

RISING to the Challenge

BY JOE DARDIS, PE

As the high-rise market continues to grow, so do the opportunities for structural steel in skylines across the country.

A CITY IS OFTEN DEFINED by its skyline.

The number and height of its high-rise structures communicate a sense of accomplishment and economic prosperity—and in most American cities today, the growing number of skyscrapers underscores a trend of people and businesses moving back into dense urban cores.

Highs and Lows of High-Rises

While cities are certainly on the rise again, high-rise construction (20+ stories) has seen some dramatic changes over the last 25 years. Relative to total square footage of construction starts (nonresidential and residential four stories and higher), high-rise construction starts were relatively stable in the 1990s followed by a peak of around 6% during the economic boom

of the mid-2000s. High-rise starts took a deep dive during the Great Recession, bottoming out at about 1%, but have since recovered and peaked at about 6.5% in 2015 (Figure 1).

To understand the peaks and valleys, it's necessary to consider who or what is going into these buildings. With the exception of the early 1990s, multistory residential (MSR) has been the predominant use of high-rise buildings (Figure 2), followed in a distant second by office and finally by the occasional healthcare facility or government building. The largest variance between MSR and all other building types occurred in the early 2000s, followed by an almost equal, albeit low-volume, split between MSR and office during the great recession. MSR has gained back its dominance in recent years, accounting for roughly 85% of the high-rise market.

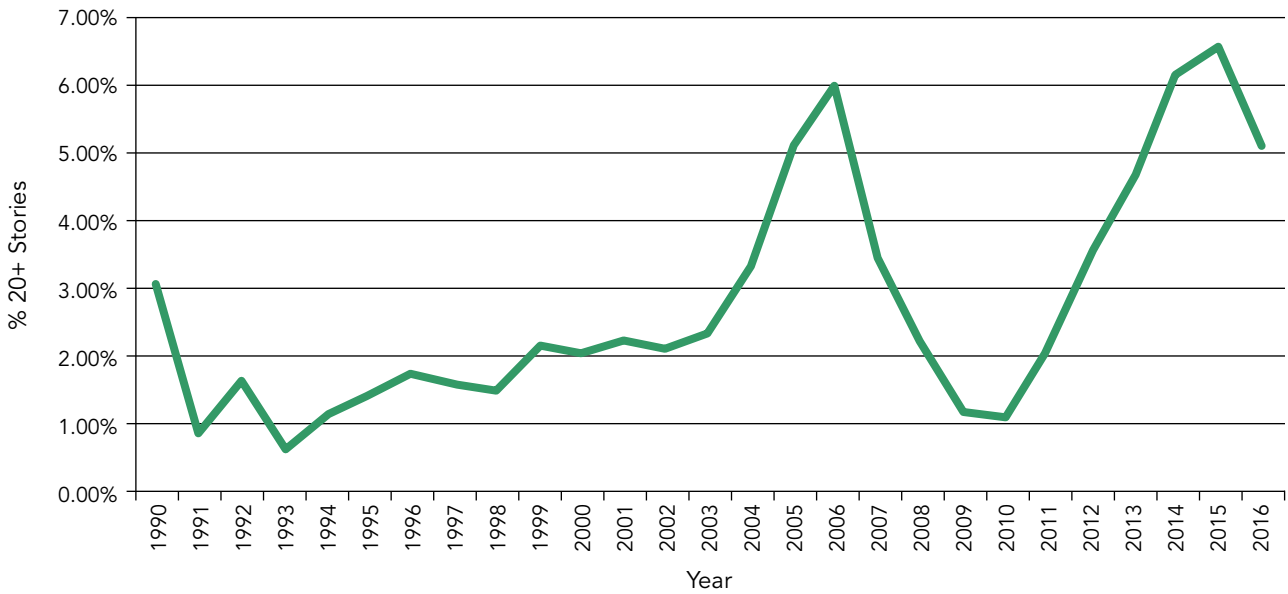
Looking at Figures 1 and 2 together, there is one strong inference to be made: During economic booms, there is a direct correlation between an increase in the percentage of high-rises relative to the overall construction market. This indicates that the increase in high-rise square footage in Figure 2 isn't just due the fact that overall square footage is up, but also that we tend to build taller buildings when the economy is humming along.

Where are these high-rises being built? Figure 3 shows the total number of high-rise starts by state between 2014 and 2016. It's no surprise that New York (specifically, the New York City metro area) is the dominant state for high rise buildings, followed by Florida, Illinois, California and Texas.



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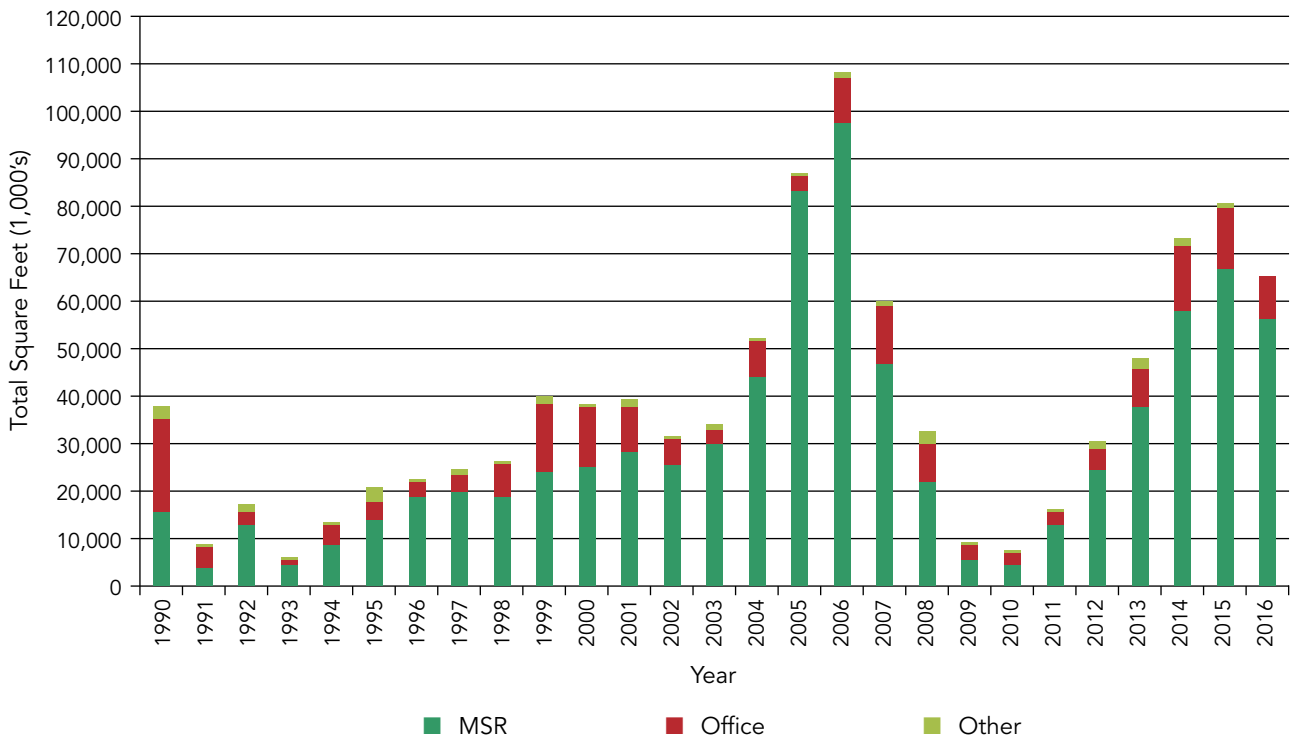
Percentage of Overall Construction by Square Footage 20+ Stories



▲ Figure 1. Overall U.S. construction in square feet.

▼ Figure 2. Total U.S. building square footage by occupancy.

Total Square Feet by Occupancy 20+ Stories



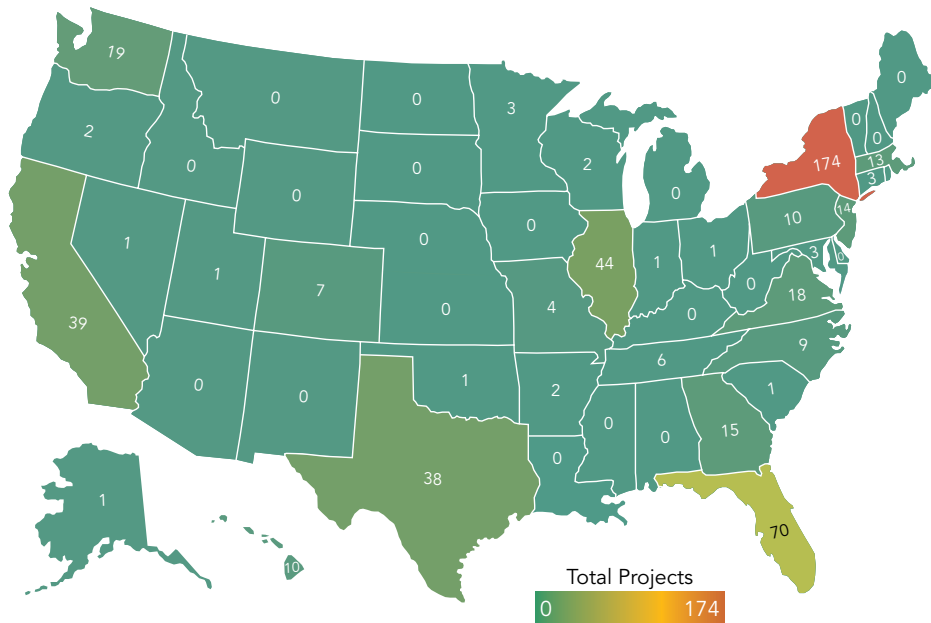


Figure 3. Total number of high-rise starts by state between 2014 and 2016.

Steel's Role

How does steel stack up? The percentage of high-rise construction using steel as the dominant framing material hovers around 40% to 50%, with a notable drop to the 20% to 30% range during the early 2000s (Figure 4). Putting this together with Figure 2 during this same time period, there is a direct correlation between the percentage of high-rises using steel and the variance in occupancy type between MSR and office. As the variance becomes smaller, as is the case in recent years, the percentage of high-rises using steel returns to the 40% to 50% range.

So what's next for steel in tall buildings? Recent innovations like steel plate composite walls and materials such as ASTM A913 and ASTM A1085 structural steel give steel a leg up in high-rise building design. Steel plate composite walls can be used as a lateral system in both high-seismic and high-wind regions. This system provides the strength, stiffness, safety and serviceability of a reinforced concrete core without the negatives of rebar congestion and complex formwork. The core and perimeter steel can rise in tandem, resulting in much faster erection. This leads to a reduced overall schedule, lowered overhead and general conditions costs and earlier rental

their projects, reducing overall tonnage on a project. In addition, using A913 can eliminate the use of built-up column sections in some scenarios, which can result in big savings when it comes to fabrication costs. Lastly, using a lighter column section, particularly at the base of a building, puts less demand on the crane. In situations where a heavier column would require a crane with a higher load capacity, A913 can address that constructability challenge.

A1085, which increases the design strength of HSS from 46 ksi to 50 ksi, can be used as an economical solution in braced frame applications. The increased strength can help reduce overall tonnage on a project and also reduce member sizes, which can be beneficial if the designer is trying to fit a brace within a wall.

In the high-rise world, innovative products and solutions are critical in order to keep pushing the envelope. If current high-rise trends stay consistent over the next few years, the steel industry will have plenty of opportunities to show off the advancements that can make steel the material of choice for your next high-rise project. ■

Figure 4. Percentage of predominantly steel-framed high-rises.

