Flower Power

BY MICHAEL E. SHERIDAN, P.E.

A new mixed-use project blossoms in downtown Louisville.

THE FLEUR-DE-LIS, OR "LILY FLOWER," is an enduring symbol of France—and Louisville, Ky.; it appears on the latter's flag, as the city was named for King Louis XVI of France. In a similar fashion, the Fleur-de-lis on Main, a new mixed-use building at Preston and Main in Louisville, provides a new emblem for the city in its architectural revival of old downtown.

The first floor of the 200,000-sq.-ft, five-story development is contains retail space and two interior greenscape courtyards. Residential units, 82 of them, make up the top four floors of the building, with interior units overlooking the courtyards. A below-grade parking garage includes spaces for 150 cars.

Positive Projection

The building's architecture is intended to create an ambience of elegance and nature. The pointed balconies and plan projections of the residential units cantilever over the courtyards and out from the building's exterior, promoting a sense of being only steps away from nature, even at the upper levels. The structural design of these elements uses 26 weld-through beam connections at the second floor, with 13 vertical posts at the points of the plan projections. These vertical posts provided support to the upper floor projections and eliminated the use of 162 weld-through connections at the third, fourth, and fifth floors.

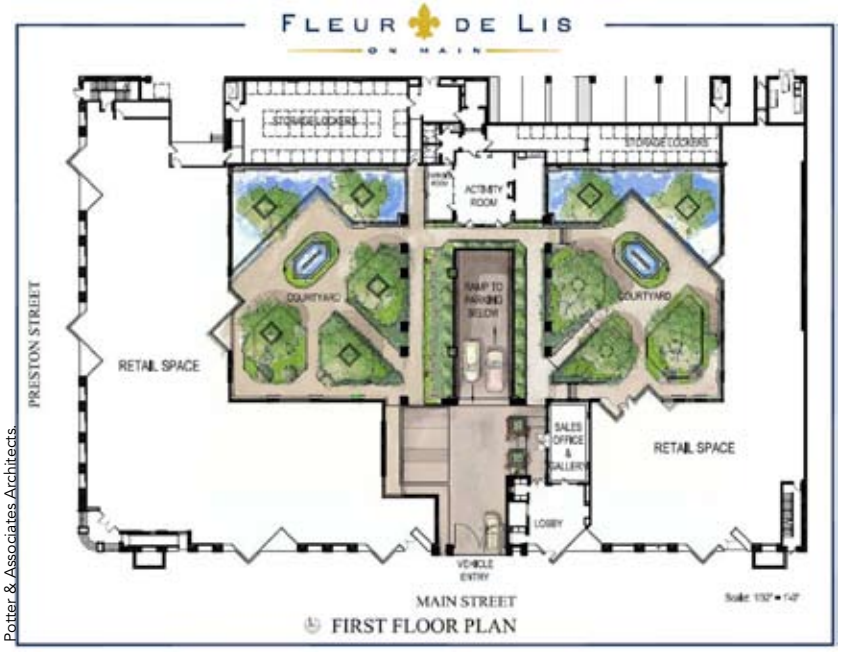
While this type of system is very economical, it does collect the entire load at the second floor cantilever. Therefore, a deeper beam system was required to support this large load on a 9-ft cantilever. The W30×116 beams at the second floor are accommodated by the extra story height provided by the grade-level retail space.

The building employs an open-web composite joist system, and the first-floor gravity structure is a 5¼-in. concrete slab on composite deck, with typical composite structural steel beam and girder framing. The gravity system of the second through fifth floors is a 20-in. joist on a 3-in. cast-in-place concrete slab. The system is supported by typical composite structural steel girders, with a depth limitation in the interior of 18 in. The composite steel girders use ½-in.-diameter headed studs to achieve the required composite action with the 3-in. concrete slab. The 20-in. joist depth is standard throughout the project to furnish ample clearance for the duct penetrations through the webs, and provides a uniform depth of structure for the attachment of the sound barrier and ceiling grid.

Laterally Unique

One of the most unique structural features in the building is the lateral load resisting system. Early designs called for a series of solid concrete shear walls along the alley at the south and west sides of the building. However, when final grade of the existing alley was established and alley parking was implemented, the shear walls at the alley had

Thirteen vertical posts at the points of the plan projections support the third, fourth and fifth floors, reducing the number of weld-through beam connections required from 188 to just 26 on the second floor.



Potter & Associates Architects.

Opposite page and above: The 200,000-sq.-ft, five-story Fleur-de-lis on Main in downtown Louisville, Ky., contains retail space, two interior courtyards, 82 residential units, and a covered entryway that leads to underground parking.

Michael E. Sheridan was the primary structural engineer for Fleur-de-lis on Main as an associate at Stanley D. Lindsey and Associates Ltd. He is now the chief structural engineer for the U.S. Army Corps of Engineers, Memphis District.

Designed with large openings and much glass, the building's front elevations left little room for a lateral load resistance system. Although perforated concrete shear walls were retained on the street sides, they were replaced by a steel system on the alley sides.

to be eliminated, which also allowed a smaller crane to be used and thus reduced the crane cost for the project.

The front building elevations only had a few locations for concrete shear walls: behind the brick panels and between the glass projections. Structural analysis indicated that the shear walls barely worked. But with so much glass and large openings, changing to braced frames at the front was not an option. Moment frames were considered, but to control the lateral drifts and column moments, the column sizes would have to be increased from a large W10 column to a large W14 column (about 16 in.×16 in.). However, increasing the column size would wreck the intricate space planning as well as make it very difficult to open a garage door in the below-grade parking area. Therefore, the W10 gravity columns had to stay and were incorporated in the final design.

In order to keep the series of perforated concrete shear walls at Preston and Main Streets, a braced frame system had to be designed at the south and west using structural steel. This system had to have similar stiffness as the previous shear walls. Designing to a normal ductility of R=3 was no longer an option, since the remaining north and east shear walls were designed with R=5. As such, a series of ordinary concentrically braced frames were designed with R=5 in conjunction with the ordinary reinforced concrete shear walls on the north and east sides of the building, and the perforated shear wall system was able to be maintained.

Below Grade

The parking garage offered the opportunity for another unique framing solution. Due to very soft soils near the Ohio River, the geotechnical engineer recommended a mat foundation for the building. The reinforced concrete mat is three ft thick and supports the parking garage's gravity steel columns. The special base plate has a 2-in. thick, 16,500-psi, epoxy grout bed (HP Epoxy Grout by The Five Star Company) formed, cast, and cut flush with the base plate. The base plate is slightly larger than the W10 columns and fastens to an embedded plate with cast-in-place headed studs in the concrete mat and four 1-in.-diameter threaded studs (Nelson CFL) welded to the top of the embed plate and field bolted to the base plate.

The use of above-slab grout pads and base plates with embedded steel bearing plates in the mat foundation is a truly unique solution for steel columns in parking structures. The design results in no exposed anchor rods, better facilitating parking access and minimizing the risk of damage to vehicles and the structure.

Thanks to the resourceful structural solutions employed on the Fleur-de-lis on Main project, the building is on the path to becoming an enduring edifice in the Louisville cityscape—much like its namesake symbol. MSC

Architect

Potter & Associates Architects, Louisville

Structural Engineer

Stanley D. Lindsey and Associates, Ltd., Brentwood, Tenn.

Steel Fabricator

Sentry Steel, Inc., Louisville (AISC Member)

A series of steel ordinary concentrically braced frames on the south and west sides of the buiiding provide lateral load resistance, replacing the original concrete shear wall design.

Dave Hornby, Stanley D. Lindsey and Associates