Agency (FEMA) to test many different building materials for their suitability to withstand wind damage from hurricanes and tornados.

Of particular interest is the ability of a given material to defeat or resist “missiles,” which refers to debris and other objects picked up by the wind and moved with enough force to damage and even penetrate windows, doors, walls and other parts of a building. The stronger the wind, the larger and heavier the missiles it can carry, increasing the risk of severe damage.

ArmorCore® UL 752 Level 3 panels (1/2” thick and 5.0 lbs per sq. ft.) at 4’ x 4’ were submitted to the Wind Engineering Research Center at Texas Tech University for testing to see how well they could resist an airborne missile typical of an F5 strength tornado. The results clearly indicated that ArmorCore® bullet resistant panels are well suited for safe room construction, provided the overall structural system that supports the ArmorCore® panels is adequate.

Following is the project report on the Investigation of Wind Projectile Resistance of Waco Composites, Inc. ArmorCore® UL572 Level 3 Panels. Videos of the actual test are available upon request.

ARMORCORE

BULLET RESISTANT FIBERGLASS PANELS

Project Report on:

INVESTIGATION OF WIND PROJECTILE RESISTANCE OF WACO COMPOSITES, INC. ARMORCORE® UL 752 LEVEL 3 PANELS.

Submitted to:

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October 3, 1999

OVERVIEW

Waco Composites initiated contact for testing of ArmorCore® UL752 Level 3 by the Wind Science and Engineering (WISE) Research Center at Texas Tech University to assess the missile shielding ability of the composite panels. The panels were 4' x'4' x ½" mounted to wood studs spaced at 16" on center. The panels were attached to the studs with 3" x ¼" diameter self-tapping screws spaced at 6" on center the length of the studs. The panel was placed in front of the reaction frame and impacted with the tornado test missile. The specifics about each test and results follow.

The missile criterion used for the tests was a 15 pound 2x4 in. wood stud traveling along the board's longitudinal axis, striking the panel perpendicular to the panel face. The tornado test criterion uses this missile traveling at 100-mph which corresponds to a 250-mph wind and is the criterion used in designing for occupant protection. Additional margins of safety are inherent in the criterion since there is a very small probability that a missile will be traveling along its axis and will strike a wall perpendicular to its surface.

MISSILE SHOT 1 – 101.0 mph

The missile impacted near the center of the panel between the studs. The panel had a permanent deformation 1/4” (0.25 inches) at the point of impact. The panel began to delaminate as indicated by the lines of delamination originating from the point of impact. The non impact surface began to show signs of delamination. This was concentrated from the point of impact to the screw at the bottom of the panel.

MISSILE SHOT 2 – 102.6 mph

The missile impacted the same place as Missile Shot 1 in order to determine the ability of the material to resist the missile after delaminiation of the panel had occurred. The impact propogated the expansion of the delaminated line evident in the region of the impact surface. Other areas of delamination away from the point of impact also began to be more evident.

CONCLUSIONS

The ArmorCore® UL752 Level 3 panel is able to resist perforation of the 15 pound 2x4 traveling at 100 mph. Further testing would be required to determine the minimum number of layers of weave required to resist the missile. The amount of energy transferred from the panel to the main structural system caused the wood studs to split and break. For a structure clad in ArmorCore® to resist the combined effects of debris impact and severe wind load, a stronger structural system will be required. Once a structural system is designed, testing would be performed to determine the system meets debris impact performance criteria.