Safe Haven Door Evaluation Under Blast Loading

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Outline

- Project Summary
- Safe Haven Wall Specific Work
- Background
- Status
- Plan Forward

Project Summary

- Research, Technology and Human Interventions for Self-Escape in Underground Mine Emergencies
  - NIOSH Contract 75D30120C08913
  - 36 Months
- Intelligent Communication for Efficient Self-Escape
- Initiative to Empower Miners for Self-Escape
- **Advancing Refuge Alternatives in Mine Emergencies**
- Underground Mine Fire Emergency Evacuation Optimization

Advancing Refuge Alternatives in Mine Emergencies

- Specifically, looking at Refuge Alternative Doors and their performance under blast loading
- 5 Tasks (summarized)
  1. Obtain Doors and Determine where to Position Them
  2. Construct Reaction Structure and Dial in Explosion
  3. Test Doors
  4. Computer Models
  5. Provide Design Recommendations

Background

- Relatively easy to computationally determine thicknesses of plates, supporting members, etc. to resist a pressure vs. time curve
- Much more difficult to determine how the “fine” mechanisms will respond
  - Locks
  - Handles
  - Hinges
  - Seals
  - Etc.

Previous Experience

- Similar experience in testing blast resistant windows
- Often, the glazing and frame perform fine, but the locking mechanism and hinges (depending on window type) would fail
- These are often overlooked, but are necessary to be robust enough to ensure the safe haven remains accessible and air-tight

Doors of Interest

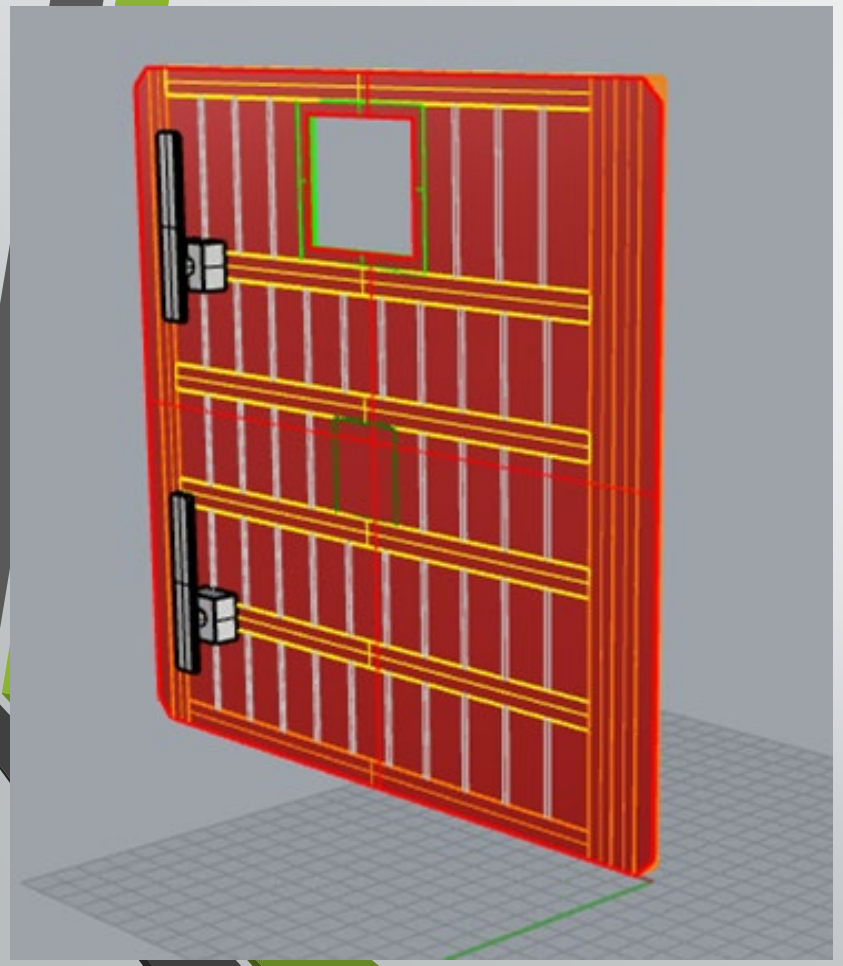
- Kennedy Metal Products
- Aurora Manufacturing

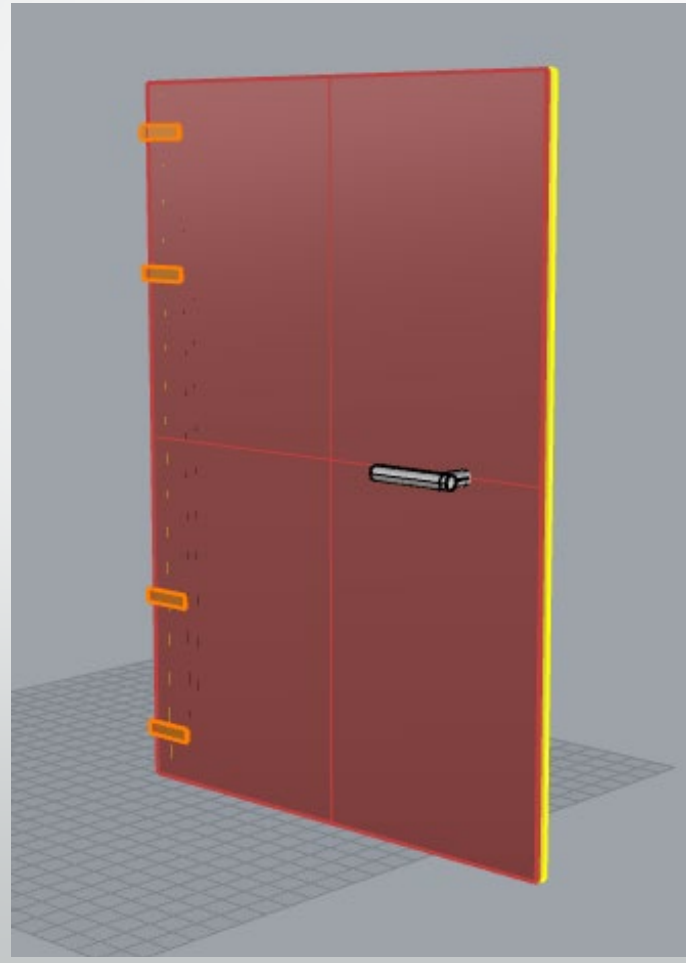
Kennedy Door

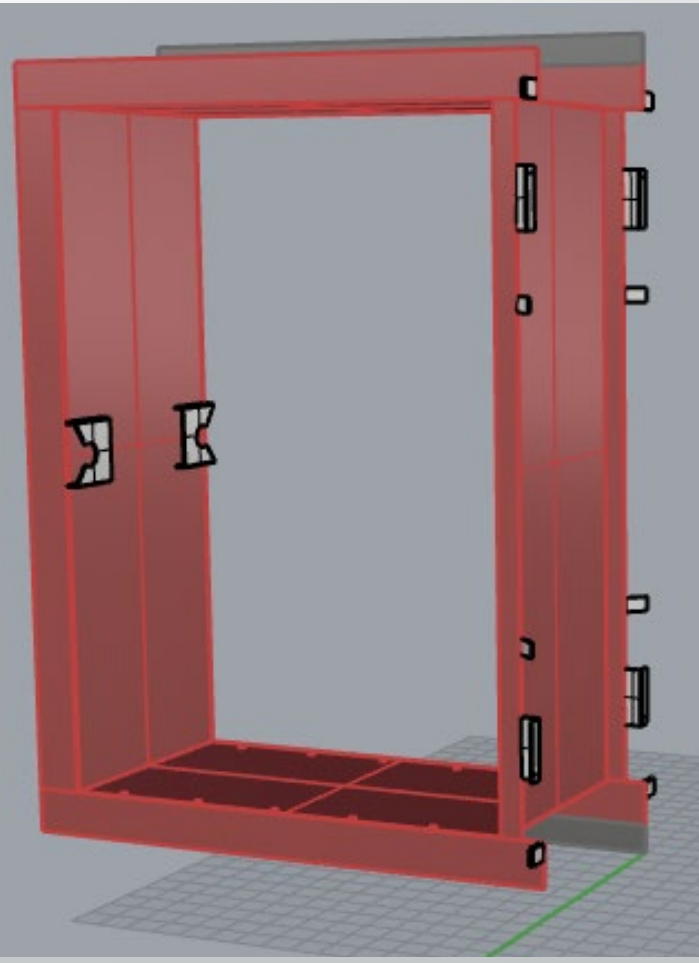
Aurora Door

- Courtesy of NIOSH

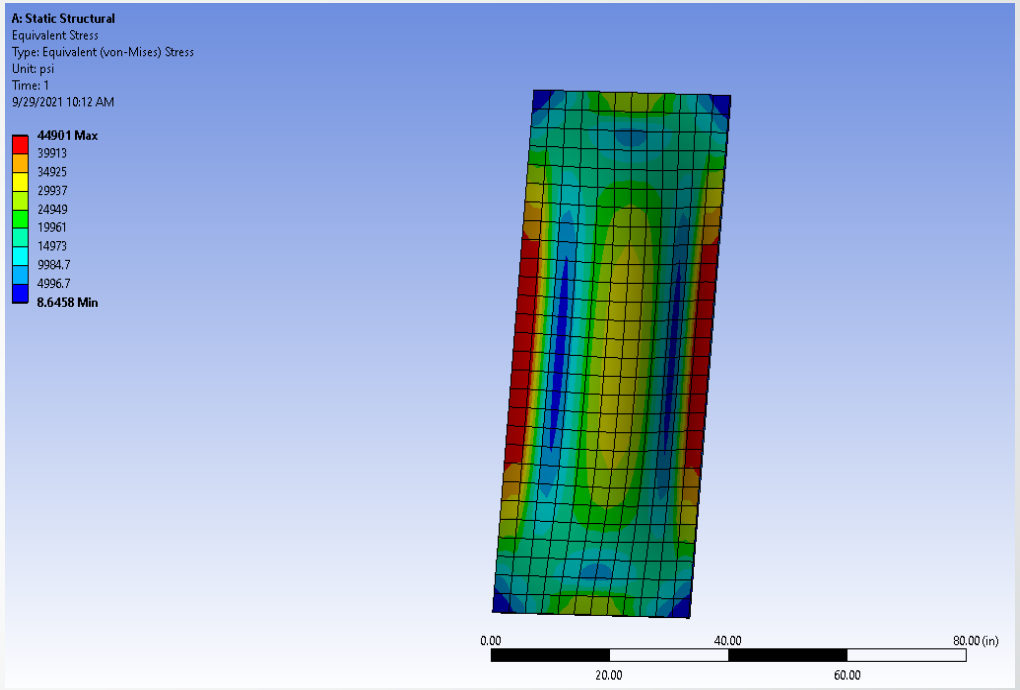
Preliminary Modeling







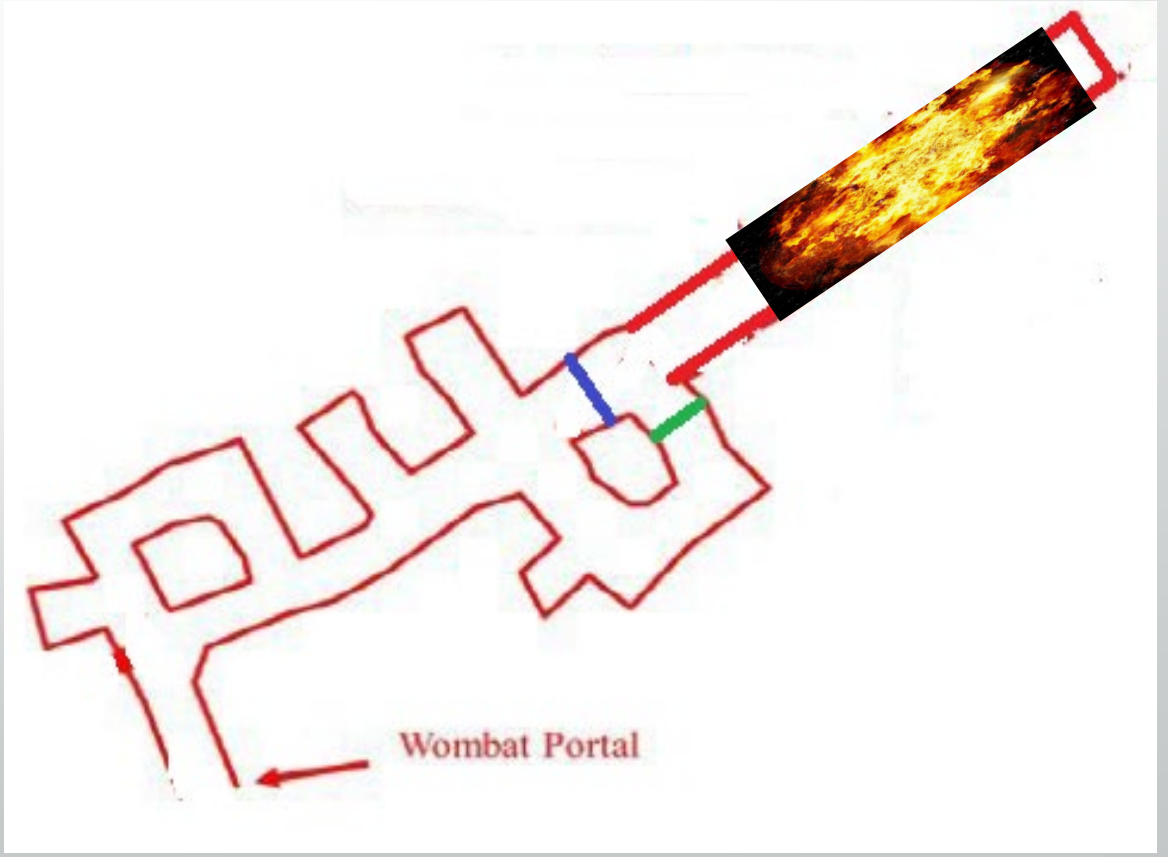
Status



- Doors are on Site
- Design of the Reaction Structure is complete
- Once materials can be sourced, will be ordered and constructed soon

Door Positioning

- Blue Line
  - Orientation for initial phase of testing
- Green Line
  - More realistic
  - Potential second round of testing



Plan Forward 1

- Achieve an acceptable pressure vs. time waveform
  - “Blank” door
  - C_4
  - Coal dust of various quantities
  - Instrumentation

Plan Forward 2

- Door Testing
  - Kennedy
  - Aurora
  - Instrumentation & Documentation
  - Operational? Functional? Damage?

Plan Forward 3

- Model Calibration and Extrapolation
  - Calibrate models to measured data
  - Extrapolate to various waveforms
  - Careful care to look at hinges, latches, locks, etc.
  - Hopefully determine failure points

Plan Forward 4

- Provide Design Recommendations
  - Benefits of certain design components?
  - Drawbacks of others?
  - Failure points to be reinforced?
  - Recommendations determined by data obtained from physical testing and models.

Limitations

- This research is only focused on two Refuge Alternative Door Manufacturers
- However
  - Lessons will be learned on what works
  - There are differences in latches and hinges (among others) between the manufacturers
  - This will help future designs to be as safe as possible to help ensure functionality after an explosion

For Example

- Single Latch Point

Vs

- Dual Latches

Challenges

- Finding skilled personnel to weld/construct reaction structure
- Experimental Mine Manager position is vacant for the second time in less than a year
- Need more hours in a day

Thank You

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