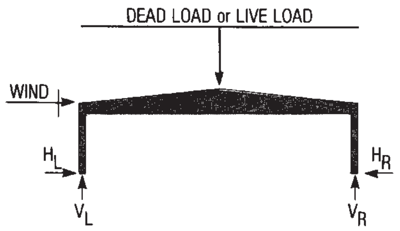

BAY SPACING — 25 ft.
ROOF SLOPE — 1:12
LIVE LOAD — 20 psf
WIND LOAD — 80 mph

REPRESENTATIVE FRAME REACTIONS 1:12 ROOF SLOPE

NOTES:

1. Dead load equals self weight of members.
2. Wind load is applied in accordance with MBMA (1986).
3. Negative value of reaction indicates direction opposite to that shown on sketch.
4. Reactions shown are approximate only and are not exact submittal values.
5. Reactions for various load combinations may be obtained by adding or subtracting the appropriate values.
6. Forces on the foundation will act in the opposite direction to the direction of the frame reactions.

FRAME REACTIONS (KIPS)									
SIZE		DEAD LOAD		LIVE LOAD		WIND LOAD			
SPAN	E.H.	V_L V_R	H_L H_R	V_L V_R	H_L H_R	V_L	H_L	V_R	H_R
20	10	0.6	0.1	5.0	0.4	-3.7	-1.7	-1.7	1.2
	12	0.6	0.0	5.0	0.3	-4.0	-2.0	-1.4	1.6
	14	0.6	0.0	5.0	0.3	-4.3	-2.3	-1.1	1.9
	16	0.6	0.0	5.0	0.3	-4.8	-2.7	0.7	2.2
30	10	0.9	0.2	7.5	1.5	-4.9	-2.0	-3.2	0.6
	12	0.9	0.1	7.5	1.1	-5.1	-2.2	-3.0	1.1
	14	0.9	0.1	7.5	0.9	-5.3	-2.5	-2.8	1.6
	16	0.9	0.1	7.5	0.7	-5.7	-2.8	-2.5	2.0
40	10	1.2	0.4	10.0	3.4	-6.3	-2.9	-4.5	-0.5
	12	1.2	0.3	10.0	2.7	-6.4	-2.7	-4.4	0.3
	14	1.2	0.3	10.0	2.2	-6.6	-2.9	-4.2	0.8
	16	1.2	0.2	10.0	1.8	-6.9	-3.1	-4.1	1.4
50	12	1.6	0.6	12.5	4.9	-7.8	-3.8	-5.7	-0.9
	14	1.6	0.5	12.5	3.8	-8.0	-3.5	-5.5	0.1
	16	1.6	0.4	12.5	3.2	-8.2	-3.5	-5.5	0.6
	18	1.6	0.3	12.5	2.6	-8.7	-3.8	-5.5	1.3
60	12	2.1	1.0	15.0	7.0	-9.3	-5.0	-6.9	-2.1
	14	2.1	0.8	15.0	5.6	-9.4	-4.4	-6.8	-1.1
	16	2.1	0.7	15.0	4.6	-9.6	-4.2	-6.8	-0.2
	18	2.1	0.6	15.0	3.9	-10.2	-4.2	-6.9	0.5

MODIFYING FACTORS:

To obtain approx. reactions for other bay sizes, live loads, and/or wind loads use the following rules:

BAY SIZE: (up to 30′) Divide all reactions shown by 25 then multiply by the bay length required.

LIVE LOAD: Divide live load reactions shown by 20 then multiply by the live load required.

WIND LOAD: Multiply the wind load reactions shown by the applicable factor:
70 mph use 0.8
90 mph use 1.3
100 mph use 1.6
110 mph use 1.9
120 mph use 2.3

FIGURE 12.5 Typical column reactions for tapered beam-straight column system. (*Ceco Building Systems.*)

be more than adequate for this purpose. There is a fair chance, however, that reactions supplied by the manufacturer will still be different from those determined by the software because of slight variations in member sizes and construction details.

12.4.3 General Frame Analysis Software and Frame Formulas

Most frame analysis software programs are acceptable for determination of approximate column reaction values, especially when multiple-span rigid frames with unequal spans are involved and the tables cannot be used.

Reactions of statically determinate, but relatively rare, three-hinge gable frames can be readily computed by statics equations. Two-hinge frames, which are statically indeterminate to one degree of freedom, are much more common. Vertical reactions of a two-hinge frame are the same as for a simply supported beam. Horizontal reactions of a single-span rigid frame with nontypical roof pitch that is not covered by the manufacturers' tables can be estimated by standard frame formulas found in Kleinlogel[5] and elsewhere.

12.4.4 Uplift Check

Wind uplift, rather than downward loading, often controls the footing sizes for metal building systems. A check for uplift involves taking the tributary area of a column, multiplying it by the vertical component of the wind uplift force, and comparing the result with the counteracting weight of roof and foundations. For multispan rigid frames the computed uplift load may be increased by 10 to 20 percent to account for the effects of continuity. If the dead load does not provide a required factor of safety, the foundation size or depth is increased.

12.4.5 Other Scenarios

As an alternative to the methods of estimating reactions described above, it might be wise to establish a good working relationship with a few pre-engineered building manufacturers. Many such companies would be glad to run a proposed framing scheme on their computers and print out the column reactions (and perhaps even indicate some preliminary member sizes). An additional benefit of this involvement might include good advice on constructibility of the project.

Occasionally, despite best efforts of the engineers in estimating column reactions, the final numbers provided by the manufacturer will differ substantially from the assumed values. Smaller numbers are obviously acceptable, but larger column reactions may lead to a foundation redesign. If a schedule-driven "early foundation package" has already been awarded—or worse, built—a change order from the foundation contractor is sure to follow. One such experience is usually enough to open the engineer's mind to the perils of such guesswork, however educated, and to the advantages of using large safety margins in such circumstances.

12.5 METHODS OF RESISTING LATERAL REACTIONS

After column reactions from various loads are determined, they must be combined into loading combinations required by the governing building code to arrive at the most critical values for both inward and outward loads (Fig. 12.6). Once the worst-case combination of reactions is known, a method of resisting the forces must be chosen. There are several foundation designs capable of resisting horizontal loads, some of which are discussed below.