and the maximum values of shear and moment are compared.

Sloping beam method (left rafter illustrated)	*Horizontal plane method* (right rafter illustrated)

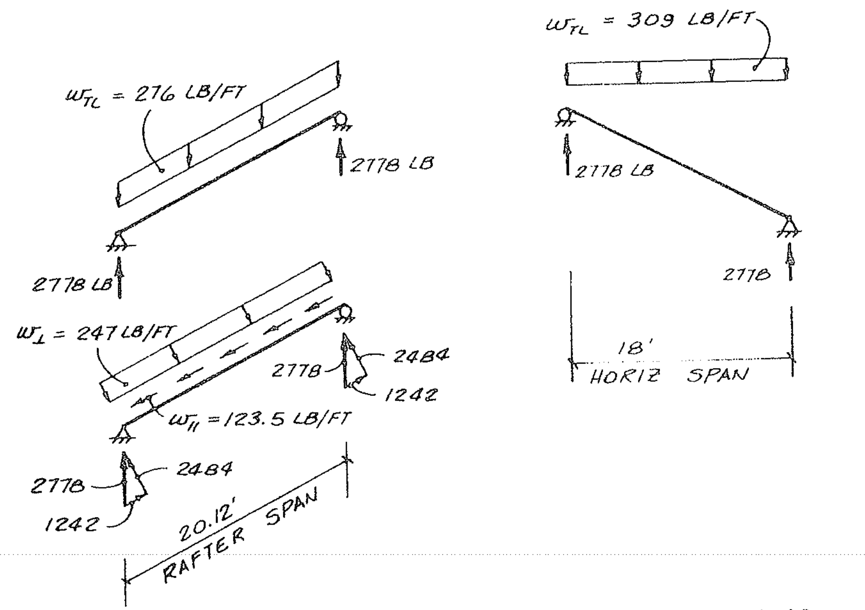

Figure 2.5b Comparison of *sloping beam method* and *horizontal plane method* for determining shears and moments in an inclined beam.

Sloping beam method:

$$TL = DL + SL = 10 + 66\left(\frac{18}{20.12}\right) = 69 \text{ psf}$$

$$w = 69 \text{ psf} \times 4 \text{ ft} = 276 \text{ lb/ft}$$

Use load normal to roof and rafter span parallel to roof.

$$V = \frac{wL}{2} = \frac{0.247(20.12)}{2} = 2.48 \text{ k}$$

$$M = \frac{wL^2}{8} = \frac{0.247(20.12)^2}{8} = 12.5 \text{ ft-k}$$

Horizontal plane method:

$$TL = DL + SL = 10\left(\frac{20.12}{18}\right) + 66 = 77.2 \text{ psf}$$

$$w = 77.2 \text{ psf} \times 4 \text{ ft} = 309 \text{ lb/ft}$$

Use total vertical load and projected horizontal span.

$$V = \frac{wL}{2} = \frac{0.309(18)}{2} = 2.78 \text{ k} \quad \text{(conservative)}$$

$$M = \frac{wL^2}{8} = \frac{0.309(18)^2}{8} = 12.5 \text{ ft-k} \quad \text{(same)}$$

NOTE: The horizontal plane method is commonly used in practice to calculate design values for inclined beams such as rafters. This approach is convenient and gives equivalent design moments and conservative values for shear compared with the sloping beam analysis. (By definition *shear* is an internal force *perpendicular* to the longitudinal axis of a beam. Therefore, the calculation of shear for the left rafter in this example is theoretically correct.)

The designer should understand that the snow load provisions given in UBC Chap. 23 have been in the Code for many years, and these requirements represent a simplified approach to design criteria. For example, the Code merely states that the "potential accumulation of snow at valleys, parapets, roof structures and offsets in roofs of uneven configuration shall be considered." However, the method of handling the increased snow load because of this accumulation is not specified, and the procedure is left to the discretion of the designer.

There are more comprehensive snow load criteria available for use in design. ASCE 7-88 (Ref. 5.1) provides a thorough treatment of snow load which includes, among many other refinements, a method of accounting for the buildup of snow. Steps have been taken to include these more complete snow load provisions in the UBC by allowing the designer to use the Appendix to UBC Chapter 23. This appendix incorporates the essentials of ASCE 7-88 in a somewhat simplified and condensed form. After an appropriate trial use period, it is expected that the material in this appendix will be incorporated into the main body of the UBC. *The BOCA National Building Code* (Ref. 21) and the *Standard Building Code* (Ref. 22) currently use snow load criteria based on ASCE 7-88.

2.6 Floor Live Loads

As noted earlier, floor live loads are specified in UBC Table 23-A. These loads are based on the occupancy or use of the building. Typical *occupancy* or *use* floor live loads range from a minimum of 40 psf for residential structures to much larger values, say 250 psf, for heavy storage facilities.

These Code unit live loads are for members supporting small tributary areas. A small tributary area is defined as an area of 150 ft^2 or less. From the previous discussion of tributary areas, it will be remembered that the magnitude of the *unit* live load can be reduced as the size of the tributary area increases.

It should be pointed out that no reduction is permitted where live loads exceed 100 psf or in areas of public assembly. Reductions are not allowed in these cases because an added measure of safety is desired in these critical structures. In warehouses with high storage loads and in areas of public assembly (especially in emergency situations), it is possible for high unit loads to be distributed over large surface areas.

However, for the majority of wood-frame structures, reductions in floor