Wind Science & Engineering Research Center
Debris Impact Test Facility
P.O. Box 41023
Lubbock, Texas 79409-1023

Report No. _20111020A
Specimen No. _Multiple____
Test Date: _Oct. 20, 2011_

1.0 MANUFACTURER'S IDENTIFICATION

1.1 NAME OF APPLICANT: **CEM Wall**
1516 20th Street South
Birmingham, AL 35250

1.2 CONTACT PERSON: **Mr. Joe M^{c}Clure**

1.3 TEST LAB CERTIFICATION: Federal Emergency Management Agency (FEMA) and the ICC-500 Shelter Standard; ISO 17025 certified tests available.

2.0 TEST UNIT IDENTIFICATION

2.1 PRODUCT TYPE: **Series 1 & Series 2 - Tornado Panels**
2.2 MODEL NUMBER: Unavailable
2.3 CONFIGURATION: Tornado Panels
2.4 SAMPLE SIZE: 4-ft. x 4-ft.
2.5 PANEL UNITS: 4-ft. x 4-ft.
2.6 DOOR ASSEMBLY: N/A
2.7 DRAWINGS: N/A

3.0 TEST UNIT DESCRIPTION

3.1 ASSEMBLY CONSTRUCTION:

3.1.1 **Series 1 Panel:** Composite wall system (6 3/4-in thick) with fiber cement board attached to metal edge channels and the cavity poured with 4000 psi pea gravel concrete. The concrete is reinforced with #4 rebar at 12-in. on center each way, held in place with PVC spacers glued to the back cement board panel.

3.1.2 **Series 2 Panel:** Composite wall system (4 3/4-in thick) with fiber cement board attached to metal edge channels and the cavity poured with 4000 psi pea gravel concrete. The concrete is reinforced with #4 rebar at 12-in. on center each way, held in place with PVC spacers glued to the back cement board panel..

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4.0 TEST RESULTS

4.1 SCOPE: Conduct Missile Impact Test on Above Ground Shelter Assembly

4.2 SUMMARY OF RESULTS:

Test Method	Test Conditions	Test Conclusion
Missile Impact Test FEMA 320 & ICC-500 – Tornado Protocol 4, See Appendix A	15-lb. 2 x 4	The Series 1 & 2 panels passed the 100 mph impact test.

4.3 OUTDOOR WEATHER CONDITIONS:

Temperature	84 degrees
Wind	20 mph
Relative Humidity	92 %

4.4 MISSILE IMPACT TEST RESULTS:
Missile Type: 2 x 4
Missile Weight: 15 lb.
Missile Impact Speed: 100 mph

Impact Tests

Spec. / Impact No.	Velocity (mph)	Location	Results
1 / 1	100	Impact upper right corner	Unremarkable damage; no backside damage; see photos, pages 5 & 6.
1 / 2	100	Impact center	Unremarkable damage; no backside damage; see photos, pages 7 & 8.
1 / 3	100	Impact lower left corner	Unremarkable damage; no backside damage; see photos, pages 9-11.

2/1	101	Impact lower left corner	Unremarkable damage; no backside damage; see photos, pages 12 & 13.
2/2	102	Impact center	Unremarkable damage; no backside damage; see photos, pages 14 & 15.
2/3	102	Impact upper right corner	Unremarkable damage; no backside damage; see photos, pages 16-18.

5.0 CONCLUSIONS

Within the bounds of reasonable engineering and technical certainty, and subject to change if additional information becomes available, the following is my professional opinion:

Impact tests were conducted on October 20, 2011 on two series of tornado panels for CEM Wall. The impact tests on both series of panels (6 3/4-in. and 4 3/4-in. thick) were successful and therefore meet the debris impact guidelines of FEMA 320 and ICC-500 for 100 mph impacts produced by a missile propelled by a 250 mph tornado. A previous test on a thinner panel was conducted on October 6, 2011 with unsuccessful results. All tests were conducted in strict accordance to the guidelines of FEMA 320/361 and ICC-500. Refer to Appendix A for test protocols.

Any alterations made to the shelter design or construction must be approved or retested by WISE at Texas Tech University.

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Engineer of Record
Larry J. Tanner, P.E.