SurvivalRing

Study Yesterday . . Prepare Today . . Live Tomorrow

This digital document created and presented by Richard Fleetwood. He is the founder, author, producer, and webmaster of the **SurvivalRing** *(http://www.survivalring.org)* and **Civil Defense Now!** *(http://www.survivalring.org/cd-main.htm)* websites.

SurvivalRing has as its goal the ideal of being the leading source of survival, preparedness, and self reliance information on the Internet. Linkage, assistance, and creation of digital content in areas that until now have only been hinted at or impossible to find, is being added to everyday via the Survival-Ring website and email lists.

Thousands of hours of searching, writing, and communications have been spent collecting over 2 gigabytes of digital content, as well as tens of thousands of pages of hard copy original public domain material in the areas of civil defense, survival, training, and preparedness, from all over the globe. As much as possible is being put online at his website at

http://www.survivalring.org

Civil Defense Now!

Part of The SurvivalRing website

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There are too many situations and incidents that can come to pass in everyday life, that when time is taken to learn and skills obtained, can mean the difference between life and death. Sept. 11, 2001 proved to the world that no matter how safe a person thinks they may be, death and injury can come from the most UN-LIKELY place, at any time. The documents presented in this series of digitized works, can help the average person with the knowledge within, to know how to save those persons closest to them in REAL disaster. Help spread this idea of sharing SURVIVAL INFORMATION.

If you have documents from any era, on any disaster or civil defense area, PLEASE contact Richard at his email address of **RAFLEET@AOL.COM**. Check the website for the LATEST additions to the CIVIL DEFENSE NOW online library archive. All data online, and much more, is also available on CD-ROM. Information is available at the website on how to obtain it. Thanks for your support, and enjoy the information contained on the following pages. Share them with those who will learn from them and teach what they know to others.

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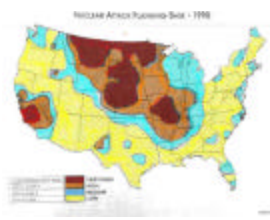

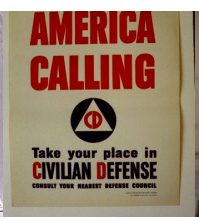

Appendix G
Design Guidance on Missile Impact Protection Levels for Wood Sheathing

Reinforced concrete and reinforced masonry have been the most common wall and roof materials used with success in non-residential shelters. The use of wood panels for exterior wall sheathing in non-residential shelter applications had been limited. This appendix provides limited information on wood panel testing that has been performed for both hurricane and tornado shelter applications.

Data from the missile impact tests on walls with plywood and oriented strand board (OSB) sheathing conducted at Texas Tech University (Carter 1998) and at Clemson University (Clemson 2000) have been combined to determine the variation of missile perforation resistance with thickness of the sheathing. In order to put all the data on a consistent basis, missile weights and lowest impact velocities for perforation of the sheathing have been extracted from previous test results. The weight and impact velocity information were used to calculate the impact momentum {weight (lb) x velocity (ft/sec) / acceleration of gravity (32.2 ft/sec2) = momentum (lb/sec)} and the impact energy {weight (lb.) x velocity squared (ft/sec) 2 / acceleration of gravity (32.2 ft/sec2) = energy (ft/lb)}. The resulting impact momentum and impact energy for perforation of the sheathing are plotted as a function of sheathing thickness (in 1/32 inch) in Figures G-1 and G-2.

The momentum required for a wood 2x4 missile to cause perforation varies essentially linearly with thickness of the sheathing material for both plywood and OSB. This suggests, at least for this type of missile and common sheathing materials, that a desired target penetration resistance (ability to resist a certain impact momentum) can be achieved by simply adding up the contributions of the various layers of sheathing. For example, in Figure G-1, sheathing with a 30/32-inch thickness represent two layers of 15/32-inch material.

Figure G-1
Variation of impact momentum required for missile penetration vs. wall sheathing thickness.

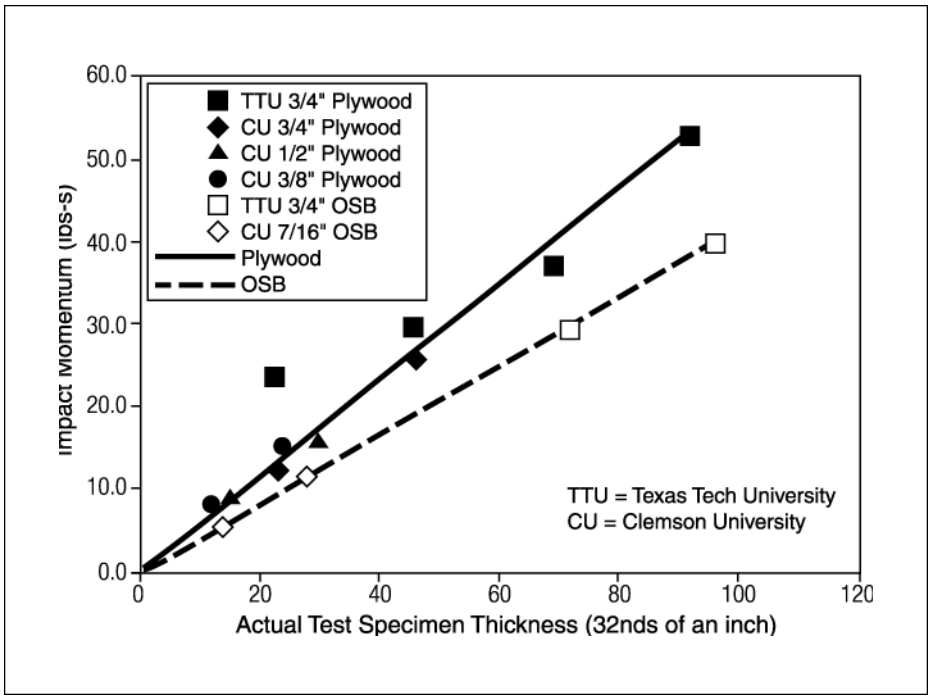

Figure G-2
Variation of impact energy required for missile penetration vs. wall sheathing thickness.

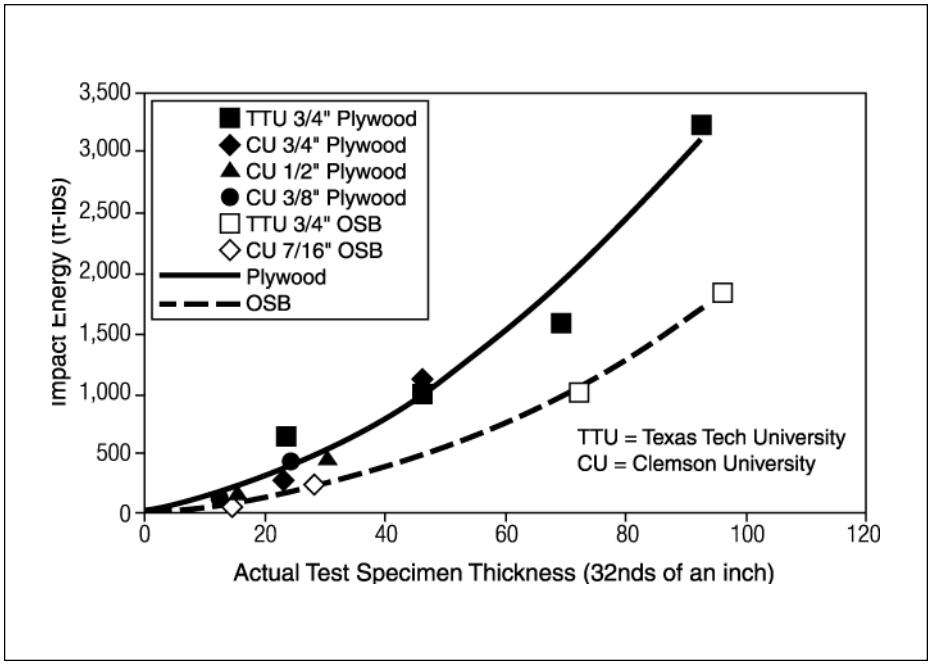

Figure G-3 provides information on the relative resistance of various common sheathing materials, in terms of impact momentum absorption, for a compact impact area such as that associated with a wood 2x4 missile impacting perpendicular to the sheathing material. Summing the momentum resistance of the various layers of common sheathing materials is permissible when developing initial design criteria for walls that provide adequate protection. However, this process may not work for other types of missiles or for wall materials that absorb impact energy by undergoing large deformations (i.e., corrugated metal panels).

For the design missile of this manual (a 15-lb wood 2x4 missile with a horizontal impact speed of 100 mph), the corresponding momentum is approximately 68 lb/sec. For vertical impacts, the impact velocity is reduced to 67 mph and the corresponding momentum is approximately 46 lb/sec.

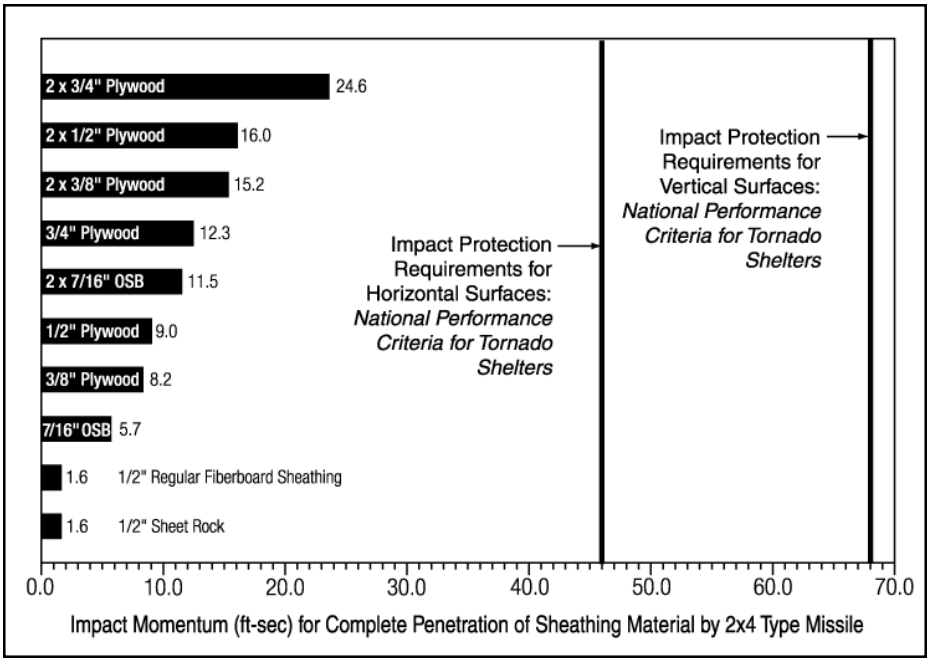

Figure G-3
Impact momentum required for a 2x4 wood missile to penetrate various common sheathing materials (impact perpendicular to sheathing surface). Note: All wood products provide less than half the required impact momentum resistance needed to meet the horizontal surface impact resistance required by the *National Performance Criteria for Tornado Shelters*.