At the Center of Things

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A new luxury condo building holds its own in a thriving commercial and cultural hot spot in suburban St. Louis.

CLAYTON, MO. MIGHT BE A SMALL TOWN IN TERMS OF POPULATION, but it packs a punch. This suburb of St. Louis, with less than 15,000 residents, serves as a secondary business district for the metro area and a major financial center for the Midwest, and features a thriving cultural scene.

The Crescent, a new $73 million, nine-story luxury condominium/retail development, fits well into this environment. Located in Clayton's downtown area, it is designed to reinforce the urban context established by a dramatic fountain and sculpture located on a circular plaza at the intersection of a high-rise Ritz-Carlton hotel and 30-story condominium development.

The building includes 72 condominiums, 27,000 sq. ft of retail space, and a 300-car parking garage located on a rectilinear, tight, sloping site. Since the structure occupies the entire site, a landscaped terrace was created on the upper level of the garage with easy access for residents to the green space.

A Slight Change in Plans

A nine-story luxury condominium with a curving footprint would typically be thought best framed with cast-in-place concrete. In fact, that's how the Crescent almost ended up. After schematic design discussions with the initial general contractor, after Alper Audi began modeling the structure as a cast-in-place, post-tensioned concrete system with concrete shear walls, and after structural drawings were already underway, a second contractor offered to provide a steel-framed structure more quickly and at considerably less expense. A redesign using steel beam and purlin composite framing was rapidly completed and priced; the steel design showed potential savings of more than $3 million from the overall $45 million shell cost of construction.

The contractor was able to offer this pricing reduction because the steel system was considerably less expensive and could be erected more quickly, and a concrete structure would have required two expensive tower cranes in order to cover the elongated work area; these cranes would have had to be rented for almost the entire duration of the project. Conversely, the steel frame could be erected using only a single mobile crane moving from one end of the site to the other, and could then leave the site after erection was complete. Also, since the steel structure could be completed earlier, the overall cost of the contractor's general conditions and the owner's construction interest

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One of the condo units in the steel-framed Crescent.

carriage would be reduced. The project's schedule would no longer be driven by the time for concrete to cure, stress, and cycle floor placements. With steel, much of the work would be fabricated off-site, so there would be less weather concerns and less waste on-site.

Immediate benefits of using steel framed construction included:

- Producing a lighter structure with noticeable savings in the foundations and seismic/ lateral-force resisting systems.
- Allowing the structural steel to be designed and fabricated and the foundation design to be complete and under construction before the architect finished his design. The team used the steel structure's ability to easily accommodate inevitable owner and architectural detailing changes as the design was finalized.
- Eliminating the need for formwork shoring and re-shoring, which impedes any subsequent work on the floors below until the concrete achieves minimum strengths.
- Producing smaller columns than with a concrete scheme, therefore having less physical impact on tenant space.

However, initial concerns about changing to steel included:

- Corrosion aspects of the two-level steel-framed parking structure and outdoor terraces.
- Increased story heights with steel framing and its effect on the building skin.
- Vibration perceptibility, sound transmission, and fire ratings.
- Relative difficulty to frame the curved floor plan and terrace depressions.
- Minimized extraneous steel framing needed to hang the brick and masonry façade.

To address these concerns, galvanized steel framing and form-deck were used for the supported level of the garage and landscaped terrace to provide corrosion resistance and to be compatible with spray fireproofing. We carefully developed the terrace and railing details to allow proper waterproofing and sloped drainage to protect the support structure and to keep water out of the occupied space below. A thicker-than-minimum concrete slab thickness was used to achieve excellent vibration and noise performance characteristics—closely comparable to the previous all-concrete scheme.

The steel building's story height gained more than 12 in. per floor from the previous 8-in. concrete flat-plate scheme, thus increasing the height of building by almost 12 ft. This required architectural revisions to window sizing and fenestration to properly rebalance the building proportions for the new height. However, the steel framing and its time savings more than made up for any increased cost of the skin. Furthermore, the taller building makes for a more impressive appearance from the street, views are much improved from the upper floors, and the larger windows are a welcome upgrade in the living units, thus enhancing their value.

The composite girder and purlin framing system was organized to require the minimum number of pieces to be erected while simultaneously providing generous space between beams to accommodate mechanical units and piping. Spray-on fireproofing was required on all beams and columns, but the slab and composite deck system satisfied the needed 2-hour rating without additional fireproofing of the decking. The third-level roof over the garage was designed for much heavier loading to accommodate 12 in. to 36 in. of planting material, which creates a beautifully landscaped half-acre park for building residents.

Despite stacking the different uses for apartments, retail, and parking—each with their own preferred column arrangement—the designers were able to achieve an efficient layout for each without column transfers. However, it was necessary to laterally offset and transfer some of the vertical braced frames to free up drive aisles in the parking levels.

The property-line-to-property-line construction site was tight, so the rear, lower-story portion of the footprint that was not located

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under the condominium tower was erected last to leave work room for material deliveries, laydown, and crane maneuvering. This sequencing required several temporary braced frames to be installed through the lower stories in order to stabilize the initial erection of the nine-story L portion. This bracing was later removed after the lower "infill" stories were completed.

Cut in Half

Due to plan irregularities and size, the 450-ft-long building is separated nearly in half by an expansion joint. Calculations determined that the building required more than a 4-in. joint width at the roof level to accommodate wind and seismic effects; yet when magnified by the required C_d factor, the joint width became approximately 18 in. This large expansion joint width was functionally difficult to plan and detail for, so an innovative approach using a sacrificial slab zone was developed to satisfy the code requirement and then detailed for a more acceptable 4-in. joint width.

The project was executed under a CM-at-risk contract with guaranteed pricing based on the early steel and foundation packages. These packages were issued for construction use more than six months before completion of architectural building and shell documents. Furthermore, foundation construction and steel fabrication and erection were well underway before these final drawings were issued. Modeling the structure in 3D, files were converted to SDS-2's structural steel detailing format and made available to the fabricator early in the process to expedite preliminary pricing, scheduling, and shop drawing preparation. A wide variety of skewed connections were required to accommodate the building's irregular and curved footprint, so it was a great benefit to the fabricator to have these shared BIM files. MSC

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