Structural steel is a versatile building material. While it can be used in a great variety of ways, consider the following guidelines for what is most economical in common practice.

FLOOR AND ROOF FRAMING

The most economical span range for conventional steel floor and roof framing is from 25 to 40 ft (8 to 12 m). Individual column bays should be approximately 1,000 square feet (95 m^2) in area, and rectangular in shape, with the long side 1.25 to 1.5 times as long as the shorter side. Above spans of approximately 40 feet (12 m), consider open-web steel joists for their lighter weight and greater economy (see pages 100–101).

The spacing between individual beams depends on the applied loads and the decking system. Spacings from 6 to 15 ft (1.8 to 4.6 m) are common with corrugated steel and concrete slab decking. Spacings up to approximately 8 ft (2.4 m) are typical for roof decking systems.

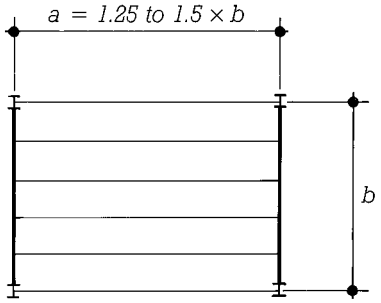
BEAM AND GIRDER CONFIGURATION

The orientation of beams and girders in a floor or roof framing system may depend on a variety of factors. In relation to the building at large, it may be advantageous to run girders parallel to the building's shorter axis, the direction most susceptible to lateral forces. In this way, these stronger members can contribute additional lateral resistance to the building through rigid frame action.

Within individual column bays, it is usually more economical to run girders in the shorter direction of a rectangular bay, allowing the lighter beams to span the longer way. However, when cellular decking is used as part of a wiring system, beam and girder directions may be set so that the wire conduits within the decking run in preferred directions as required by communications or power distribution plans (see page 187).

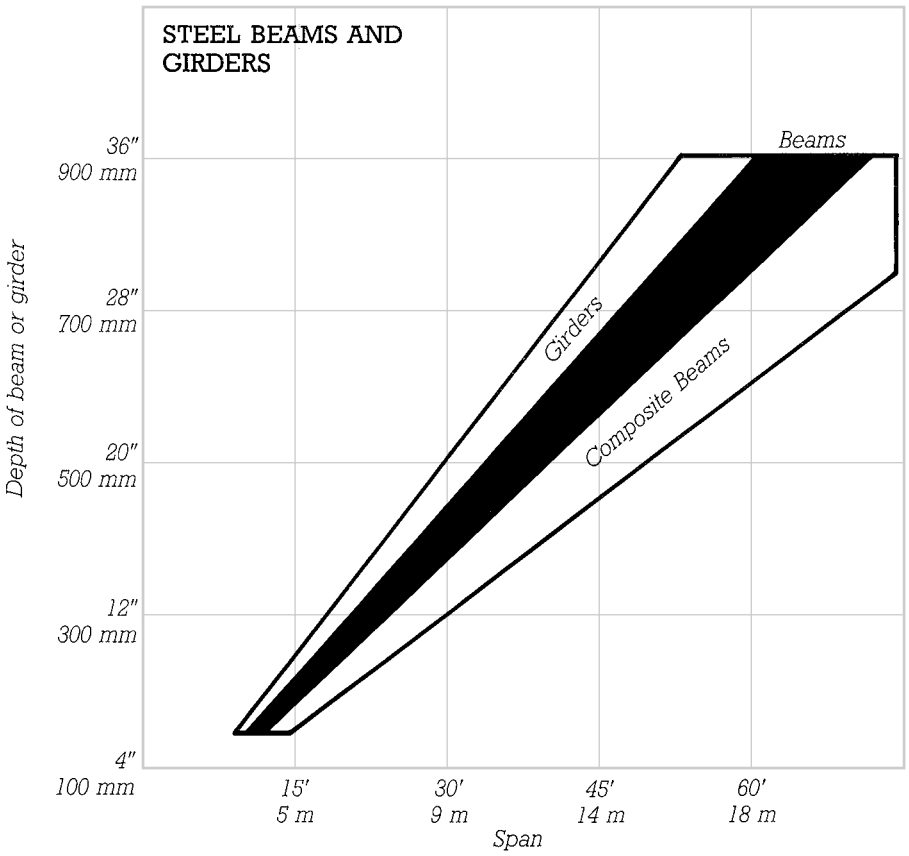
COMPOSITE BEAMS

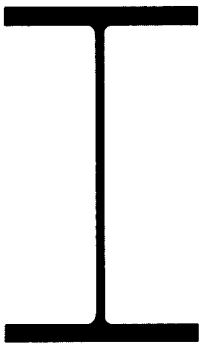
In composite construction, shear studs are added to the top of the floor beams. This causes the concrete deck and steel framing to act as a unified structural element and results in reduced beam depths. Composite construction can be more economical, particularly at longer spans. However, a thicker concrete deck may be required. In some cases "partial" composite design, where fewer studs are used and less than full composite action is achieved, proves to be the most economical solution.



For economical framing of steel bays, the lighter beams should span 1.25 to 1.5 times the span of the heavier girders. Bay area should equal approximately 1000 ft² (95 m²).

STEEL BEAMS AND GIRDERS





This chart is for steel wide-flange beams and girders. For average and light loads, read toward the right in the indicated areas. For heavy loads, read toward the left.

- For beams acting as girders or as composite beams, read in the open areas indicated.
- Beams or girders also acting as part of a rigid frame for lateral stability may be deeper than indicated by this chart.
- Typical widths of beams and girders range from approximately one-third to one-half the depth of the member. Heavy sections used for heavy loads or to conserve depth may be wider.
- Depths of up to 36 in. (914 mm) are available as standard rolled sections. Greater depth beams capable of longer spans may be shop fabricated.

FIRE-RESISTANCE RATINGS FOR STEEL BEAMS AND GIRDERS

Exposed steel beams and girders may be used in Unprotected Noncombustible construction. Fire-resistance ratings of as high as 4 hours are easily achieved with applied fireproofing or an appropriately fire resistive ceiling. Some building codes also allow reduced fire protection or exposed steel for roof structures that are 15 to 25 ft (4.6 to 7.6 m) or more above the floor.

OPEN-WEB JOIST FRAMING

The light weight of open-web steel joists makes them an economical alternative to conventional structural steel members for spans greater than 30 to 40 ft (9 to 12 m). Where significant concentrated loads exist, open-web joists may need to be supplemented with additional structural members.

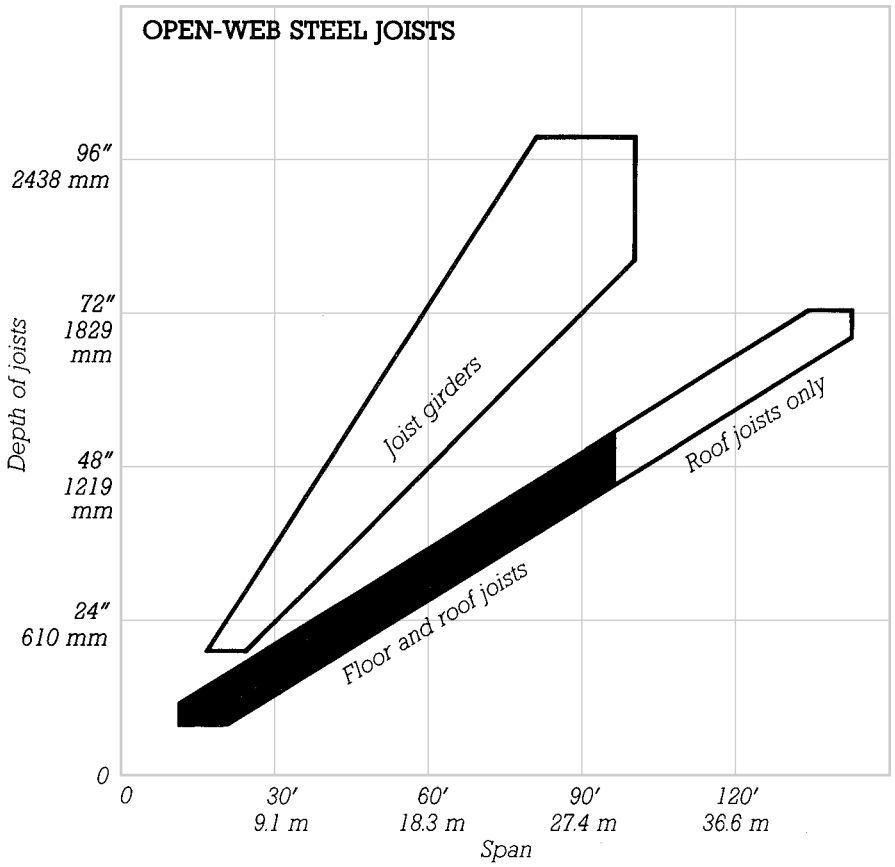
Girders used with open-web joists may be joist girders (a heavier version of an open-web joist) or conventional structural steel members. For greater loads and spans, heavy steel trusses may also be used. For rectangular bays, the joists usually span the longer direction. (See pages 98–99 for structural steel beams and girders and pages 104–105 for heavy steel trusses.)

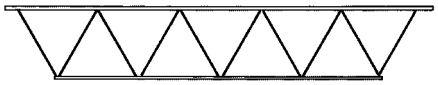
A variety of proprietary composite systems are also available. Such systems are particularly effective at overcoming the excessive flexibility sometimes encountered with long-span joist systems.

FIRE-RESISTANCE RATINGS FOR OPEN-WEB STEEL JOISTS

Exposed open-web joists and joist girders may be used in Unprotected Noncombustible construction. Fire-resistance ratings of as high as 3 hours are easily achieved with applied fireproofing or an appropriately fireresistive ceiling. The fire-resistive ceiling is used more commonly, due to the difficulty of applying fireproofing directly to the complex surfaces of an open-web joist. Some building codes also permit reduced fire protection or exposed steel for roof structures that are 15 to 25 ft (4.6 to 7.6 m) or more above the floor.

STEEL OPEN-WEB JOISTS





This chart is for open-web steel joists and joist girders for floors and roofs. For light loads or close joist spacings, read toward the right in the indicated areas. For heavy loads or large joist spacings, read toward the left.

■ Joist spacings range from 2 to 10 ft (0.6 to 3.0 m) or more, depending on the floor loads and the decking system applied over the joists.

■ Joists generally come in depths of 8 to 32 in. in 2-in. increments (from 203 to 813 mm in 51-mm increments) and from 32 to 72 in. in 4-in. increments (from 813 to 1829 mm in 102-mm increments). Availability of sizes varies with the manufacturer.

■ Joist girders come in depths of 20 to 96 in. in 4-in. increments (from 508 to 2438 mm in 102-mm increments).

RELATED DIMENSIONS FOR SINGLE-STORY RIGID STEEL FRAMES

For the span ranges indicated on the chart on the facing page, the following dimensions may be used:

Wall Height	Depth at Base	Roof Pitch
8'–30' (2.4–9.1 m)	7"–21" (178–533 mm)	1:12–4:12

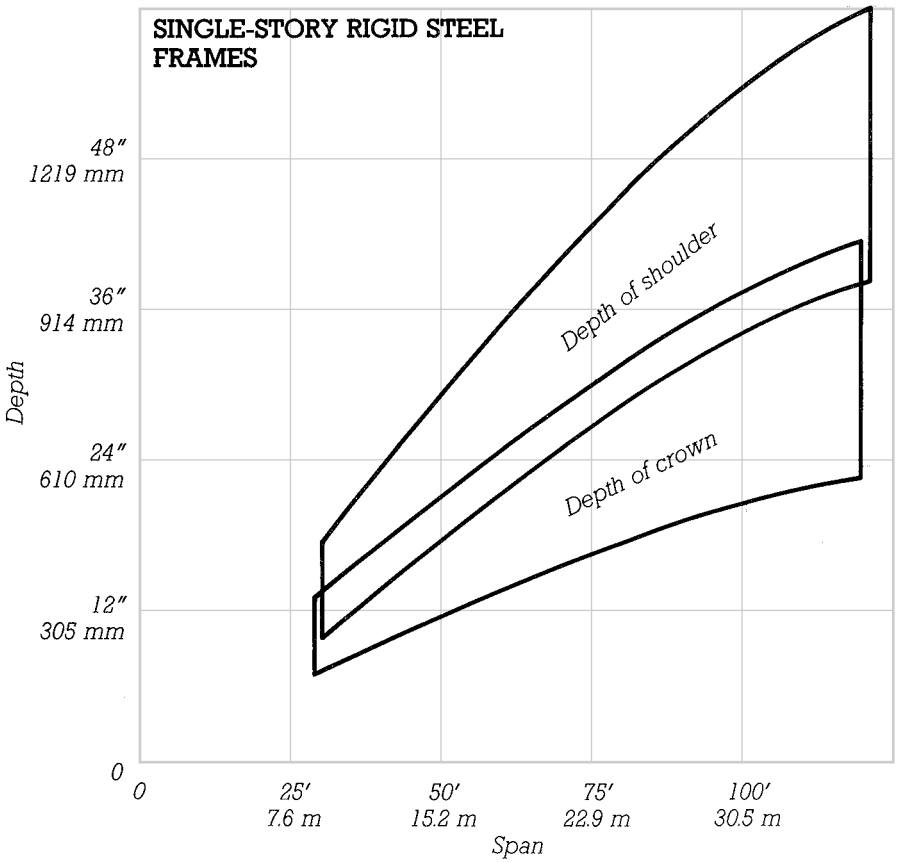
Typical spacing of frames is 20 or 25 ft (6.1 or 7.6 m).

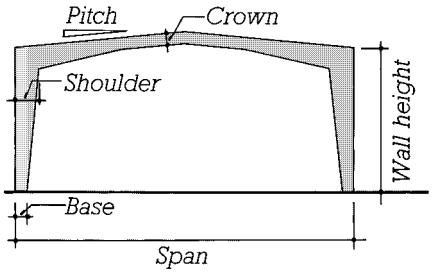
For variations on the rigid frame system, or for sizes outside the range of those shown in the chart, consult with individual manufacturers.

FIRE-RESISTANCE RATINGS FOR SINGLE-STORY RIGID STEEL FRAMES

Exposed steel frames may be used in Unprotected Noncombustible construction. Fire-resistance ratings of as high as 4 hours are easily achieved with applied fireproofing or an appropriately fire-resistive ceiling. Some building codes also allow reduced fire protection or exposed steel for roof structures that are 15 to 25 ft (4.6 to 7.6 m) or more above the floor.

SINGLE-STORY RIGID STEEL FRAMES





This chart is for single-story rigid steel frame structures. For heavy loads, read toward the top in the indicated areas. For light loads, read toward the bottom.

■ Spans as great as 200 ft (61.0 m) or more may be available from some manufacturers. Greater spans are also available with the use of intermediate columns.

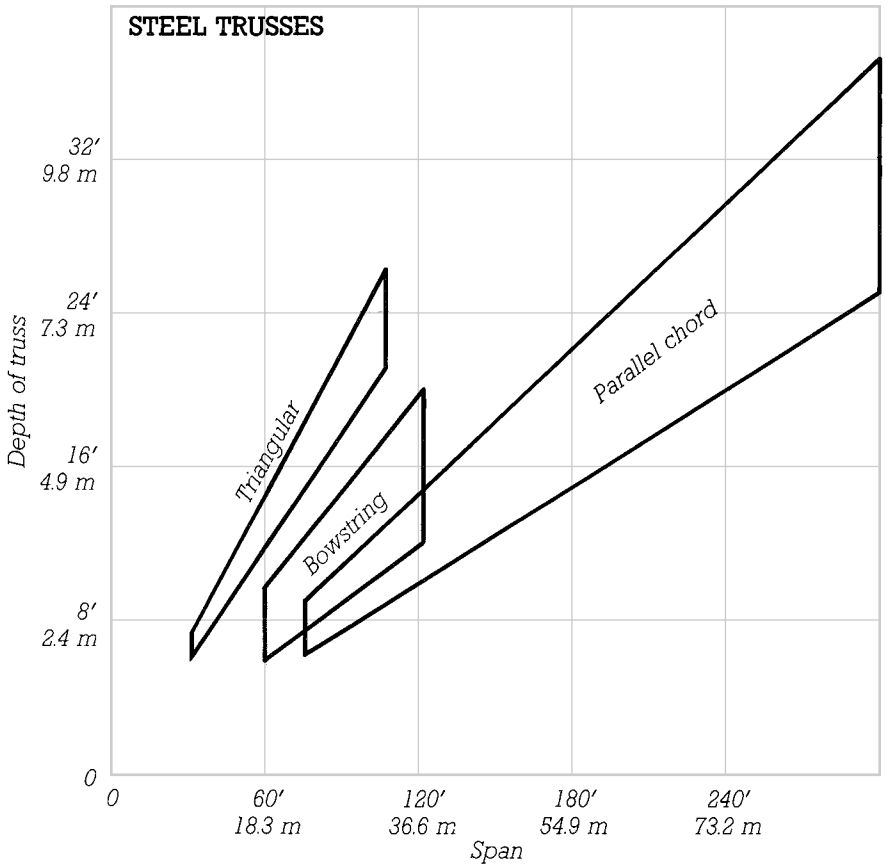
ECONOMICAL SPAN RANGES FOR PARALLEL CHORD TRUSSES

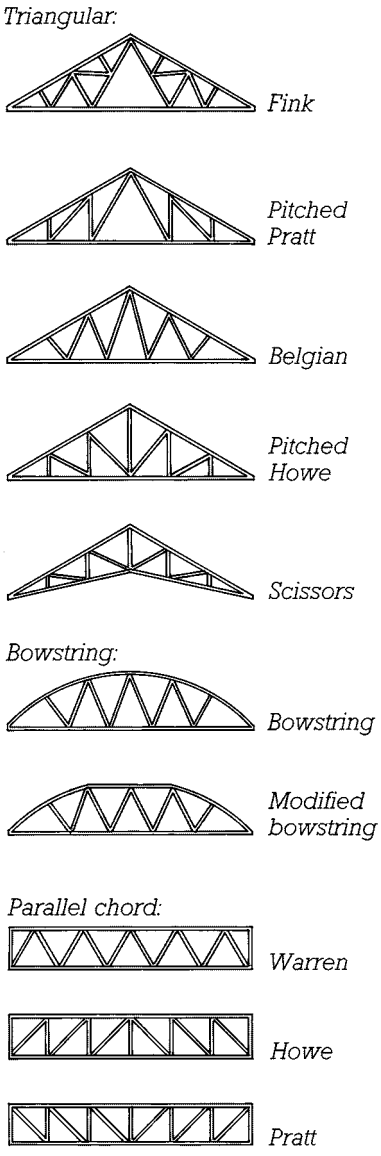
Parallel chord trusses are most economical for spans up to 120 to 140 ft (35 to 45 m), due to the increased difficulty of shipping elements greater than 12 ft (3.7 m) deep. Triangular and bowstring trusses can be shipped at slightly greater depths. Trusses spanning 300 ft (90 m) or more may be fabricated on-site.

FIRE-RESISTANCE RATINGS FOR STEEL TRUSSES

Exposed steel trusses may be used in Unprotected Noncombustible construction. Fire-resistance ratings of as high as 4 hours are easily achieved with applied fireproofing or an appropriately fire-resistive ceiling. Some building codes also allow reduced fire protection or exposed steel for roof structures that are 15 to 25 ft (4.6 to 7.6 m) or more above the floor.

STEEL TRUSSES





This chart is for steel trusses fabricated from structural steel members. Because these trusses are custom designed and fabricated, a great variety of shapes and configurations are possible.