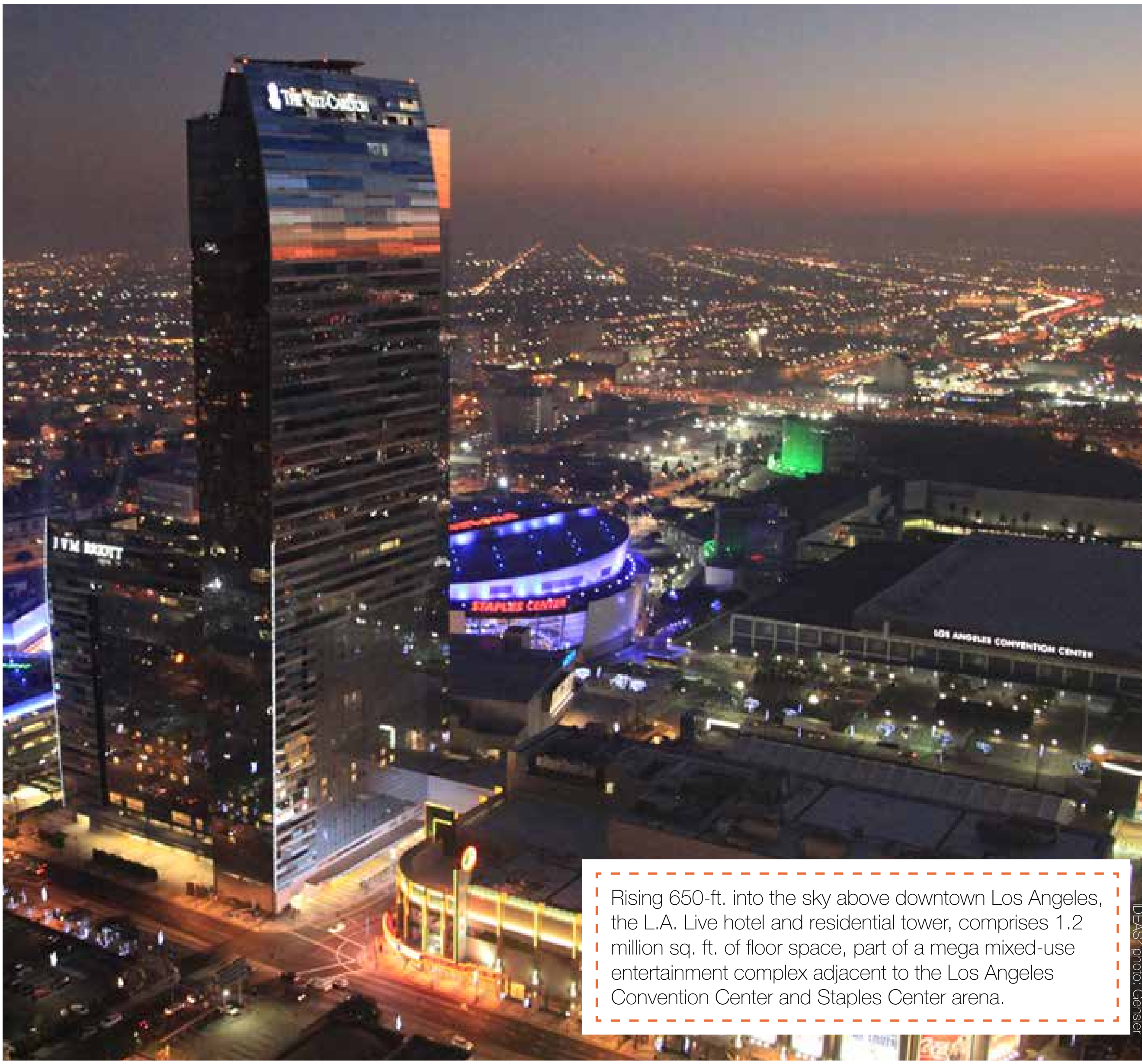
L.A. Live Hotel & Residences Los Angeles



Rising 650-ft. into the sky above downtown Los Angeles, the L.A. Live hotel and residential tower, comprises 1.2 million sq. ft. of floor space, part of a mega mixed-use entertainment complex adjacent to the Los Angeles Convention Center and Staples Center arena.

IDEAS² photo: Gensler

Project Team

Owner
AEG (Anschultz Entertainment Group), Los Angeles

Architect
Gensler, Santa Monica, Calif.

Structural Engineer
Nabih Youssef Associates, Los Angeles

Steel Detailer
Herrick Corp., Stockton, Calif.

Steel Fabricator and Erector
Herrick Corp., Stockton, Calif.

Bender/Roller
Albina Pipe Bending Co., Inc., Tualatin, Ore.

General Contractor
Webcor Builders, Los Angeles

Content provided by Nabih Youssef Associates, Los Angeles

⅜-in. Steel Wall System Replaces 3 Feet of Concrete

Thin, lightweight steel plate shear walls resist lateral loads, add stiffness, and reduce gravity loads and seismic demands while allowing more programmable space versus the use of thick concrete walls.

IDEAS² photo: Anschultz Entertainment Group

The T-shaped building includes a 26-story hotel segment and sleek tapered 55-story hotel/condominium tower, which includes high ceilings and low floor-to-floor heights.

Towering like an exclamation point on the redevelopment of downtown Los Angeles, the L.A. Live entertainment complex's hotel and residences encompasses more than 1.2 million sq. ft of floor space comprising a 26-story low-rise portion combined with a 55-story portion that reaches more than 650 ft above street level. The project carried a $1 billion development cost, and is the focal point of a large integrated development stretching across two city blocks.

The tower is composed of 26 floors of hotel rooms in each of the wings, topped by 29 additional levels of condominiums in the taller tower. The tower includes a tapered floor plate that expands and contracts to suit the requirements of the occupancy type. The design features high ceilings with low floor-to-floor heights while minimizing the curtain wall, and maximizes sellable floor space by minimizing circulation paths and back-of-house spaces.

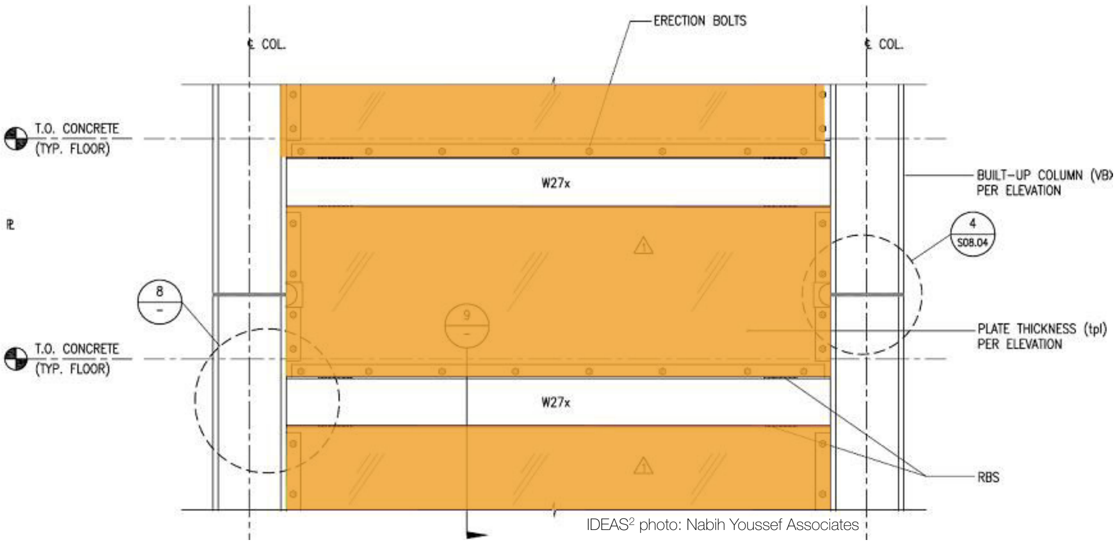
The structural system is an optimized direct fit into the architectural shape, maximizing program efficiency and seismic performance. The system consists of unstiffened thin steel plate walls (⅜-in. to ¼-in. thick) within fully welded WUF-W moment frames that act as boundary members.

The walls consist of infill plates that buckle in shear and form a diagonal tension field to resist lateral loads, resulting in substantial post-buckling ductility. As there was no centralized core of walls and the floor plan for the lower 26 stories formed a "T" shape, the steel plates were used to "tune" the stiffness of the separate wings.

The boundary element frames included composite concrete-filled box columns in order to achieve a higher axial capacity at minimal premium. Where possible, the steel columns on the tower exterior slope from one floor to the next to match the architectural profiles and maintain a constant slab edge distance while minimizing disruption to useable floor space.

Outriggers at mid-height and the roof level further control building drift, effectively reducing the aspect ratio of the tower from 20:1 to 10:1. Buckling restrained braces, some with design capacities as great as 2,200 kips, were at the time of design the largest that had been tested in the world, and are used as fuse elements to control the maximum forces that the outrigger trusses can impose upon the surrounding elements.

The design consisted of more than 18,000 tons of fabricated steel, with 12,000 structural members. These include 612 box columns, 670 wide-flange columns, 8,200 beams, 795 shear wall assemblies, 12 trusses, and 11 buckling-



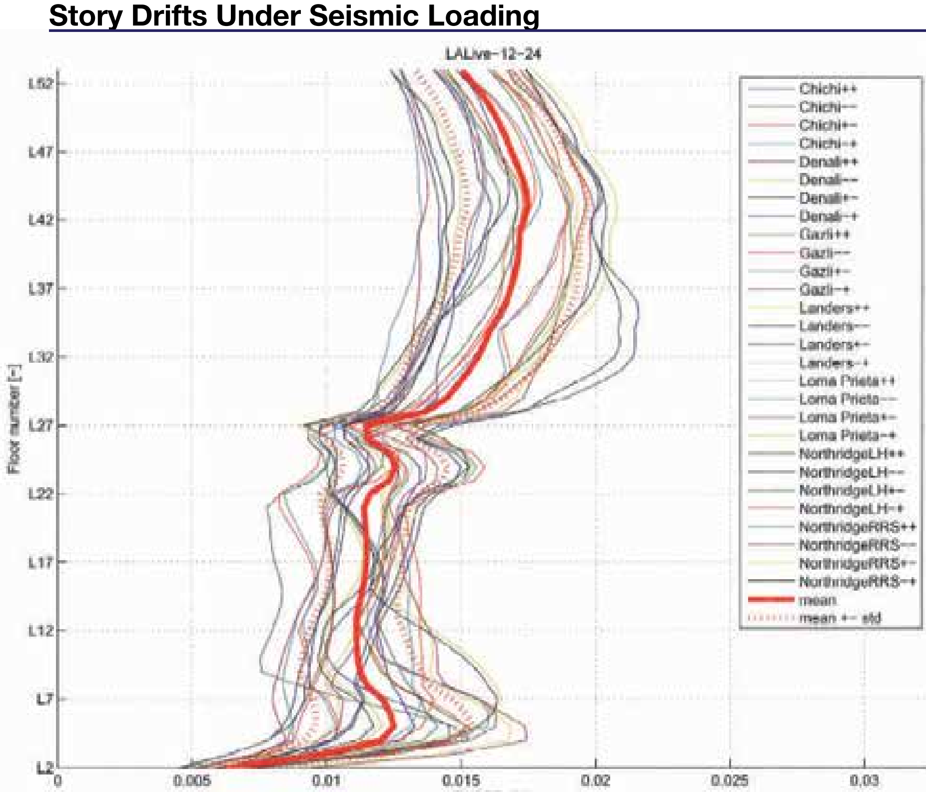
IDEAS[2] photo: Nabih Youssef Associates

A typical steel plate elevation drawing. The steel plate shear walls resist lateral loads and are designed to “tune” the stiffness of the T-shaped building’s separate wings.

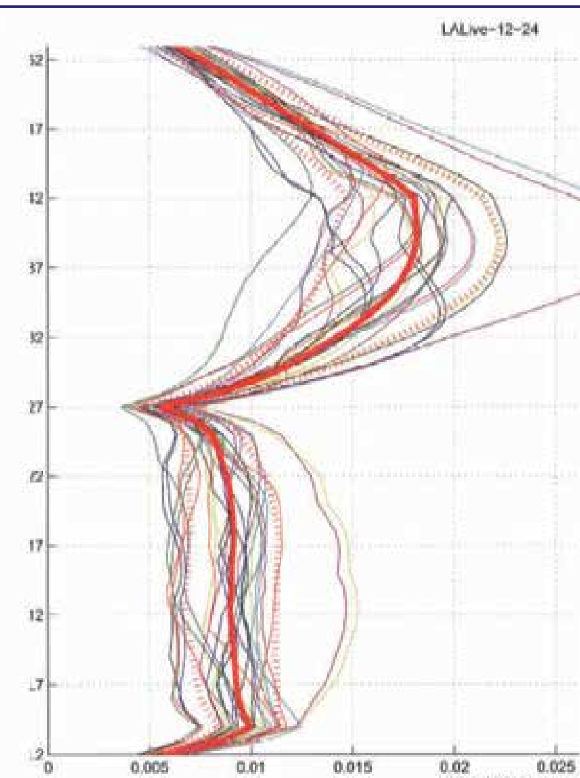
restrained braces. The low self-weight of the steel plate shear walls, compared to an equivalent reinforced concrete shear wall, reduced both gravity loads and the seismic demands that the structure is required to resist. In addition, replacing concrete walls approximately 36 in. thick with ⅜-in. steel wall plates allows for more programmable space.

Given that the tower was the first of its type in California, and did not fit within the realm of typical codified design, it was designed using the code-accepted alternative of performance-based design, with extensive nonlinear analysis for confirmation of design. Throughout the project designers worked closely with the general contractor and steel subcontractors, resulting in the tower’s substantial completion only one year after the start of erection. The use of steel members allowed for a more reliable, consistent product than concrete, while also permitting multiple tiers of construction to coexist over different levels of the tower, greatly increasing the efficiency of assembly.

Story Drifts Under Seismic Loading



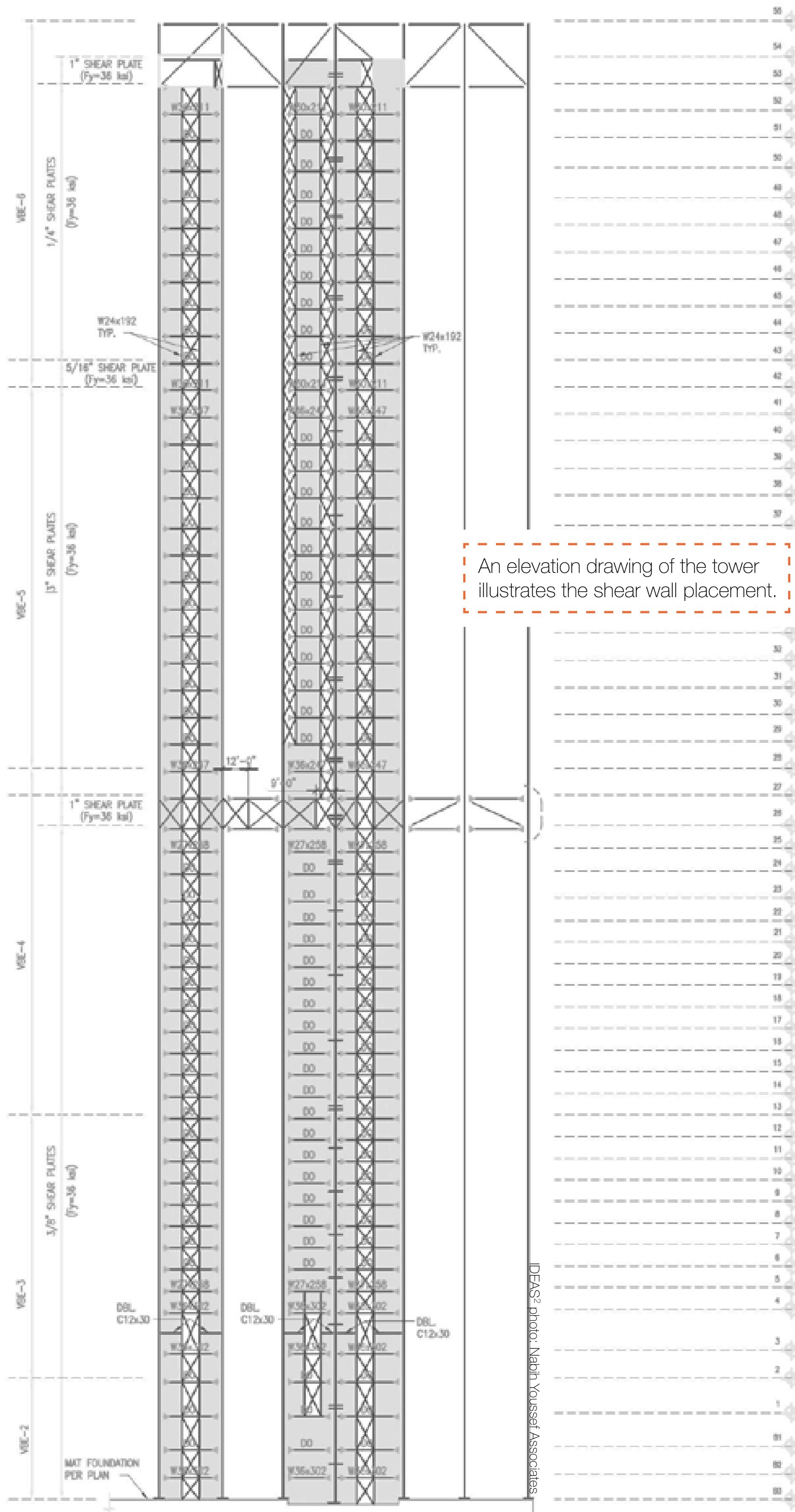
Transverse Drifts



Longitudinal Drifts

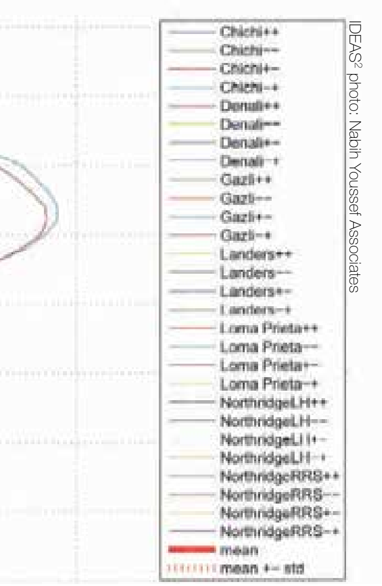
IDEAS² photo: Webcor Builders

The reliability and consistency of structural steel versus concrete were key elements to the substantial completion of the tower only one year after the start of erection.



An elevation drawing of the tower illustrates the shear wall placement.

IDEAS² photo: Nabih Youssef Associates

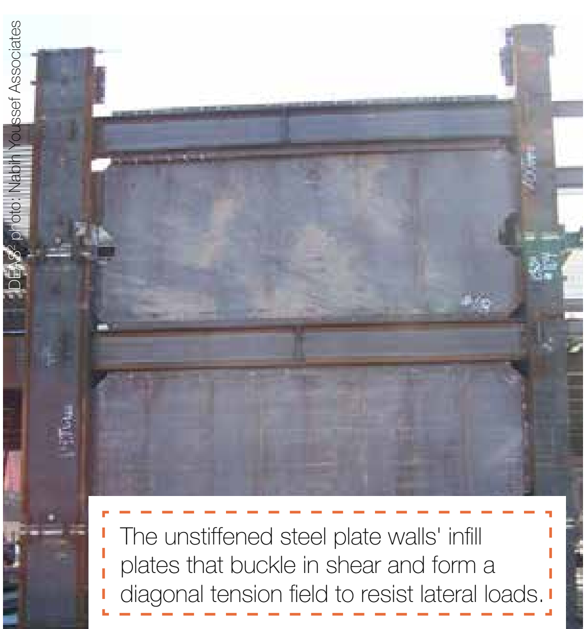


IDEAS² photo: Nabih Youssef Associates

The building's tranverse and longitudinal drifts are illustrated in this graphic. Outrigger trusses were used to control drift and buckling restrained braces were used in tandem to control the maximum forces that the outrigger trusses can impose on surrounding elements.

IDEAS² photo: Nabih Youssef Associates

Outriggers, being installed at roof level here, help control drift.



IDEAS² photo: Nabih Youssef Associates

The unstiffened steel plate walls' infill plates that buckle in shear and form a diagonal tension field to resist lateral loads.

Building Facts

Height:	655 ft
Levels:	26 and 55 stories
Sq. ft.:	1.2 million
Development Cost:	$1 billion
Structural system:	Unstiffened steel plate shear walls within fully welded WUF-W moment frames that act as boundary members; composite concrete-filled box column boundary element frames; outriggers at mid-height control building drift; buckling restrained braces fuse elements to control the maximum forces that the outrigger trusses can impose upon surrounding elements.
Innovative design:	Because the building was the first of its type, design employed code accepted alternative of performance-based design, with extensive nonlinear analysis for confirmation of design.
Structural steel:	18,000 tons of fabricated steel; 12,000 structural members, including 612 box columns; 670 wide-flange columns, 8,200 beams, 795 shear wall assemblies (⅜-in. to ¼-in. thicknesses), 12 trusses, and 11 buckling restrained braces.

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American Institute of Steel Construction
One East Wacker Drive, Suite 700
Chicago, IL 60601
312.670.2400 www.aisc.org