Technical Bulletin

MISSILE CRITERIA for TORNADO SHELTERS

Wind-Borne Debris

This bulletin provides a summary of a **Celcore Roof Deck Insulation System** placed upon a **structural concrete deck** and tested in accordance with ASTM E1886 as referenced in 2023 ICC 500, and tested per Chapter 3, Section 305 - Hazardous Debris and Chapter 8, Section 803 - Impact Testing. The objective of this testing is to establish laboratory data for a Celcore Roof Deck Insulation System when subjected to impact loading for tornado shelter design. The summary assembly and results recited herein are drawn from NEMO|etc., Laboratory Report 4g-JM-LSIMP-001.A.

ICC 500, Section 305.1.1 - Missile criteria for tornado shelter. The missile testing for all components of the storm shelter envelope for tornado shelters shall be a 15-pound (6.8 kg) sawn lumber 2 by 4 traveling at the speeds shown as follows:

Tornado Wind Speed Design[1]	Missile Speed & Impact Surface[1]	
130 mph	Vertical 80 mph	Horizontal 53 mph
160 mph	Vertical 84 mph	Horizontal 56 mph
200 mph	Vertical 90 mph	Horizontal 60 mph
250 mph	Vertical 100 mph	Horizontal 67 mph

1. Source: 2023 ICC 500, Chapter 3, Section 305, Table 305.1.1

Description of Tested Assembly:

Celcore Roof Deck Insulation System and Structural Deck[1]	
Structural Deck	Min 4" thick, min 2500 psi Structural Concrete deck w/ #6 reinforcement bars space 6" in both directions
Deck Treatment	None
Adhesion Concrete	Celcore MF Cellular Concrete w/ Celcore HS RMA applied to the structural deck at minimum 1/8" to 1/4" thickness
EPS Insulation	Minimum 1" thick, Type 1 EPS holey board set into the wet adhesion concrete and allowed to set overnight
Roof Deck Topping	Celcore MF Cellular Concrete w/ Celcore HS RMA with a cast density of 42-44 pcf at a minimum 2" thickness
Curing	After an overnight set, Celcore PVA Curing was applied at a rate of 0.3 gals per square - 28 day pretest curing

1. Source: NEMO | etc, Laboratory Report 4g-JM-LSIMP-001.A - Test sponsor, Johns Manville

The above described 4' x 6' assembly was stood vertically to receive the impact missile. A kraft paper screen was positioned 5" from the assembly's underside to detect any spall or fastener deflection. The sample received [2] impacts, one center and one corner. The impact missile speed received during the testing was 71 - 67 mph.

Summary of Test Results

250 mph Wind Speed Impact Test Data for Horizontal Surface[1]						
Perforation	Field	**Pass**	Corner	**Pass**	No perforation to interior	**Pass**
Dislodgement Disengagement	Field	**Pass**	Corner	**Pass**	Fasteners shall not penetrate the kraft paper screen	**Pass**
Spall	Field	**Pass**	Corner	**Pass**	Excessive spall shall not penetrate the kraft paper screen	**Pass**

1. Source: NEMO | etc, Laboratory Report 4G-JM-LSIMP-001.A - Test sponsor, Johns Manville