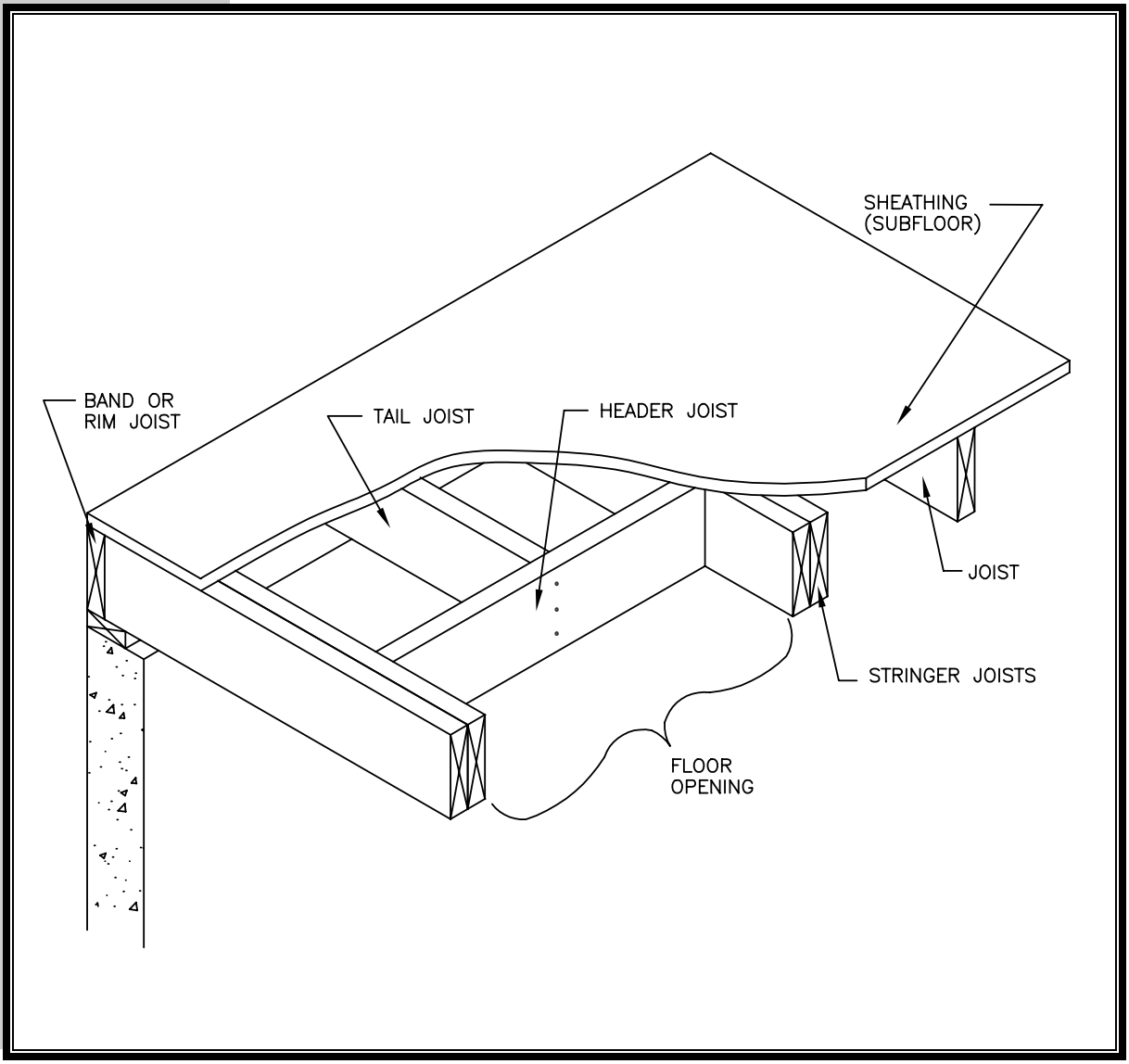
FIGURE 5.2 Structural Elements of the Floor System



The design approach discussed herein addresses solid sawn lumber floor systems in accordance with the procedures specified in the *National Design Specification for Wood Construction* (NDS), with appropriate modifications as noted. For more information regarding wood I-joists, trusses, and other materials, consult the manufacturer's specifications and applicable code evaluation reports.

Section 5.3 discusses the general design equations and design checks for the NDS. The present section provides detailed design examples that apply the equations in Section 5.3, while tailoring them to the design of the elements in a floor system. The next sections make reference to the span of a member. The NDS defines span as the clear span of the member plus one-half the required bearing at each end of the member. This guide simply defines span as the clear span between bearing points.

When designing any structural element, the designer must first determine the loads acting on the element. Load combinations used in the analysis of floor

members in this guide are taken from Table 3.1 of Chapter 3. Given that only the dead loads of the floor system and live loads of occupancy are present in a typical floor system, the controlling design load combination for a simply-supported floor joist is D+L. For joists with more complicated loading, such as cantilevered joists supporting roof framing, the following load combinations may be considered in accordance with Chapter 3:

$D + L$
$D + L + 0.3 (L_r \text{ or } S)$
$D + (L_r \text{ or } S) + 0.3L$

5.4.2 Floor Joist Design

Readily available tables in residential building codes provide maximum allowable spans for different species, grades, sizes, and spacings of lumber joists. Some efficient concepts for floor joist design are also provided in *Cost Effective Home Building: A Design and Construction Handbook* (NAHB, 1994). Therefore, it is usually not necessary to design conventional floor joists for residential construction. To obtain greater economy or performance, however, designers may wish to create their own span tables or spreadsheets for future use in accordance with the methods shown in this section.

Keep in mind that the grade and species of lumber is often a regional choice governed by economics and availability; some of the most common species of lumber for floor joists are Hem-Fir, Spruce-Pine-Fir, Douglas-Fir, and Southern Yellow Pine. Bear in mind, too, that the most common sizes for floor joists are 2x8 and 2x10, although 2x12s are also frequently used. The following examples are located in Section 5.7 and illustrate the design of typical floor joists in accordance with the principles discussed earlier:

- simple span joist (Examples 5.1 and 5.2); and
- cantilevered joist (Example 5.3).

For different joist applications, such as a continuous multiple span, the designer should use the appropriate beam equations (refer to Appendix A) to estimate the stresses induced by the loads and reactions. Other materials such as wood I-joists and parallel chord floor trusses are also commonly used in light-frame residential and commercial construction; refer to the manufacturer's data for span tables for wood I-joists and other engineered wood products. For additional information on wood floor trusses that can be ordered to specification with engineering certification (i.e., stamped shop drawings), refer to Section 5.6.3 on roof trusses. Cold-formed steel floor joists or trusses may also be considered. Figure 5.3 illustrates some conventional and alternative floor joist members.