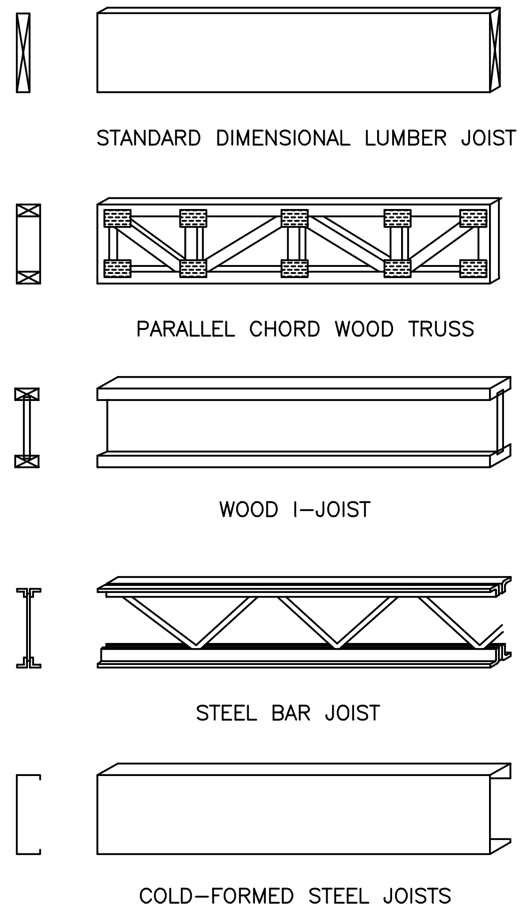
FIGURE 5.3 Conventional and Alternative Floor Framing Members



Notes:
[1]Trusses are also available with trimmable ends.
[2]Cold-formed steel is also used to make floor trusses.

For typical floor systems supporting a concentrated load at or near center span, load distribution to adjacent joists can substantially reduce the bending stresses or moment experienced by the loaded joist. A currently available design methodology may be beneficial for certain applications such as wood-framed garage floors that support heavy concentrated wheel loads (Tucker and Fridley, 1999). Under such conditions, the maximum bending moment experienced by any single joist is reduced by more than 60 percent. A similar reduction in the shear loading (and end reaction) of the loaded joist also results, with exception for “moving” concentrated loads that may be located near the end of the joist, thus creating a large transverse shear load with a small bending moment. The above-mentioned design methodology for a single, concentrated load applied near mid-span of a repetitive member floor system is essentially equivalent to using a C_r factor of 1.5 or more (see Section 5.2.4.2). The system deflection adjustment factors in Table 5.6 are applicable as indicated for concentrated loads.

Bridging or cross-braces were formerly thought to provide both necessary lateral-torsional bracing of dimension lumber floor joists and stiffer floor systems.

However, full-scale testing of 10 different floor systems as well as additional testing in completed homes has conclusively demonstrated that bridging or cross-bracing provides negligible benefit to either the load-carrying capacity or stiffness of typical residential floors with dimension lumber framing (sizes of 2x6 through 2x12) and wood structural panel subflooring (NAHB, 1961). These same findings are not proven to apply to other types of floor joists (i.e., I-joists, steel joists, etc.) or for dimension lumber joists greater than 12 inches in depth. According to the study, bridging may be considered necessary for 2x10 and 2x12 dimension lumber joists with clear spans exceeding about 16 feet and 18 feet, respectively (based on a 50 psf total design load and L/360 deflection limit). To the contrary, the beam stability provisions of NDS•4.4.1 conservatively require bridging to be spaced at intervals not exceeding 8 feet along the span of 2x10 and 2x12 joists.

5.4.3 Girder Design

The decision to use one girder over another is a function of cost, availability, span and loading conditions, clearance or head-room requirements, and ease of construction. Refer to the Figure 5.4 for illustrations of girder types. Girders in residential construction are usually one of the following types:

- built-up dimension lumber;
- steel I-beam;
- engineered wood beam;
- site-fabricated beam;
- wood I-joist; or
- metal plate connected wood truss.

Built-up beams are constructed by nailing together of two or more plys of dimension lumber. Since load sharing occurs between the plys (i.e., lumber members), the built-up girder is able to resist higher loads than a single member of the same overall dimensions. The built-up member can resist higher loads only if butt joints are located at or near supports and are staggered in alternate plys. Each ply may be face nailed to the previous ply with 10d nails staggered at 12 inches on center top to bottom. The design method and equations are the same as those in Section 5.4.2 for floor joists; however, the adjustment factors applying to design values and loading conditions are somewhat different. The designer needs to keep the following in mind:

- Although floor girders are not typically thought of as “repetitive” members, a repetitive member factor is applicable if the floor girder is built-up from two or more members (three or more according to the NDS).

- The beam stability factor, C_L, is determined in accordance with NDS•3.3.3; however, for girders supporting floor framing, lateral support is considered to be continuous and $C_L = 1$.

Example 5.4 illustrates the design of a built-up floor girder.