AC Martin

Case Studies in Structural Steel № 9

Wilshire Grand Center
Los Angeles

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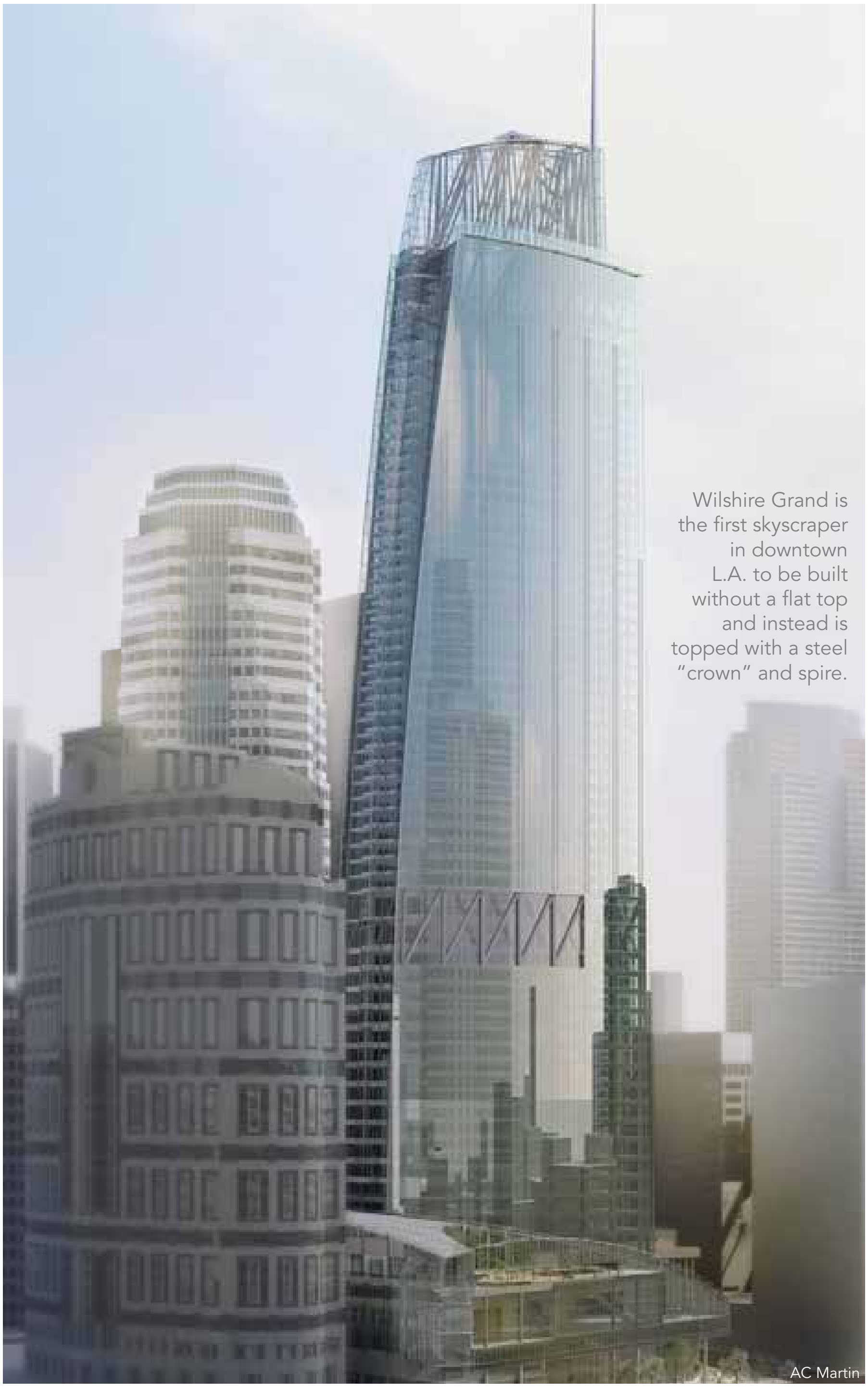
Smarter.
Stronger.
Steel.

At 1,100 ft, Wilshire Grand Center Rises Above It All in Downtown Los Angeles

Steel buckling restrained brace outriggers hold things steady, with several acting as seismic fuses in the event of an earthquake.



Wilshire Grand is the first skyscraper in downtown L.A. to be built without a flat top and instead is topped with a steel "crown" and spire.

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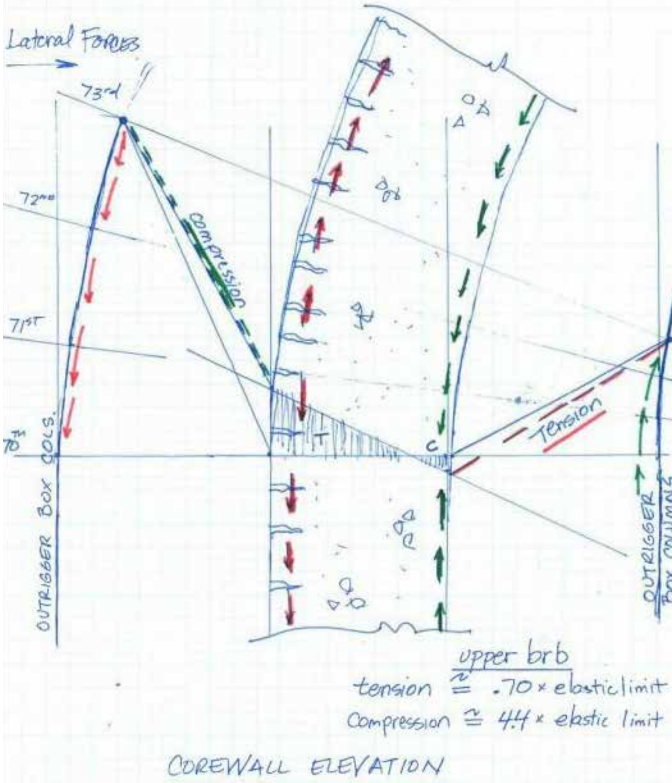
Wilshire Grand Center in downtown Los Angeles is the tallest building west of Chicago. The 73-story building, whose roughly 2 million sq. ft of enclosed space comprises a hotel and offices, uses a structural steel frame (19,000 tons in all) to carry the gravity loads and a concrete shear wall core that serves as the lateral system.

The building, the first high-rise in downtown L.A. to be built without a flat helipad, is topped with a sail-like crown and an architectural spire. Due to its height and slenderness, steel buckling restrained brace (BRB) outriggers were incorporated to resist the wind and seismic overturning and to provide rigidity for wind and seismic drifts. The tower employs 40 2,200-kip outriggers at the lower levels (28 to 31), 120 800-kip outriggers in the middle levels (53 to 59) and 10 2,200-kip outriggers in the upper levels (70 to 73). At the lower outriggers, each BRB weighs roughly 19.5 tons and they are positioned four per brace, resulting in a capacity of 8,800 kips at 10 different points. The lower-level BRBs, which act as seismic fuses in the event of an earthquake, are all 42 ft long and span from the exterior wall into the core wall.

The building also has two three-story-tall belt trusses around the perimeter at the lower and upper outrigger levels that increase torsional stiffness in the structure, distribute vertical loads more uniformly around the perimeter and add redundancy to the structural system.

The tower sits adjacent to an L-shaped steel podium (with a west wing and a south wing) built over five levels of basement parking and extending above the 11th floor. A curved trellis made of galvanized hollow structural sections (HSS) extends above and across much of the 11th floor at the west wing (note that there are no floors 8, 9 and 10). This trellis extends eastward from Level 11 down to connect with a tall parapet, curved in



Brandow and Johnston

A sketch of the tower's deflected shape.

elevation and plan and braced with moment frames, that supports a glass curtain wall.

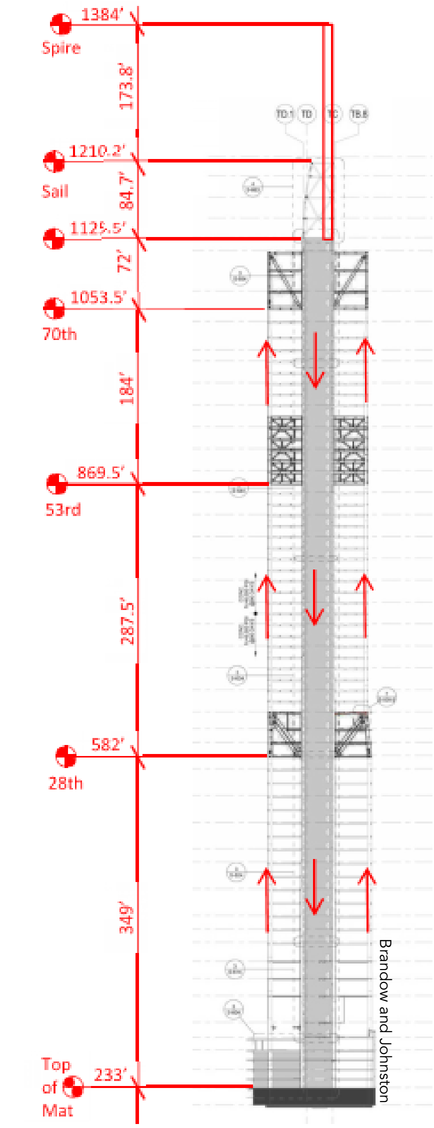
An atrium skylight located between the tower and podium descends down from about Level 11 to Level 2 as it progresses from west to east. And between the atrium and tower is a seismic joint that allows as much as 15 in. of movement each way via sliding bearings on steel outriggers supported by the tower's steel framing.

The ceiling in the main ballroom on Level 7 required a series of pairs of trusses at 5 ft. on center, spanning 118 ft. These trusses also support steel columns above Level 7, which in turn support the Level 11 roof and carry heavy mechanical equipment and the curved trellis structure.

On the north side of the building, several columns—supporting Levels 6, 7 and 11—required a series of transfer girders. The major transfer girder occurring at Level 5 is a 5-ft, 6-in. upturned plate girder spanning 84 ft. On the east side of the podium—where Levels 5, 6 and 7 abut the tower—the steel framing is supported on sliding bearings, sized to accommodate as much as 13 in. of seismic movement each way. These bearings are supported on outriggers connected to the tower's framing.

The pool deck offers stunning views of downtown L.A.

Eric Laignel

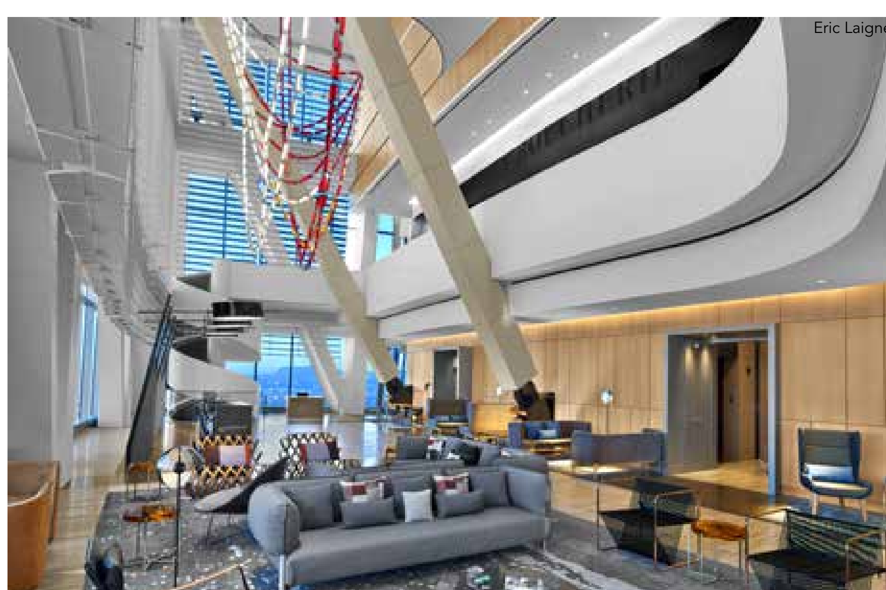


Tower elevation with BRBs.

The building incorporates 19,000 tons of structural steel to frame about 2,000,000 sq. ft of enclosed space.

above: BRBs were selected so that brace areas could be sized based on tension instead of compression, which resulted in less-demanding connections to the core wall and outrigger columns.

below: Exposed bracing in the lobby.



The lateral force-resisting system for the podium is a concrete shear wall system using steel columns. The basement and podium structural layouts do not align, resulting in several offset wall conditions. As a result, special details transfer large overturning forces between the steel and concrete columns at critical locations, and also transfer shear forces from an upper wall to the lower staggered wall. Due to architectural limitations, shear walls are located in such a way that substantial drag forces occur. These drag forces were accommodated both with special structural steel drag connections and with steel reinforcement in the slab-on-deck. Part of the diaphragm at Level 6, which is only a partial floor, involved plan bracing comprising steel HSS members located adjacent to a major shear wall.

BRB installation.

Schuff

Building Facts

Completion Year:	2017
Structural Steel:	19,000 tons
Construction Cost:	$1.2 billion
Building Area:	2,000,000 sq. ft

Eric Laignel

above: Massive braces, like this one, help the building resist wind and seismic forces.

below: The building flips the script on the typical hotel layout by positioning the lobby at the top.

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