

Two conditions occur so frequently in building structures that their formulas and shear and moment diagrams are worth remembering. These conditions are: (1) a simple beam with a uniformly distributed load over the entire span, and (2) a simple beam with a concentrated load at midspan.

The beam diagrams and formulas for these two conditions are shown in Figure 2.24, reprinted from the AISC Manual by permission of the American Institute of Steel Construction.

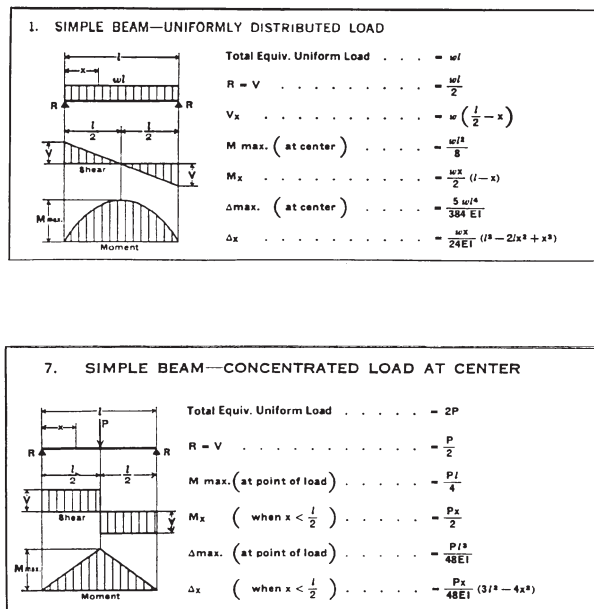


Figure 2.24

Example #8

A simple beam 20 feet long has a concentrated load of 5,000 lbs. at midspan. What is the maximum shear (V) and the maximum bending moment (M)?

Solution:

From the second diagram in Figure 2.24,

$$\text{Maximum } V = \frac{P}{2} = \frac{5,000}{2} = 2,500\#$$

$$\text{Maximum } M = \frac{PL}{4} = \frac{5,000(20)}{4} = 25,000\#$$

Example #9

The framing system for a floor consists of beams spaced at six feet on center which span 32 feet between girders. The beams support a uniform load of 100 pounds per square foot. What is the maximum shear (V) and the maximum bending moment (M) for each floor beam?

Solution:

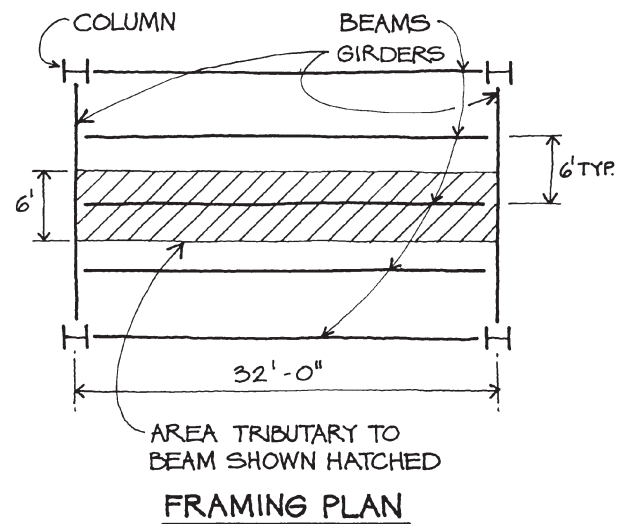
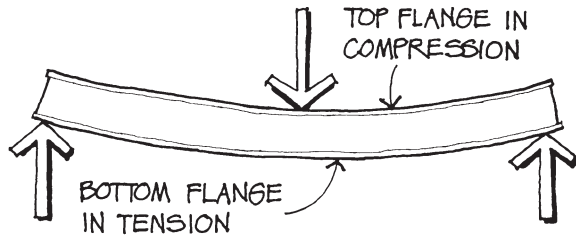


Figure 2.25

The floor area supported by each beam, known as the beam's *tributary area*, extends halfway to each adjacent beam and the full length of the beam, as shown in Figure 2.25. The uniformly distributed load (w) in pounds per lineal foot supported by each beam is equal to the load in pounds per square foot (100) multiplied by the beam spacing in feet (6), or $100 \times 6 = 600$ lbs. per foot.

$$\text{Maximum } V = \frac{wL}{2} = \frac{600(32)}{2} = 9,600\#$$

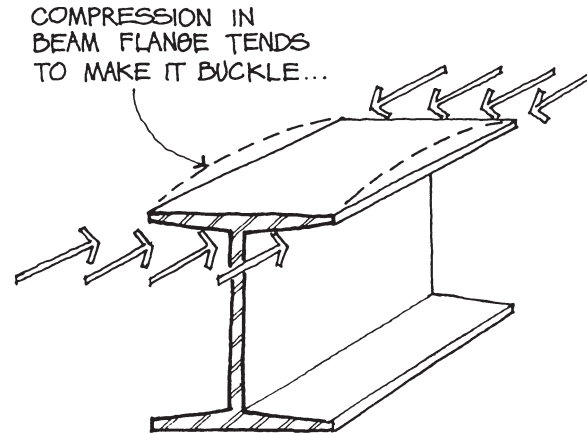
$$\text{Maximum } M = \frac{wL^2}{8} = \frac{600(32)^2}{8} = 76,800\#$$



SIMPLE BEAM

- BENT CONCAVE UPWARD
- POSITIVE MOMENT

Figure 4.6



The compression flange of a steel beam is similar to a column. Its compressive stress tends to make it buckle, just as a column tends to buckle under compressive load, as shown in Figure 4.8.

If lateral support is provided, the beam cannot buckle laterally, and the full allowable bending stress may be used. However, if the beam is laterally unsupported, its tendency to buckle reduces its ability to resist moment.

Most simple beams used in building framing have continuous lateral support along the top (compression) flange provided by the floor or roof construction. Some examples are shown in Figures 4.9 and 4.10.

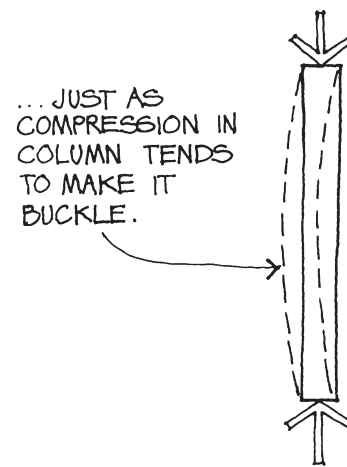
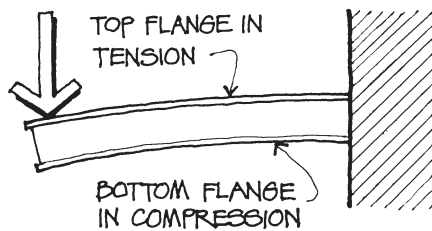


Figure 4.8



CANTILEVER BEAM

- BENT CONCAVE DOWNWARD
- NEGATIVE MOMENT

Figure 4.7

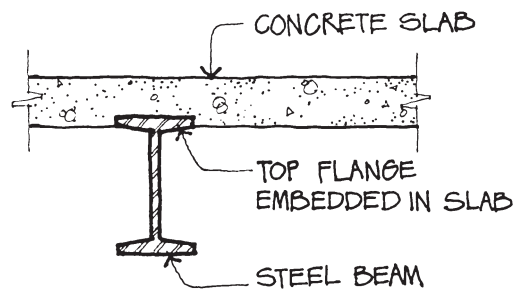


Figure 4.9

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