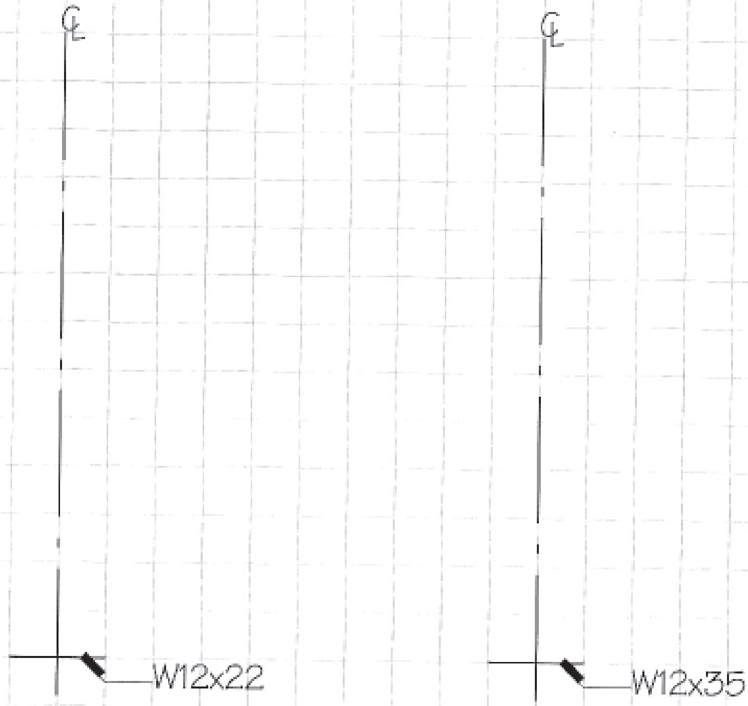
Steel Structural Shapes

This exercise will help you become more familiar with the dimensional properties of steel structural shapes. You will need to refer to Figures 11.12 and 11.13 of the text. Keep in mind that you are looking here at only a small sampling of the available sizes of steel members. Wide-flange shapes, for example, are available in depths ranging from 4" to 36" (100 to 900 mm), although the relative proportions of the shapes are more or less constant regardless of size.

Figure 11.12 is divided vertically into two parts. The second part gives structural properties of the shapes that will be familiar to those of you who have studied structural engineering. All the information you need to complete this exercise is contained in the first part. You will see that the cross-sectional area of each shape is given, along with its actual depth and the detailed dimensions of its flanges and web. The distances T, k, and k_1 are particularly useful; they locate the point at which the curved fillet begins between the flange and the web. T is also the maximum length of plate or angle that can be fastened to the web.

Notice that each grouping of shapes in the table shares the same nominal flange width and nominal overall depth. T is constant within each grouping because the same interior roller is used throughout, with only the outside rollers being moved to create the different weights (see Figure 11.10 in the text). The shapes with 12" and 10" flange widths are used largely for columns and H-piles, while those with the narrower flanges are used primarily for beams.

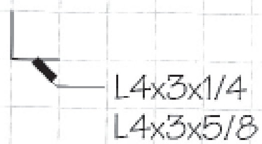
1. Draw accurate sections of the shapes indicated, each centered on the given centerline with its lower edge on the solid line.

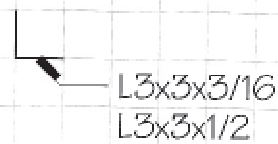


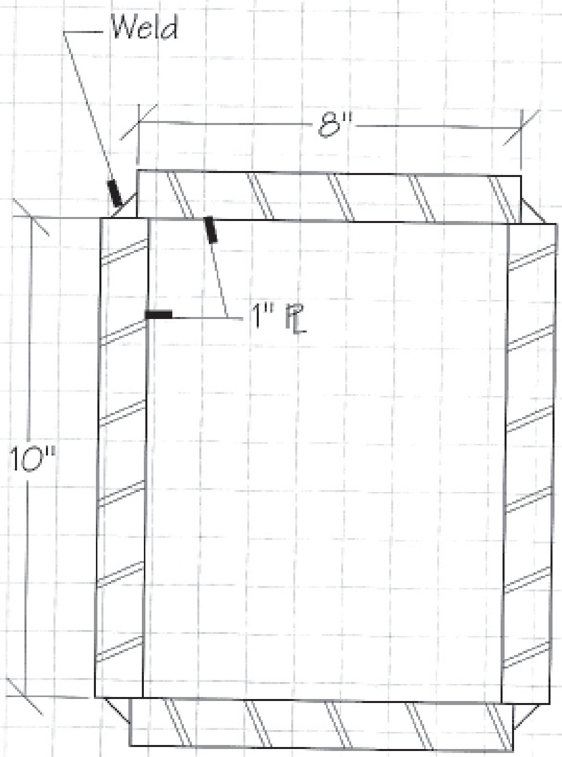
2. For a better idea of the true size of these shapes, draw your hand at the same scale.

Name: ______________________ Scale: 3" = 1' (1:4)
1 square = 1" (25 mm)

3. Draw accurate cross sections of the angle shapes indicated.





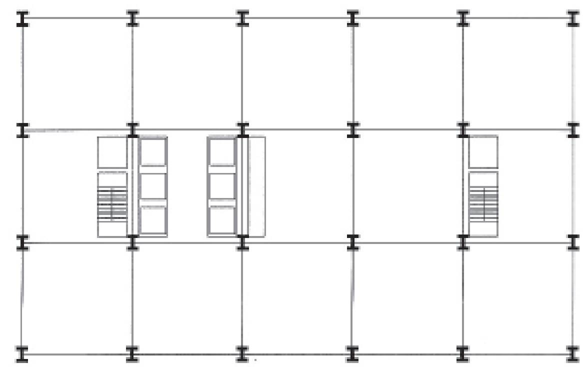


Cross Section

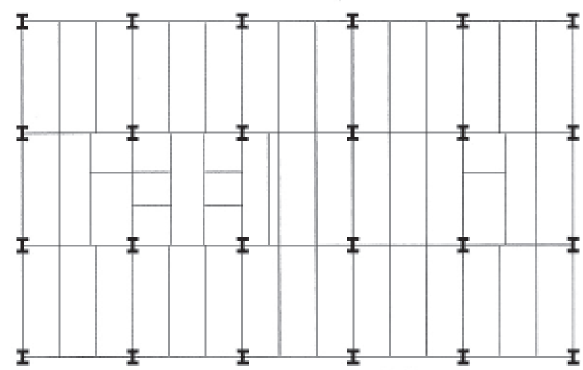
4. How much will a one-foot (305 mm) length of this built-up steel box column weigh, including the corner welds? Hint: Calculate the cross-sectional area of the steel in this column, and relate it to an area/weight ratio calculated from Figure 11.12 of the text, or use the density of steel from Figure 11.91. Show calculations.

Scale: 3" = 1' (1:4)
1 square = 1" (25 mm)

The complete structural design of a steel building frame is an involved process, but it begins with the laying out of a framing plan, which can be rather simple for many buildings. See Figure 11.42 in the text for example of a typical structural steel framing plan.



Step 1-Find an overall bay spacing that works.



Step 2-Insert special framing around openings, then add the rest of the framing.

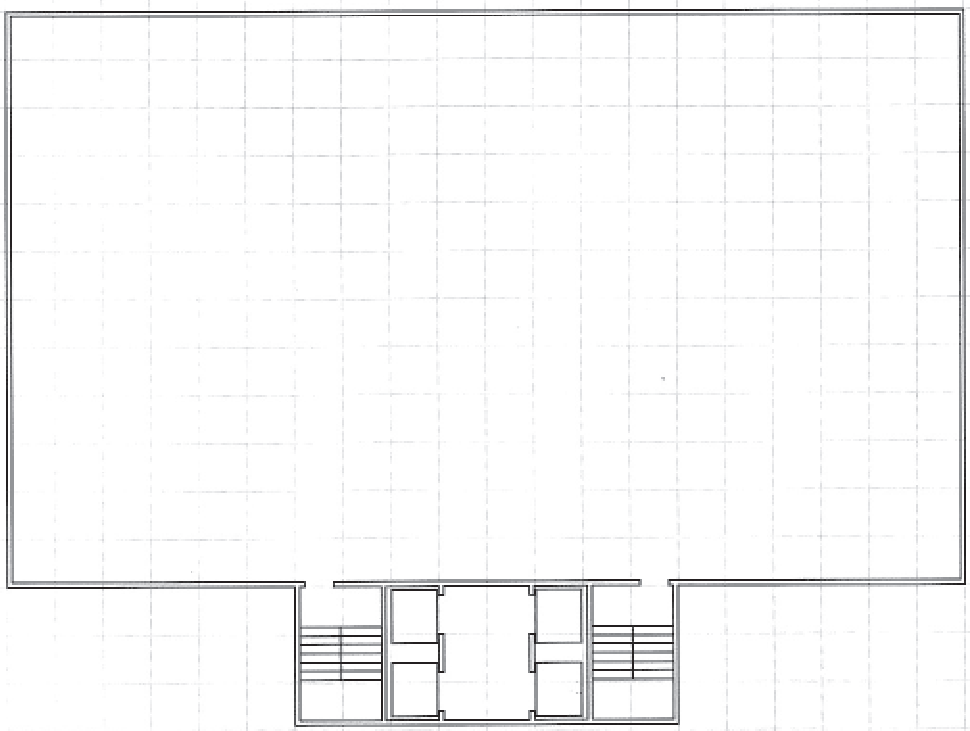
Usually the bay spacings in a steel frame are kept to about 36' (11 m) or less in order to minimize the size of the beams and girders, and bay sizes are kept constant except where interruptions such as elevator shafts and stairs occur. A good way to begin laying out a framing plan is to use freehand overlays on tracing paper to try dividing the building plan into a number of different sizes and shapes of bays, until one layout shows promise of working better than the others.

Then special arrangements of beams and girders, much like the headers and trimmers used around openings in platform frame wood floors, must be designed to frame around stairs and shafts. Move lines of columns on tracing paper until you arrive at a simple, logical layout that avoids excessive irregularities. (Usually the architectural plan can be adjusted slightly if necessary to arrive at a satisfactory framing plan.) Check to be sure that the layout does not involve excessively long spans, which are costly, or spans that are so short that they require too many columns and/or cut the habitable space of the building into too many little pieces.

Within a typical bay, the layout of girders, beams, and decking should be done with the aid of the rules of thumb on page 373 of

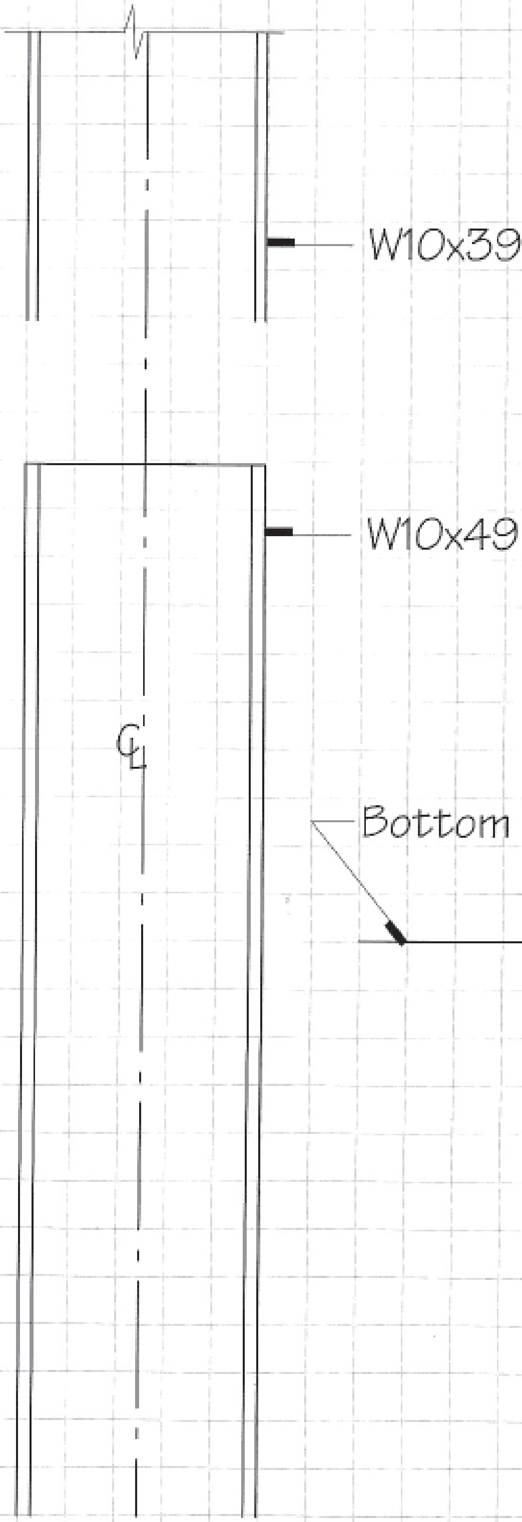
(continued from previous page)
the text. Select a trial depth and type of deck, and lay out girders to support the beams or joists. Determine preliminary depths for each of these members--are they reasonable? If not, adjust spacings and sizes until they are.

You are designing an 8- to 10-story regional office building in downtown Omaha, Nebraska, for Associated Mutual Casualty and Life Corporation. Three possible plan arrangements for a typical floor of the building are shown below and on the following page. Draw a feasible framing plan over each of the plans, and give approximate depths for the typical beams and girders. Assume that you will use W10 columns.



Name: ____________________ Scale: 1" = 20' (1:250) 1 square = 5'-0" (1.5 m)

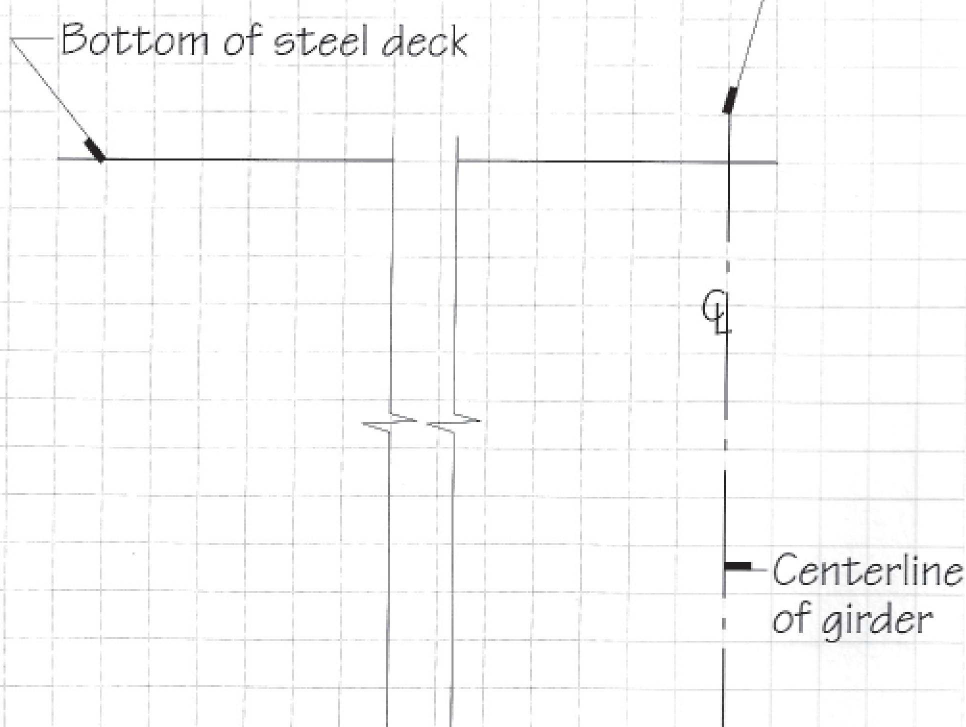
1. Select any exterior column location from one of the framing plans you developed in Exercise 11.2 and draw details for it as specified. A W10x49 column is assumed.



a. (left) A W10x39 column rests on the W10x49 column; design and draw the connection.

b. (below left) Design and draw the beam and girder shear connections to the column. Use 7/8" bolts and the longest angles that will fit. Show an end clearance of 3/4" (see Figure 11.26 in the text).

c. Draw a beam-to-girder connection here. Top faces of the beam and girder should be flush.



Name: ______________________ Scale: 1 1/2" = 1'-0" (1:8) 1 square = 2" (50 mm)