

Changes shown by ↗

SCOPE

- I 1.1 **This practice covers** the structural design of certain Category 3 type plant buildings for a prescribed level of blast resistance in lieu of using the explicit blast resistant design requirement of [IP 4-3-2](#).
- I 1.2 **An asterisk (*)** indicates that additional information from the Owner, or approval by the Owner is required.

SUMMARY OF ADDITIONAL REQUIREMENTS

- I 2.1 **Table 1** lists the practice, standard and specification which shall be used as specified in this practice.
- I * 2.2 **Table 2** lists the practice, specification and standards which shall be used with this practice **as applicable**.

TABLE 1

PRACTICE	
IP 4-3-1	Plant Buildings for Operation and Storage
STANDARD AND SPECIFICATION	
ACI Standard 318 Building Code Requirements for Reinforced Concrete	AISC Specification Specification for Structural Steel Buildings - Allowable Stress Design and Plastic Design

TABLE 2

PRACTICE	
IP 4-3-2	Blast Resistant Buildings
STANDARDS AND SPECIFICATION	
ACI Standard 531 Building Code Requirements for Concrete Masonry Structures AISI Specification Specification for the Design of Cold-Formed Steel Structural Members ASTM Standards A 36 Specification for Structural Steel A 82 Specification for Steel Wire, Plain, for Concrete Reinforcement A 446 Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot Dip process, Structural (Physical Quality)	ASTM Standards (Cont) A 525 / A 525M General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process A 572 Specification for High-Strength Low Alloy Columbium-Vanadium Steel of Structural Quality A 615 Specification for Deformed and Plain Billet Steel Bars for Concrete Requirement A 792 Specification for Steel Sheet Aluminum-Zinc Alloy-Coated by Hot-Dip Process C 90 Specification for Hollow Load-Bearing Concrete Masonry Units C 1048 Standard Specification for Heat-Treated Flat Glass

- I * 2.3 Local codes and standards may be substituted for the ones referenced herein provided the following provisions are met:
 - a. The resultant design meets the safety and serviceability criteria attained through this practice.
 - b. Substitution is accepted by the authorities where the facility is to be located and by the Owner's Engineer.

DEFINITIONS

- I ↗ * 3.1 **Special Category 3 Blast Resistant Buildings** are buildings specified by the Owner as requiring a level of blast resistance, corresponding to a **Category 3 VCE #3** per [IP 4-3-2](#), that can be achieved by the conventional design and construction requirements specified in this practice.
- I 3.2 **Working blast load** is the equivalent static service load used for the design of building components for blast effects based on normal allowable stresses.
- I 3.3 **Girts and Purlins** as used herein are the horizontal structural members which directly support the **wall and roof** cladding, respectively, in a building.
- I 3.4 **Roof diaphragm** is the structural system which transfers lateral loads in the plane of the building roof to the walls or frames.
- I 3.5 **Shear Wall** transfers lateral loads through the plane of the wall to the foundation or other structural support.

IP 4-3-4		Special Category 3 Blast Resistant Buildings	
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DESIGN

GENERAL

- I 4.1 **Special Plant Buildings** satisfying the limitations specified in **Pars. 4.2** and **4.3** may be designed and constructed in accordance with the additional requirements of this practice. Other Category 3 building structural systems not covered in **Pars. 4.2** and **4.3** shall be designed in accordance with **IP 4-3-2**.
- I 4.2 Building structural systems covered by this practice are as follows:
 - a. Metal building with steel frame and steel cladding.
 - b. Steel framed building with reinforced concrete or reinforced masonry exterior walls and a reinforced concrete roof.
 - c. Multiple span frame building, concrete frame building, building with reinforced concrete or reinforced masonry exterior walls in combination with steel clad roof, and building with steel wall cladding in combination with a reinforced concrete roof are not covered by this practice.
- I 4.3 **Building construction** shall comply with the following general requirements:
 - a. One-story with wall height not exceeding 20 ft (6 m).
 - b. Exterior walls shall not be used to support the roof loads.
 - c. Roof slope shall not exceed 1 vertical to 12 horizontal.
 - d. Lateral load carrying systems shall be reinforced concrete or reinforced masonry shear walls, rigid steel frames, or diagonally braced steel framing. Rigid steel frames shall be single span.
 - e. Girder spans between supports shall not exceed 50 ft (15 m).
- S,I 4.4 **Structural components** shall be designed for the conventional load (dead, live, wind or earthquake) and working blast load combinations, whichever is governing. The working blast load shall be applied as an inward pressure on the building component. The load combinations shall be as follows:
 - a. Dead load + live load + wind load or earthquake load.
 - b. Dead load + live load (where applicable) + working blast load.
 - c. Dead load – 0.5 x working blast load.
- S,I 4.5 **Safety factors, load factors, or allowable stresses** shall be in accordance with applicable codes and standards. **Working blast loads** shall be considered as **live loads** for the determination of load factors and allowable stresses.
- I,R 4.6 **Deflection limits** for conventional load combinations per **Par. 4.4a** shall be according to the applicable codes. They shall not apply to the working blast load combinations per **Pars. 4.4b** and **c**.
- I 4.7 **Working blast loads** provided are for the design of the individual component and its connections and should **not** be used in the design of other supporting components/portions except as explicitly stated.
- I 4.8 **Roof diaphragms, shear walls and foundations** shall be designed for the reactions from the supported elements.

METAL BUILDINGS

PURLINS AND GIRTS SUPPORTING METAL CLADDING

- I 5.1 **Purlins and girts shall be cold-formed or hot-rolled steel sections, designed to AISI or AISC specifications, as appropriate.** Cold-formed steel shall conform to ASTM A572 with minimum yield stress between 42 and 55 ksi (290 and 380 MPa). Hot rolled steel shall be to ASTM A36 or A572.
- I 5.2 **Purlins and girts** shall be doubly symmetric shapes either back-to-back channels, "I" shaped or wide flange members. The minimum allowable thickness shall be 0.06 in. (1.5 mm) (16 gage).

S,I 5.3 **Working blast loads** for cold-formed purlins and girts shall be as follows:

SUPPORT TYPE	WORKING BLAST LOAD, psf (kPa)			
	$F_y = 42 \text{ ksi (290 MPa)}$		$F_y = 55 \text{ ksi (380 MPa)}$	
	Purlins	Girts	Purlins	Girts
a. Simple Supports	85 (4.1)	175 (8.3)	100 (4.8)	200 (9.5)
b. Propped Cantilever	70 (3.3)	150 (7.1)	80 (3.8)	170 (8.1)
c. Fixed Ends	62 (3.0)	133 (6.3)	70 (3.3)	150 (7.1)

Notes:

- (1) F_y is the specified minimum static yield stress.
- (2) For sections with a minimum specified static yield stress F_y , between the values listed, the working blast loads can be determined by interpolation.
- (3) The working blast loads are to be applied to the tributary area of each member.
- (4) The working blast loads are applicable for spans from 10 to 25 feet (3 to 7.5 m).
- (5) Hot rolled or welded sections shall be designed for 10% higher loads.
- (6) The first two and last two spans of a continuous member shall be assumed simply supported.
- (7) The table is applicable to sections with heights between 7 in. (180 mm) and 12 in. (310 mm).

I 5.4 Connections and splices shall be designed to transfer the full capacity (shear and/or moment, as appropriate) of the purlin or girt under consideration.

I 5.5 **The webs of back-to-back channels** shall be bolted together with pairs of 1/2 in. (12 mm) diameter bolts at a maximum spacing of 3 ft (1 m) on centers.

COLD-FORMED WALL AND ROOF PANELS

I 5.6 **Materials for cold-formed steel cladding** for walls and roof shall be per ASTM A446, Grade A, ASTM A792, Grade 80 or equivalents.

I 5.7 **Minimum uncoated thickness** of cold-formed steel panels used as cladding shall be 0.024 in. (0.6 mm) (24 gage) for walls and 0.018 in. (0.46 mm) (26 gage) for roofs.

S,I 5.8 **Working blast loads** for cold-formed steel cladding shall be as follows:

- a. Wall Panels 230 psf (11 kPa)
- b. Roof Panels 110 psf (5.3 kPa)

Note: These values apply for materials whose allowable bending stress $F_b = 0.6 F_y$, where F_y is the specified minimum yield stress. Otherwise the values shall be adjusted by multiplying by the ratio $F_b / 0.6 F_y$.

S,I 5.9 **Maximum permissible spans** for steel cladding for wall and roof shall be as follows:

METAL GAGE NO.	METAL THICKNESS in. (mm)	MAXIMUM PERMISSIBLE SPANS, ft (m) FOR COLD-FORMED STEEL CLADDING	
		Wall	Roof
26	0.018 (0.46)	—	4.5 (1.37)
24	0.024 (0.60)	3.5 (1.07)	5.25 (1.60)
22	0.030 (0.76)	4.0 (1.22)	6.0 (1.83)
20	0.036 (0.90)	4.5 (1.37)	6.75 (2.06)
18	0.048 (1.20)	5.5 (1.68)	8.0 (2.44)

I,R 5.10 **Cold-formed cladding** shall be securely attached with self-tapping sheet metal screws. Each fastener shall be supplied with an "oversized" washer to prevent the heads of the screws from pulling through the cladding.

I,R 5.11 **Cold-formed wall cladding** shall be secured at the base with a continuous angle anchored to the foundation.

END WALL COLUMNS AND FRAMES

I 5.12 **End wall columns** (columns along the exterior walls parallel to the rigid frames) shall be fabricated from hot rolled shapes, welded or cold-formed steel conforming to ASTM A36 or A572 and having minimum specified yield stress F_y from 36 to 55 ksi (250 to 380 MPa).