PROTECTION FROM WINDBORNE DEBRIS
TESTING IS IMPORTANT!

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Mayflower, AR door failure

Brought new awareness to importance of appropriate door selection

Mayflower a “Perfect Storm” Situation

- Installation of an inadequate, untested door
- Inward swinging, away from the stops
- Debris impact at critical location
  - Unusual missile though not thought to be extraordinary
  - Occupants in contact with door or close to it

Consequences:
- One occupant killed, apparently from head injuries
- Second occupant injured with broken bones, lacerations

NSSA/TTU
Door performance demonstration

- Phase 1. Perform forensic analysis on failed Mayflower door

Completed

Findings

- 3' wide x 6'-8" high x 1-3/4" thick
- 18 gage steel skin; 16 gage edge channel 1-11/16" x 5/8"
- Lapped, projection-welded edges, 3" o.c. top and bottom, 5" o.c. on edges
- 8" concrete masonry walls; 18 gage wrap-around frame
- Three Residential Grade dead bolts and a latch set

Good quality hollow-core steel door, but not suitable for tornado safe room application

NSSA/TTU
Door performance demonstration

- Phase 2. Perform demonstration tests; document successful and failed performances under
  - Pressure, Debris Impact

Completed series of tests

- Journal publication in preparation
- Videos planned for NSSA websites

NSSA/TTU
Door performance demonstration

- Phase 3. Show ways to improve performance of inadequate doors, already installed

No conclusive results

- Perforation can be averted by adding to thickness
- Preliminary research using cross bars was not successful

More research into alternative improvements is needed
Public funding required
**Demonstration door testing project**

- Demonstrated failure modes
  - Perforation
  - Structural
    - Bending
    - Folding
  - Hardware
    - Latches
    - Hinges

**Modes of failure**

- Metal Clad Wood Frame door
- Residential Grade 1 hardware

Failed pressure test
Impact knocked entire door out of frame

**Demo 3**

- 18 gage metal door open cell Styrofoam Core;
- Heavy Duty Hinge Reinforcement;
- Residential Grade 1 hardware

Successful Demonstration

- 14 gage HM Door & frame with vertically stiffened core, reinforced frame, strike boxes, lock boxes; Commercial grade 1 locks; HD hinges

Door passed pressure and debris impacts

**Mitigation attempt**

- 16 gage Hollow Metal door, 16 gage hollow metal frame, Styrofoam Core with 3 deadbolts and 1 latch, commercial grade 2 hardware
- 3 crossbars

Passed pressure test
Top crossbar ejected and top corner folded

**Modes of failure**

- Metal clad Wood 6 Panel Hurricane Impact Resistant Door
- Residential Grade 1 hardware

Failed pressure test
Perforation of each of 3 impacts

**Demo 3**

- 18 gage metal door open cell Styrofoam Core;
- Heavy Duty Hinge Reinforcement;
- Residential Grade 1 hardware

Passed pressure test
Impacts destroyed top 2 locks and folded top corner
Guidance available

- Consult FEMA Fact Sheet
- Purchase only doors that can be shown to be tested or that bear a ‘tested’ label
- See list of tested doors
  - UL Laboratories
  - Texas Tech Debris Impact Facility
  - Comprehensive listing forthcoming

“There is no substitute for a tested tornado safe room door.”

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