Office Space

What you may not know about the "typical" steel-framed office building might suprise you!

BY ERIKA WINTERS DOWNEY

LOW- TO MID-RISE STRUCTURAL STEEL OFFICE BUILDINGS ARE OFTEN THOUGHT OF AS ROUTINE CONSTRUCTION. These buildings often use traditional composite design due to its efficiency and economy. In fact, there are design aspects inherent to structural steel office buildings that can give you a competitive advantage. Best of all, they are easy and straightforward to employ. Read on—you might learn something new!

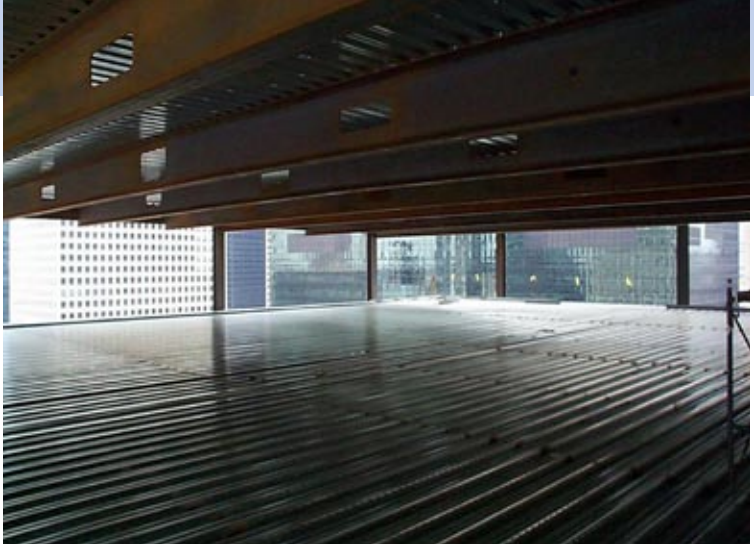
Structural Steel is Green Construction

In the green game, it's all about gaining credits. LEED credits can be obtained for using recycled material: structural steel is 95 percent recycled material, an average of 65 percent of which is post-consumer. In addition, credit is available by using local (within 500 miles) fabricators and building materials. Credit can also be obtained for reducing the amount of waste removed from the site by 50 percent. Because steel systems are fabricated in the shop and not in the field, there is virtually no waste. Any small amount of scrap that is produced on the site will be recycled. In addition, most steel systems do not use shoring—a major source of waste in concrete projects. For more information on LEED credits, refer to "Structural Steel Contributions Toward Obtaining a LEED Rating" in the May 2003 issue of MSC at www.modernsteel.com.

Big Buildings, Bare Steel

Did you know that you can build a *quarter-million* square foot office building that will require no fire protection system beyond sprinklers? It's true! The area limits for Type II construction for office buildings permit this. Here's how it works:

- Per Table 601 in the IBC 2003, construction Type IIB permits a 0-hour fire resistance rating. Type II construction is for buildings that have their main components built out of non-combustible material.
- For Group B (Business) occupancy, IBC Table 503 limits Type IIB construction to 4 stories with 23,000 ft^2 per story, with a maximum height of 55 ft. If you employ a sprinkler system, the maximum number of stories is increased by one and the maximum height is increased by 20 ft.
- Providing sprinklers also increases



Long spans and open vistas with steel mean less waste is created.

Shoring creates waste in concrete projects.

floor area limits 200 percent for multi-story buildings and 300 percent for single-story buildings (IBC 506.3). If you are able to take full advantage of frontage and separation per IBC section 506.2, another 75% can be added to the floor area. This means that any one floor of your building can be as large as 86,250 ft^2.

• The maximum allowable area for the total building is limited to three times the maximum floor area per IBC section 506.4. Thus, the maximum total building area is 258,750 ft^2 whether you have a three, four, or five story building.

Custom solutions can be designed by employing a fire protection engineer on your project. IBC section 703.3 explains that the designer has the choice of using either the code's prescriptive approach or an active design.

For example, fire protection engineers were able to design a custom system for the ADC Communications building in Eden Prairie, Minn., that satisfied the stringent local code, yet was still able to provide adequate protection. Two separate sprinkler systems were installed: one that provided a quick wash of primary framing, while a more traditional system covered the office space below. This system eliminated the need for spray-on fire protection on over 80 percent of the structure.

Avoiding spray-on fire protection means that the building designer is free to express the bare structure architecturally. It can also save your project the cost of the spray-on material and the labor to apply it.

Finding the Sweet Spot

Beam web penetrations can be extremely useful in enhancing the economy of your office project. Electrical, mechanical, plumbing, and fire protection systems can be run within the depth of the floor framing, decreasing overall floor-to-floor height. By using well-planned web openings, the typical office can save about 1 ft in plenum depth per floor.

AISC *Design Guide 2*, *Steel and Composite Beams with Web Openings*, outlines the design process for and proportioning of beam web penetrations. In general, the opening depth should be placed within the center two-thirds of the beam depth, and the center two-thirds of the beam span. Openings should not be placed under concentrated loads. Uniformly loaded simple-span composite beams are good candidates for web openings. The article "Design Aids for Unreinforced Web Openings in Steel Beams" in AISC's third quarter 2006 *Engineering Journal* includes charts to aid in quickly finding the "sweet spot" for locating beam penetrations—the areas that can accept openings without having to provide reinforcement.

Change Can Be a Good Thing

The space function in an office building is constantly in flux. Examples of typical changes include new tenant remodels, addition of storage space, mechanical units, skylights, or floor openings for stairs or elevators.

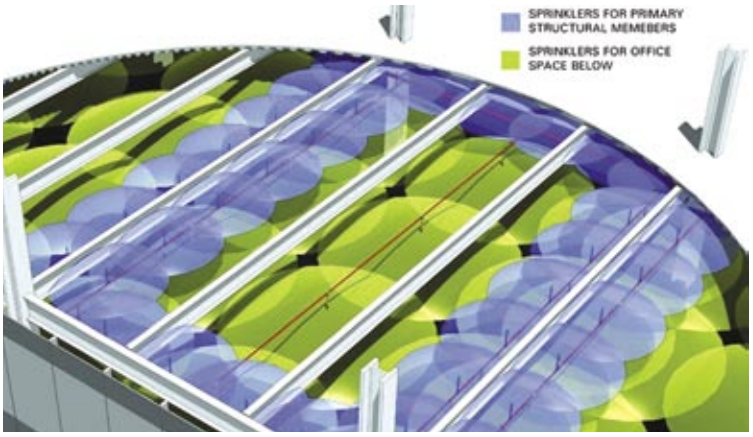
According to Kim Robinson, P.E., AISC's northwest regional engineer, steel office buildings offer you the ability to always work with your client's change requests. She personally has worked on steel office projects that have come back for tenant modifications. In the end, the adaptable steel structure was able to accommodate all the changes.

Steel systems inherently incorporate ease of modification. If additional strength is needed due to increased demands of storage or mechanical equipment, adding additional beams or coverplating existing beams are straightforward and economical solutions. For example, adding a 7 in. × ½ in. coverplate to the bottom flange of a W18×35 section raises the section modulus from 57.6 in.^{3} to 100.2 in.^{3}, thus increasing the positive moment-carrying capacity by 74 percent.

Long beam spans provide large open spaces, which is helpful should you have to reconfigure the use of a space. Beam spans in steel office buildings regularly reach 45 ft and longer. Fewer columns are required, providing ultimate flexibility to the designer both now as well as down the road, when modifications come along. Accordingly, fewer foundations are required, providing an immediate savings on material cost and labor.

Rehabilitation and renovation of steel buildings can be done with a great amount of accuracy. In an existing steel structure, the bare steel beams are usually easily acces-

Web penetrations provide savings in floor-to-floor height.



A custom fire protection solution can be cost-effective.

sible for quick inspection and verification. You don't have to guess as to what may be lurking, or the condition it's in. AISC's website at **www.aisc.org** has downloadable current and historical shape database information.

Additional Resources:

- *Design Guide 2, Steel and Composite Beams with Web Openings* (AISC)
- *Design Guide 11, Floor Vibrations due to Human Activity* (AISC)
- *Design Guide 15, Rehabilitation and Retrofit* (AISC)
- *Design Guide 19, Fire Resistance of Structural Steel Framing* (AISC)
- AISC is planning a design guide on façade attachments to steel frames for 2007. MSC

Erika Winters Downey is an advisor in AISC's Steel Solutions Center.

Steel is adaptable for future building renovations.