

1.0 BLAST LOADING

1.1 Blast Loads

1.1.1 All blast loading shall be applied as dynamic shock waves (rising instantly to their peak value), then decaying linearly to zero over the specified positive phase duration, as shown in Figure 1:

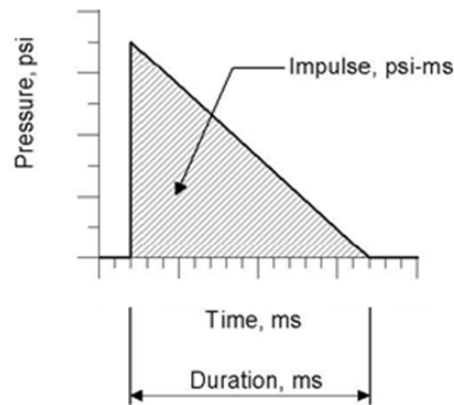


Figure 1. Idealized Blast Load

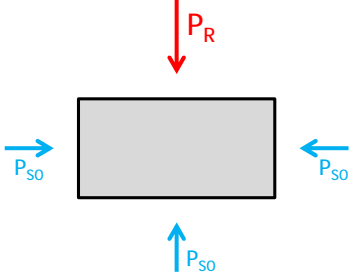
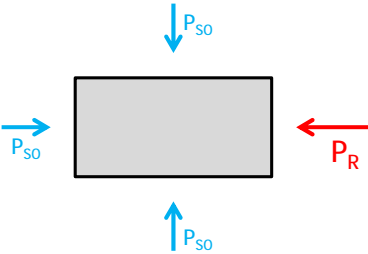
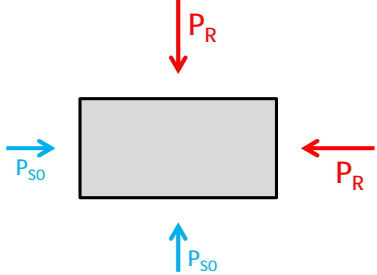
- 1.1.2 Design Side-On Blast Overpressure, $P_{SO} = X.X [psi]$
- 1.1.3 Design Reflected Blast Overpressure, $P_R = X.X [psi]$
- 1.1.4 Duration of Positive Phase = $XXX [ms]$

1.2 Application of Blast Loading

- 1.2.1 All walls are subject to the reflected blast loading *OR specify which walls are subject to the reflected blast loads.*
 - 1.2.1.1 Clearing effects can be considered in the design of the wall structural components.
- 1.2.2 Two adjacent walls could be subject to the reflected blast loading at the same time.
 - 1.2.2.1 Load directionality shall be considered in the design, as shown in Table 1:
- 1.2.3 The roof is subject to the side-on blast loading.
- 1.2.4 Net lateral blast loading can be considered in the design of the frames and bracing elements.
- 1.2.5 A lateral system analysis shall be included in the design.

Example Blast Specification for Pre Engineered Metal Building

Table 1. Directional Load Cases

Load Case 1	Load Case 2	Load Case 3
		
<p><i>Any one long wall reflected; all other walls side-on</i></p>	<p><i>Any one short wall reflected; all other walls side-on</i></p>	<p><i>Any one long wall and any one short wall reflected; all other walls side-on</i></p>

2.0 REFERENCE DOCUMENTS

2.1 The blast resistant structural design and the design of ancillary items such as doors and windows shall follow the requirements of the current edition of the following documents:

- 2.1.1 American Society of Civil Engineers (ASCE), Task Committee on Blast Resistant Design, "Design of Blast Resistant Buildings in Petrochemical Facilities."
- 2.1.2 American Institute of Steel Construction (AISC), ANSI/AISC 360, "Specification for Structural Steel Buildings."
- 2.1.3 Federal Emergency Management Agency (FEMA), FEMA 172, "NEHRP Handbook for Seismic Rehabilitation of Existing Buildings."
- 2.1.4 *Provide reference Other Owner Specific or Project Specific references*

3.0 STRUCTURAL DESIGN CRITERIA

3.1 General

- 3.1.1 All components directly exposed to and/or indirectly loaded by blast loading shall be designed using dynamic structural analyses for a "MEDIUM" (or "LOW" or "HIGH") or better response criteria as defined in the ASCE publication *Design of Blast Resistant Buildings for Petrochemical Facilities*, as shown in Table 2:



Example Blast Specification for Pre Engineered Metal Building

Table 2. Component Response Criteria

Component	LOW	
	μ	θ
Cold-Formed Steel Panels		
Cold-Formed Steel Secondary Beams (Girts and Purlins)		
Steel Secondary Beams		
Steel Primary Members (Girders, Columns and Frames)		

Where:

μ = ductility ratio (maximum displacement of the component divided by the displacement at the elastic limit, non-dimensional).

θ = hinge support rotation (maximum plastic rotation at the supports, degrees)

4.0 QUALIFICATIONS

4.1 Engage a registered Professional engineer to perform the dynamic structural blast design of the building. The Engineer shall have a minimum of 5 years of experience performing dynamic analysis for blast resistant design and demonstrable experience designing blast resistant systems in the past 18 months. At a minimum, qualifications must list each project in which the Engineer performed dynamic analysis, the effective start and end dates of performance of the analysis, and a reference.

5.0 SUBMITTALS

5.1 Contractor shall provide, for Owner's review and approval, single-degree-of-freedom (SDOF) dynamic structural analyses calculations, or other more sophisticated form of non-linear dynamic structural analyses calculations, for all building structural components and systems.

6.0 BLAST DESIGN GUIDANCE

6.1 Foundation

6.1.1 Building foundation and slab, including connections to the steel primary frames, shall be designed to resist the peak vertical, in-plane horizontal and out-of-plane horizontal steel primary frame reactions from blast loading.



Example Blast Specification for Pre Engineered Metal Building

6.2 Building Superstructure

6.2.1 Building superstructure (i.e., columns, girders, end posts, spandrel beams, etc.) shall consist of hot-rolled or built-up steel members.

6.2.1.1 Built-up steel primary frame members (i.e., rigid frame members) may be tapered.

6.2.1.2 Steel primary frame members shall consist of sections that are both classified as *nonslender element sections* for compression and *compact sections* for flexure (as per the American Institute of Steel Construction) unless the effects of local buckling are specifically accounted for in the design of the frame.

6.3 Bracing

6.3.1 In-plane bracing (i.e., roof and side wall bracing) shall be designed to satisfy the peak inbound and rebound reactions from the components being braced.

6.4 Secondary Members

6.4.1 Purlins and girts shall be hot-rolled shapes or cold-formed shapes (zee or channel shapes) per manufacturer standards.

6.4.1.1 Connections shall be designed to satisfy the inbound and rebound reactions, including any moment demands based on the intended support conditions.

6.4.1.2 Lateral bracing of the flanges shall be provided to satisfy the inbound and rebound moment demands.

6.5 Steel Panels

6.5.1 Roof and wall sheeting shall be corrugated steel panels.

6.5.1.1 Connections of the steel panels to purlins and girts shall be designed to satisfy the full inbound and 100% rebound reactions from adjacent spans applied simultaneously.

