Analysis of Fleming H16 Series, Vertically Stiffened Door, Under 100 lb/ft² Explosion Force

PART # 1

Door details reviewed for this analysis are as follows. Drawings as prepared and submitted by Fleming:

- Figure 1 of 8 : Door Elevation, dwg # H16-101
- Figure 2 of 8 : Vertical Door Section, dwg # H16-102
- Figure 3 of 8 : Horizontal Door Section, dwg # H16-103
- Figure 4 of 8 : Assembly Reference Details - Hinges and Mortise Locks, dwg # H16-104
- Figure 5 of 8 : Hinge Reinforcing Bar Details, dwg # HG-101
- Figure 6 of 8 : Top Hinge Reinforcing Bar Details, dwg # HG-102
- Figure 7 of 8 : Mortise Lock Reinforcing Details, dwg # HG-105
- Figure 8 of 8 : Mortise Lock Reinforcing Details, dwg # HG-129

PART # 2

The Performance Specification is as follows:
1.) Door shall be Blast Resistant (Blast Pressure is 100 lb/ft²)
2.) No limitation on Deflections or Deformations
3.) No requirement that door shall operate after blast

PART # 3

Observations on Blast Conditions vs Door Performance
1.) 3/4” gap at bottom of door will vent Blast Pressure producing much lower pressures, therefore 100 lb/ft² static design pressure may be ok.
2.) Post blast deflection deformation and door operation have not been examined but they should be satisfactory.

PART # 4

Case 1 Analysis - Blast Pressure Acting Away From Frame

Assume worst case load distribution :

\[ \text{Force} = (1.5 \times 4.63) \times 0.1 \times \text{ft}^2 = 0.69 \text{kips} \]
\[ \text{Mcc} = 0.69 \times \frac{4.63}{2} = 1.61 \text{ k} \]
\[ I = \left( \frac{18 \times 0.06}{12} + 18 \times 0.06 \times 0.845^2 \right) + 3 \left( \frac{2 \times 1.63^3}{12} - \frac{1.928 \times 1.558^3}{12} \right) \]
\[ = 2 \times 0.77 + 3 \times (0.72 - 0.61) \]
\[ = 1.54 + 0.33 \]
\[ = 1.87 \text{ in}^4 \]
Using $\frac{M}{I} = \frac{f}{Y}$ then bending stress in door skin is: 

$$f = \frac{MY}{I} = \frac{(1.61 \times 12) \times 0.875}{1.87} = 8570 \text{ lb/in}^2$$

If there is no load sharing between hinges and latch bolt, shear stress in latch bolt is:

Area of latch bolt = $.75" \times .5" \times 50\% \times 75\% = 0.14 \text{ in}^2$

Force = $1.5 \times 8 \times 0.1 = 1200 \text{ lb}$

$fv^2 = \frac{1200}{0.14} = 8570 \text{ lb/in}^2$ (under this assumption there may be some deformation of door and bolt)

Case 1 will not result in failure of door
Case 2 Analysis - Blast Pressure Acting Towards Frame

In this case the door acts as a simply supported plate or slab.

\[ R_A = R_B = 1.5 \times 0.1 = 0.15 \text{k}/\text{ft} \]

\[ Mc = 0.1 \times \frac{(0.11 \times 12)^2}{8} = 0.11 \text{k}/\text{ft} < 1.61 \text{k}/\text{ft} \]

\[ I = 2 \left( \frac{12 \times 0.06}{12} + 12 \times 0.06 \times 0.845^2 \right) \]
\[ = 1.03 \text{in}^4 \]

Bending Stress in Skin \( f = \frac{(0.11 \times 12) \times 0.875}{1.03} \)
\[ = 1.12 \text{k}/\text{in}^2 \]

Case 2 will not result in failure of door

CONCLUSION

1.) Door will be satisfactory under pressure of 100 lb/ft²
2.) Lock and Hinge reinforcements are adequate
3.) Hinges should be made of steel with steel pins
4.) Check that latchbolt, etc, can withstand 1200 lb force.

Originally Signed, Sealed and Dated by:

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