

3344 Peachtree/Sovereign

Atlanta, Georgia

By Clinton O. Rex, Ph.D., P.E. and Rachel Lancaster, E.I.T.

3 344 Peachtree/Sovereign is Atlanta's most unique mixed-use development. Soaring 644 feet, it is the tallest building in the Buckhead Skyline and the tallest constructed in Atlanta in almost 20 years. The 50-story tower's asymmetrical and fluid design results in more than just another building, but instead an architectural sculpture in the heart of Buckhead. The project is highlighted by its unique exterior surface leans and curves, thus creating a building in which every floor is a different shape and size. The tower's more than 1.2 million square feet of floor space incorporates 510,000 square feet of office, 20,000 square feet of retail, 12 levels of parking, 82 luxury residences and upscale dining.

Structural System Summary

The primary structural system for 3344 Peachtree/Sovereign consists of cast-in-place reinforced concrete. Shear walls and moment frames comprise the lateral load resisting system. The shear walls are linked to perimeter columns at two levels, thus reducing the core's slenderness and producing a more economical design.

To avoid sloping columns, some columns were stepped at each level at the same amount that the floor moved. This met the architectural needs while providing typical rebar and form systems. This stepping creates transfer forces at each floor that were carefully designed and detailed. The shape changes in the floor plate were resolved using cantilever framing systems of thickened slabs alone or in combination with cantilever beams. If beams were used, the forms were kept in the same line for all floors such that the floor changes could occur by simply re-using the same form as construction progressed up the building.

The office space consists of long span beam and girder systems, allowing tenants to have flexibility with large column free space. The residential floors consist of two-way flat plate construction with more closely spaced columns. Therefore, the slab serves as the floor of one space and the ceiling of another, thus minimizing floor to floor heights.

The superstructure is supported by drilled piers with diameters ranging from 30 to 120 inches. Despite the height of the building, foundation tension loads were small enough that the drilled pier foundation did not require expensive rock sockets or rock anchors. The small tension loads were the result of a carefully balanced structural system that fully utilized the entire building weight to counteract the overturning forces. The tension loads that did exist were easily transferred to the rock mass below via friction between the drilled pier and the partially weathered rock that the drilled piers pass through before reaching the auger refusal bearing rock.

Drilled Pier Foundations

Initial geotechnical explorations revealed that the rock quality varied substantially over the building site; and, the subsequent recommendations indicated that the erratic nature of the rock would only allow the design team to use 60 ksf bearing capacities at the bottoms of the drilled piers. Initial foundation designs resulted in two drilled piers at every column, creating significant budget and schedule problems. The design team overcame this obstacle in two ways. First, it was determined that 10-foot diameter drilled piers could be installed; common practice in Atlanta was to limit drilled pier diameters to 9 feet. Second, each column foundation was custom designed for the rock quality at that location. The geotechnical engineer conducted additional borings and rock cores at each column, thus resulting in each

drilled pier having its own rock bearing capacity, which varied between 60 and 125 ksf. The revised foundation design eliminated all double drilled piers and allowed the project to remain within budget and on schedule.

As part of the project, a parking deck was constructed next to the main tower. The lowest level of this parking deck is two stories below the lowest level of the main tower, with the two being separated by an expansion joint. Architectural considerations dictated that the parking deck and tower columns along this joint needed to align. This resulted in both columns having to rest on one common foundation. Typically, the foundation would be installed at the lowest level of the deck; however, this would have required that the parking deck excavation be complete before the main tower columns could be started. This would have led to a substantial schedule delay given that the tower, not the parking deck, was on the critical path to completion. The solution was to install the common foundation from the main tower's lowest level and then use the drilled pier as a column for the two lower levels of the parking deck. The tricky part of this solution was that when the deck was excavated, it would expose 25 feet of drilled pier. This combined with a 20-foot tall first story tower column would result in



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Combined Tower Column/Drilled Pier.



Transfer Beam Construction.

the combined tower column/drilled pier being un-braced for 45 feet. The tower construction schedule was reviewed to determine how much load would be on these columns when this condition occurred, and then the combined tower column/drilled pier assembly was checked to ensure that there would not be a stability problem associated with this temporary un-braced condition.

Coordinating Transfer Construction

A transfer level was designed to transfer the column loads from the above residential tower to the office tower columns below, as well as provide needed mechanical space. The transfer level was also utilized as an outrigger level where the shear walls at the core could engage the perimeter columns, thus engaging the entire building width to resist lateral loads. The outriggers aided in the reduction of differential shortening by providing a means of redistributing loads from the highly stressed columns to the lower stressed core.

Due to the magnitude of the applied loads and the scale of the outrigger elements, the design of the transfer floor was unique and extremely challenging; however, the real challenge came during the construction phase of the floor. The shoring system required to support the casting of 14-foot deep beams presented the first obstacle. Typical shoring sequencing uses the live load capacity of three to four levels below to support the weight of the floor that is being cast, thus resulting in one forming floor and two to three re-shore floors. Due to the massive weight associated with the transfer floor casting, initial formwork design estimated 10 floors of re-shoring. This was a significant expense and schedule concern. The solution was to design the three floors below the transfer floor to carry the full weight of the transfer floor construction.

The large wall-beams that comprise the transfer floor have heavy layers of reinforcing and post-tensioning cables, therefore fitting all of the rebar and PT in the beams while maintaining room to allow the concrete to flow through was quite a challenge. The team had multiple coordination meetings that included all trades involved in the floor construction. In these meetings, the details of every bar, stirrup, tendon, and beam opening were worked out in great detail. Reinforcing splice locations were carefully selected based on a maximum bar length of 60 feet. Splices were staggered in many cases to avoid what would have otherwise been a congestion problem. Due to the large volumes of concrete necessary, it was only possible to cast short pieces of each transfer beam at a time. Casting sequences were carefully coordinated to ensure that the final structure would perform as intended, and to ensure that the floors below would not

become overstressed due to the heavy pattern loads resulting from the casting sequences. Self leveling concrete was used in the construction of the transfer floor to avoid honeycombing and voids. This technology allows the mix to be dialed in on how fluid the concrete is at the time of placement. After three trial mixes, the right balance between workability and form tightness was found and successfully used for the casting sequences.

Because transfer girders do not see the majority of the load until the upper floors have been constructed, it is important that post-tensioning of these girders be properly staged. If the tendons are stressed too early, the resulting forces can impose opposite stresses on the beam that would potentially fail stress and strength limits prior to the column loads being fully in place. Three stressing stages were designed to keep the transfer beams within code allowable limits based on careful examination of the construction sequence and the expected building loads at each stage.

A two-story penthouse and a steel-framed building crown top off the tower. The desired geometry of the penthouse and building crown resulted in another transfer level. This transfer level provided another opportunity to link the building core to the exterior columns, to once again engage the entire building width in resisting lateral loads. There were the same concerns regarding shoring, particularly since the floors below were flat plate with light live load designs. The solution this time was to construct the transfer beams in two stages. The bottom 3 feet of each beam was cast with a complete reinforcing cage, in addition to having the dowels needed to complete the overall transfer beam. This sub-beam was then used to support the weight of casting the remaining 5 feet. This beam staging allowed normal shoring procedures since the shoring did not have to support the full weight of the transfer beam.

Conclusion

Completed in 2008, 3344 Peachtree/Sovereign is Atlanta's most captivating and tallest mixed-use development. The use of transfer floors provided an innovative solution to a number of design concerns. Meticulous coordination also reduced potential problems during construction and allowed the project to be completed on time and within budget. ■

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Rachel Lancaster, E.I.T. was an integral member of the 3344 Peachtree/Sovereign team.

Project Team

Owner:	Regent Partners
Structural Engineer:	Stanley D. Lindsey & Associates, Ltd.
Architect:	Smallwood, Reynolds, Stewart, Stewart & Associates, Inc.
Curtain Wall Engineer:	Bruce Wall Systems Corporation
Contractor:	Hardin Construction Company, LLC
Concrete Supplier:	Lafarge, North America
Rebar Supplier:	CMC Rebar, Atlanta
Post-Tensioned Tendon Supplier:	DSI, Atlanta