The Features and Benefits of Steel Joists

Steel joists have always been popular for a variety of reasons. These include outstanding strength-to-weight ratios, economy, ease of erection in nearly any weather, high durability and infinite flexibility.

Strength-to-Weight and Multi-Directional Strength

More and more engineers are weighing the benefits of steel and steel joist construction. One reason is the amazing strength-to-weight ratio of steel joists which typically runs 25 to 1. And, steel can perform in both tension and compression, unlike concrete which must be steel reinforced to resist tensile forces. With their high strength-to-weight ratio, steel joists can support greater loads.

Steel itself is a wonderfully ductile material. This ductility means that steel can be more forgiving than concrete in situations such as the recent earthquakes in California. Steel can take uplift and gravity loading because steel has inherent strength in each direction.

Economy

A high strength-to-weight ratio coupled with low price per pound of steel joists contributes significantly to lower building costs. An additional economy stemming from joists’ light weight is that structural supports such as beams, columns and foundations can be lighter in many cases. This further reduces material cost.

Cost-Saving Ease of Erection

Steel erection is faster than concrete. You don’t have the expensive labor costs for setting custom-fitting forms and installing reinforcing rods at the job site. You can work with steel in almost any weather, whereas concrete pouring is limited below 40°F and, in some cases, is not recommended when the temperature exceeds 90°F. And, you don’t have to wait for curing and stripping forms because, once the steel joists are properly erected and the deck installed, you’ve immediately created a permanent working platform to begin construction of the next level.

Durability

Naturally, steel joists are subject to corrosion if left unprotected and exposed to hostile environments. Concrete can be affected in a similar way. It can crack and crumble when subjected to moisture and temperature extremes. However, steel joists have proven to be extremely durable in enclosed construction. Many years ago a bank building in New York City was torn down. The steel joists used in the construction had not suffered any deterioration despite being over 80 years old. And, the shop marks were still visible on the joists.

What You See Is What You Get

In an age of increasing liability and fault-finding, steel joist construction is much easier to inspect because it’s exposed. The specifier can see what’s been used and what’s been done for himself. He can check the design, measure every member of the joist and review connections and fastening methods. Once concrete is poured the reinforcing bars are hidden from view. The specifier must then rely solely on the integrity of his contractor and the construction crew to assure that the job has been done properly.

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Fire Resistance

The perception has been that a concrete structure possesses greater fire resistance than steel joists. It is true that high-strength steel when exposed to temperatures in the range of 1100°F will exhibit a loss of strength. However, assemblies using steel joists with spray-on fireproofing or fire resistant ceiling panels can create fire resistance ratings of up to four hours, a range of ratings similar to those for concrete.

Last year, Underwriters Laboratories, Inc., increased the allowable design stress for fire-rated steel joists by 36 percent for floors and 18 percent for roofs. The allowable tensile stress of joists used in most fire rated assemblies has been increased to 30,000 psi for floors and 26,000 psi for roofs, as compared to the previous maximum stress level of 22,000 psi. The new standards now make it more economical to achieve desired fire resistance ratings without added expense for heavier joists.

Infinite Flexibility

There is infinite flexibility in the design of a steel joist building because each joist is custom fabricated to the designer’s specifications. A variable number of depths, spans and load-carrying capacities can be custom specified and produced at the factory avoiding expensive on-site labor.

One example of the low cost and infinite flexibility of a steel joist is cantilevering. Cantilevering in concrete is an expensive, labor-intensive procedure. This involves considerable form set-up and carpentry to build the supporting structure to hold the concrete until it cures. With steel joists, cantilevering can be done by specifying an extended end or a full-depth cantilever. All of this work is done at the factory.

The design flexibility of long spans can also be achieved by using steel joists. Spans of over 100 feet are not uncommon. This is not only a factor in new construction, but the greater number of support columns needed in concrete construction often limits the designer’s ability to move walls and partitions when buildings are remodeled.

About the Author:
R. Donald Murphy is managing director of the Steel Joist Institute, a not-for-profit organization setting standards for the steel joist industry, and working closely with major building code bodies throughout the country helping to develop code regulations regarding steel joists and joist girders. The Institute also invests thousands of dollars in ongoing research related to steel joists and joist girders and offers a complete library of publications and other training and research aids.