DEPARTMENT OF MECHANICAL ENGINEERING

# Dust Shall Not Pass
# Dust & Debris Containment Barrier

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## Motivation, Goal, Impact

Interior construction creates airborne dust that escapes through doorways. Existing solutions like plastic sheeting and zipper barriers are often costly, unreliable, wasteful, and hard to install.

**Design Goals:**

- Develop a low-cost, lightweight, portable doorway barrier for effective dust containment.
- Create a reusable, durable system that deploys quickly, allows safe entry/exit, and supports negative pressure.

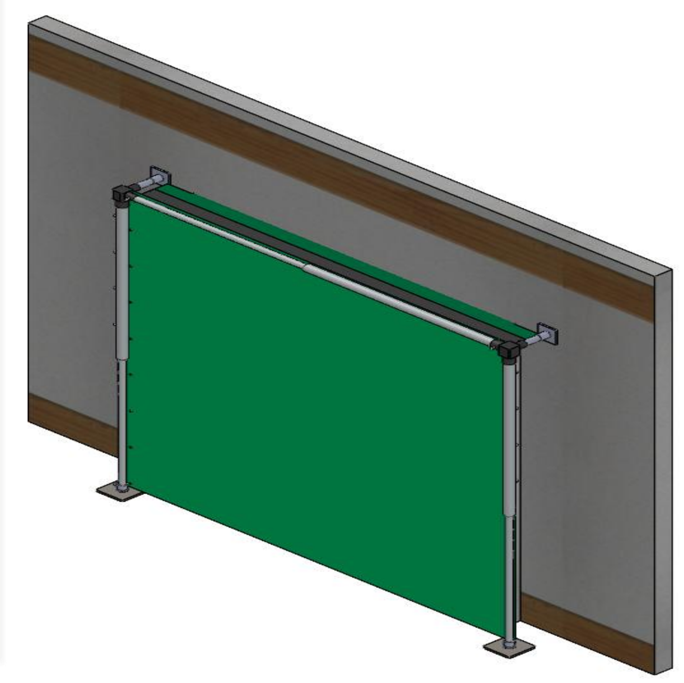
Protects over 2.3M workers by improving OSHA compliance and jobsite safety.

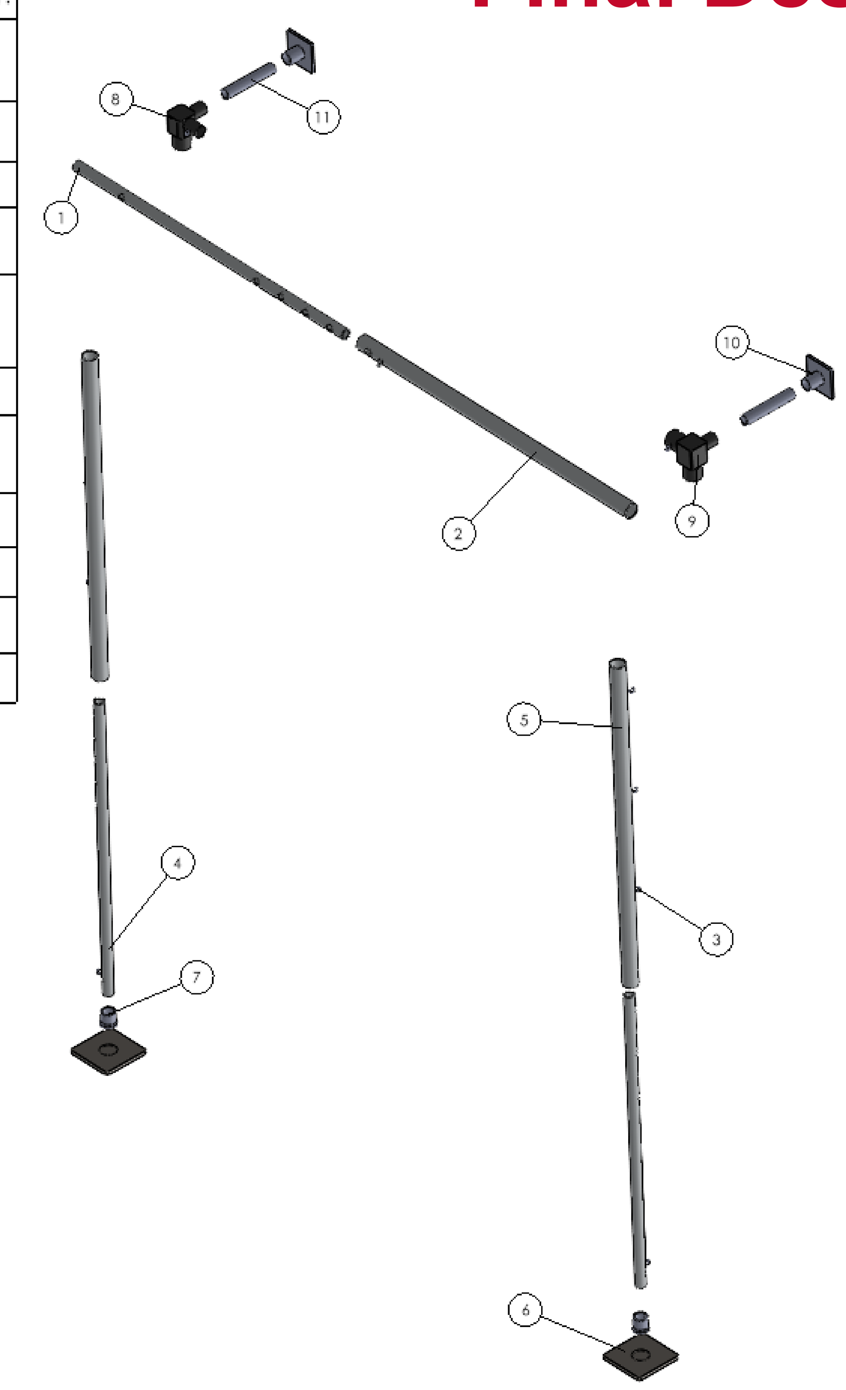
## Requirements

1. Prevent dust and debris leakage across single and double door openings.
2. Weigh ≤ 40 lbs for easy two-person transport and setup.
3. Deploy in ~5 minutes with no wall damage or external tools.
4. Maintain ≥ 0.01 in. w.g. negative pressure.
5. Enable safe entry/exit with automatic resealing.
6. Be reusable, easy to clean, and maintain seal integrity while minimizing waste.

## Final Design

| ITEM NO. | PART NAME | QTY. |
|---|---|---|
| 1 | INNER HORIZONTAL TELESCOPING POLE | 1 |
| 2 | OUTER HORIZONTAL TELESCOPING POLE | 1 |
| 3 | SCREW HOOK | 13 |
| 4 | INNER VERTICAL TELESCOPING POLE | 2 |
| 5 | INNER VERTICAL TELESCOPING POLE | 2 |
| 6 | WEIGHTED BASE PLATE | 2 |
| 7 | VERTICAL POLE TO BASE PLATE CONNECTOR | 2 |
| 8 | ELBOW LEFT | 1 |
| 9 | ELBOW RIGHT | 1 |
| 10 | RUBBER PADDING PLATE | 2 |
| 11 | RUBBER PADDING ARM | 2 |





**Aluminum Frame:**

- Includes vertical and horizontal poles, base plates, and padded arms. Telescoping aluminum poles adjust to fit single (36 in) and double (80 in) doorways.

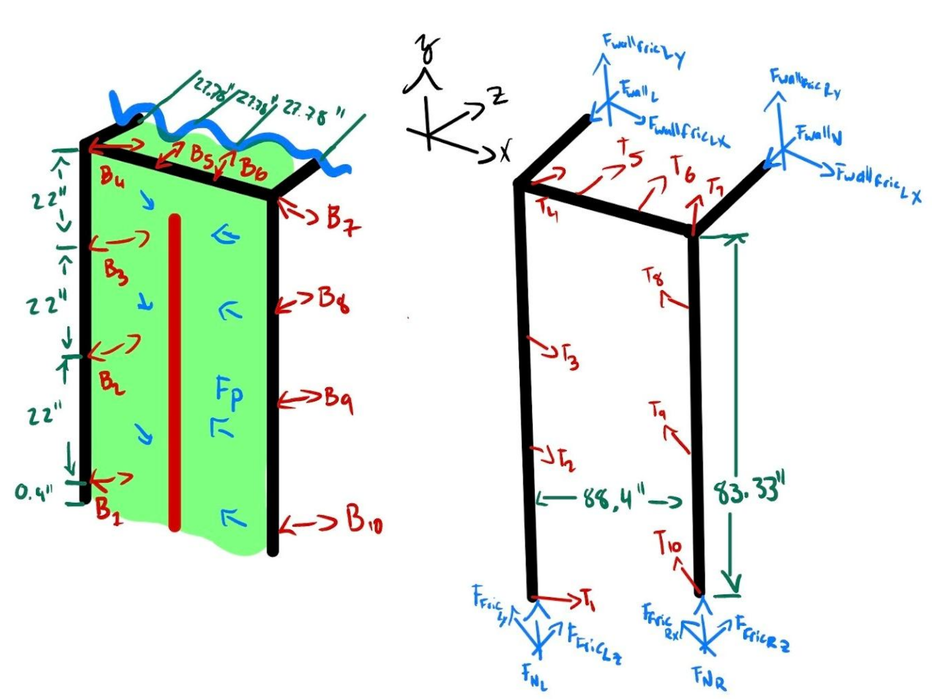
**Fabric Enclosure:**

- 3-panel 70D nylon ripstop for waterproof, anti-static performance. Elastic webbing along seams creates inward sealing tension, while a magnetic slit allows automatic resealing after pass-through.

**Full Assembly:**

- Frame is set slightly larger than the doorway for full coverage. Fabric attaches via bungee cords to form a freestanding, dust-tight enclosure. Weighted base plates and padded arms provide stability.

## Design Calculations & Decisions



FBD: Frame Section Cut

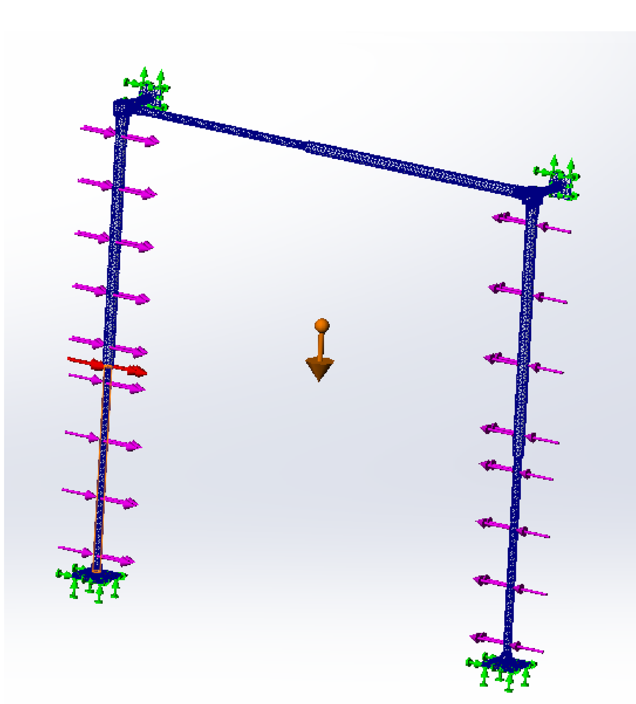
1) $F_p = \Delta P \cdot A = 0.26\ lbf/\text{ft}^2 \cdot 51.16\ \text{ft}^2 = 13.3\ lbf$

2) $k = \frac{F_{max}}{\delta} = \frac{6.25}{9.33} = 0.67\ lbf/in$

3) $F_{bungee} = F_{elongation} + N \cdot F_p = 3.75 + 0.33 = 4.08\ lbf/cord$

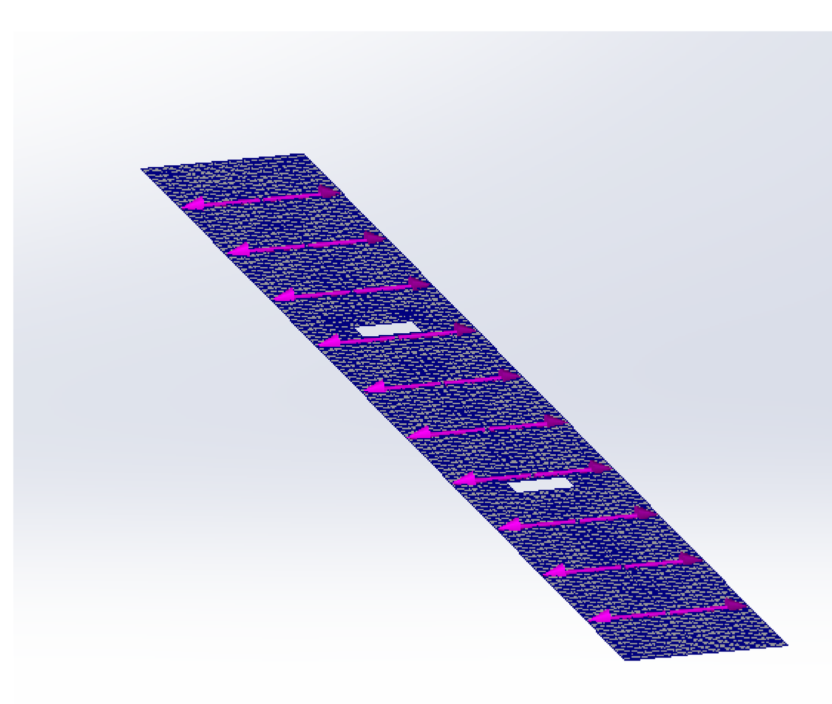
4) $T_{elastic} = \frac{F_{bungee} \cdot N}{L_{perimeter}} = \frac{3.75 \cdot 10}{240} = 0.17 lbf/in$

5) $\sum F_x = 0 = F_{friction} + F_{wall} \geq F_{elastic} + F_{bump}$



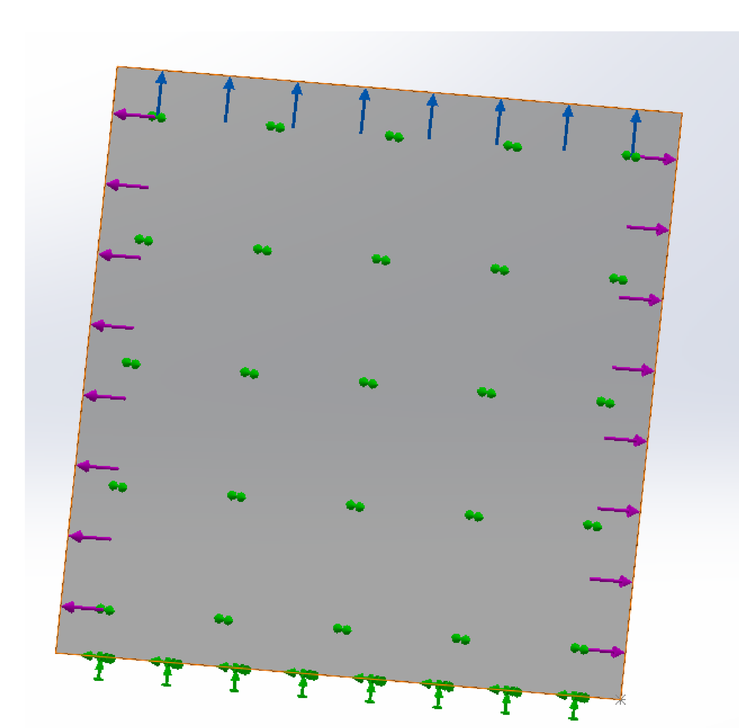
FEA: Frame Stress Results

$\sigma_{VM} = 30.9\ MPa \ll 68.94\ MPa\ (SF \approx 2.23)$



FEA: Top/Side Panel Stress Results

$\sigma_{VM} = 2.677\ MPa \ll 37.3\ MPa\ (SF \approx 13.93)$

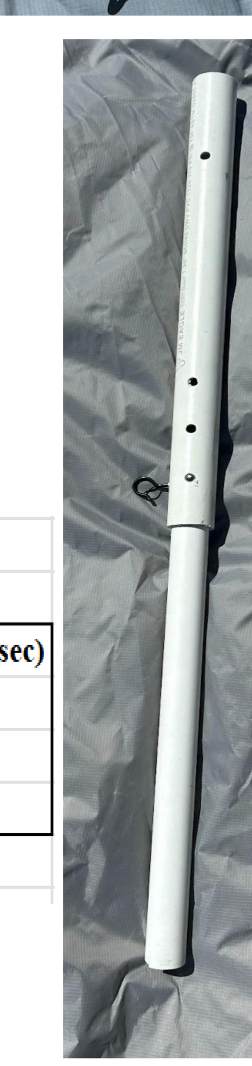


FEA: Front/Back Panel Stress Results

$\sigma_{VM} = 3.501\ MPa \ll 37.3\ MPa\ (SF \approx 10.76)$

## Prototype & Test Results

Dust Test



| Participant | Group Type | Setup Time (min:sec) | Delta from Group Average (seconds) |
|---|---|---|---|
| Group Member 1 | Associated w/ Project | 19:12 | -40.33 |
| Group Member 2 | Associated w/ Project | 21:28 | 95.67 |
| Group Member 3 | Associated w/ Project | 18:57 | -55.33 |
| Non-Group Member 1 | Not Familar w/ Project | 29:35 | 44 |
| Non-Group Member 2 | Not Familar w/ Project | 32:47 | 236 |
| Non-Group Member 3 | Not Familar w/ Project | 24:11 | -280 |

| Group Type | Average (min:sec) |
|---|---|
| Associated w/ Project | 19:52.33 |
| Not Familar w/ Project | 28:51.1 |
| Overall | 24:21.67 |

High Fidelity Prototype Setup Time Testing Results