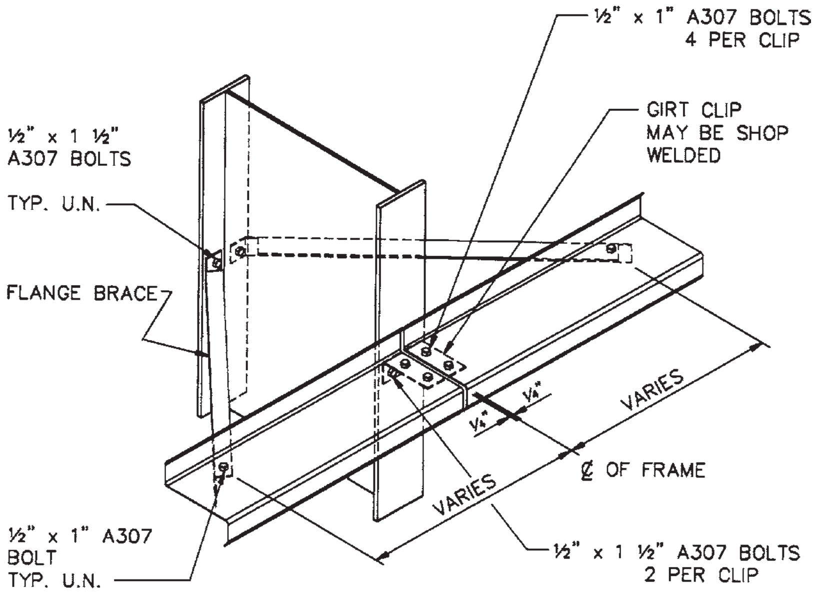

FIGURE 4.20 Typical column flange brace. (*VP Buildings*.)

Example 4.1 Selection of Frame Type and Eave Height Select the basic frame type and eave height for an industrial facility, approximately 80 ft by 250 ft in plan, without cranes. The building will have a roof pitch of 1:12 and has to resist a 30-psf roof snow load. Several pieces of equipment measuring 30 by 30 ft by 12 ft high must fit anywhere within the building.

Solution A metal building system with single-span rigid frame offers the best solution, because:

- The span of 80 ft is within the optimum range of this system.
- Tapered columns are acceptable.
- The eave height will be between 10 and 24 ft.
- This system provides the maximum planning flexibility for equipment placement.

Refer to Fig. 4.10; look in the column for 30-psf live load (snow, really), and in the row for 80-ft width. The first clear height under the knee, the distance *G,* that exceeds 12 ft corresponds to an eave height of 16 ft. However, the clearance provided with this eave height would be too small—only 6 in. Plus, the data in the table represent only a single manufacturer, and others may provide framing deeper than shown. A conservative choice would be to move to the next eave height—20 ft.

4.11 ENDWALL FRAMING

The foregoing discussion has dealt only with interior frames. What about the endwall framing? While each manufacturer has a slightly different approach and details of endwall framing, the basic design is essentially the same. The function of endwall framing is to resist all loads applied to the building's endwalls and to support wall girts. In buildings with expandable endwalls, a regular interior frame is provided at the top of the walls. This frame resists all vertical loads as well as the lateral loads applied to the sidewalls, and the endwall framing is needed only to support wall girts. In

R131-210 Pre-engineered Steel Buildings

These buildings are manufactured by many companies and normally erected by franchised dealers throughout the U.S. The four basic types are: Rigid Frames, Truss type, Post and Beam and the Sloped Beam type. Most popular roof slope is low pitch of 1" in 12". The minimum economical area of these buildings is about 3000 S.F. of floor area. Bay sizes are usually 20′ to 24′ but can go as high as 30′ with heavier girts and purlins. Eave heights are usually 12′ to 24′ with 18′ to 20′ most typical. Pre-engineered buildings become increasingly economical with higher eave heights.

Prices shown here are for the building shell only and do not include floors, foundations, interior finishes or utilities. Typical erection cost including both siding and roofing depends on the building shape and runs $1.35 to $2.60 for one in twelve roof slope and $1.40 to $3.65 per S.F. of floor for four in twelve roof slope. Site, weather, labor source, shape and size of project will determine the erection cost of each job. Prices include erector's overhead and profit.

Table below is based on 30 psf roof load, 20 psf wind load and no unusual structural requirements. Costs assume at least three bays of 24′ each. Material costs include the structural frame, 26 ga. colored steel roofing, 26 ga. colored steel siding, fasteners, closures and flashing but no allowance for doors, windows, gutters or skylights. Very large projects would generally cost less than the prices listed below. Typical budget figures for above material delivered to the job runs $1250 to $1575 per ton. Fasteners and flashings (included below) run $.46 to $.68 per S.F.

Material Costs per S.F. of Floor Area Above the Foundations						
Type of Building	Total Width in Feet	Eave Height				
		10 Ft.	14 Ft.	16 Ft.	20 Ft.	24 Ft.
	30-40	$3.90	$4.22	$4.55	$4.98	$5.63
Rigid Frame	50-100	3.95	3.95	4.27	4.48	4.98
Clear Span	110	–	–	–	–	–
	120	–	–	–	4.55	–
	130	–	–	–	–	–
Tapered Beam	30	4.38	4.87	5.41	6.22	–
Clear Span	40	4.17	4.43	4.65	5.30	–
	50-80	4.55	4.38	4.55	4.98	–
Post & Beam	80	–	3.35	3.68	3.90	4.27
1 Post at Center	100	–	3.24	3.47	3.84	4.17
	120	–	3.19	3.30	3.52	3.95
Post & Beam	120	–	–	–	–	–
2 Posts	150	–	3.24	3.47	3.68	4.17
@ 1/3 Points	180	–	–	–	–	–
Post & Beam	160	–	3.19	3.30	3.68	4.00
3 Posts	200	–	3.24	3.47	3.73	4.05
@ 1/4 points	240	–	–	–	–	–

Typical accessory items are listed in the front of the book. All normal interior work, floors, foundations, utilities and site work should be figured the same as usual.

Costs in the table below include allowance for erection, normal doors, windows, gutters and erector's overhead and profit. Figures do not include foundations, floors, interior finishes, electrical, mechanical or installed equipment.

Total Cost per S.F. Above the Foundations, 16′ Eave Height				
Project Size: Rigid Frame 30′ to 60′ Spans 1 in 12 Roof Slope	Basic Building Using 26 ga. Galvanized Roof & Siding	Add to Basic Building Price		
		R13 Field Insulation	Exterior Finish	S.F. of Skin
	S.F. Floor Area	S.F. Floor Area	Sandwich wall	$6.10
			Corrugated fiberglass	3.28
4,000 S.F.	$7.65	$1.44	Corr. fiberglass-insulated	4.09
10,000 S.F.	6.78	1.23	10 year paint	.23
20,000 S.F.	6.27	1.17		

FIGURE 4.21 Typical square-foot cost of pre-engineered buildings. (*From Means Building Construction Cost Data 1995. Copyright R. S. Means Co., Inc., Kingston, MA, 800-334-3509. All rights reserved.*)

buildings where endwalls are not expandable, the endwall framing also supports vertical loads and contains wall cross-bracing (or fixed-base wind posts).

Endwall framing consists of columns (posts), roof beams, and corner posts, all with base plates and other accessories. Endwall columns are frequently made of either single or double cold-formed channels with a metal thickness of at least 14 gage, as shown in Figs. 4.2, 4.5, and 4.22. Alternatively, endwall columns may be made of hot-rolled or built-up wide-flange sections. End rafters are usually made of cold-formed channels unless a regular rigid frame is used for future expansion. The rafters are designed as simple-span members and spliced at each column; a reinforcing channel may be needed at each splice (Fig. 4.22).