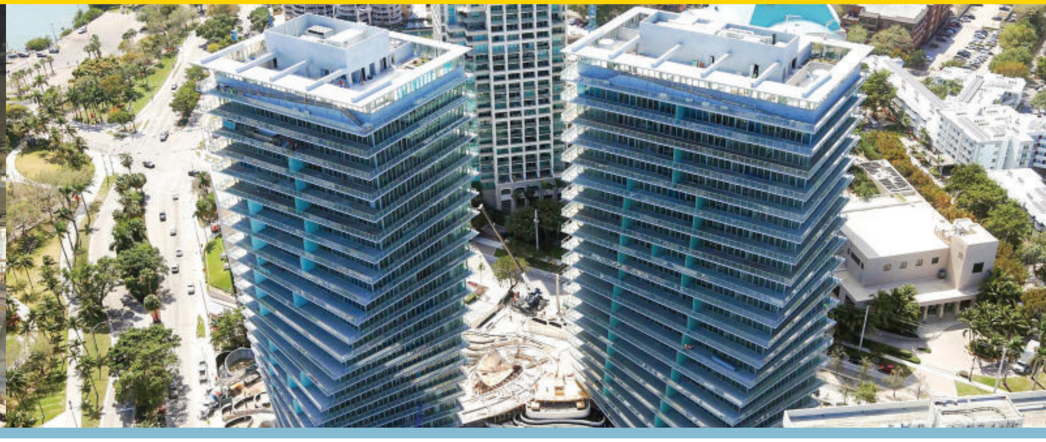
Grove at Grand Bay

Coconut Grove, FL



Team

Owner:
Terra Group, Coconut Grove, FL

Architect:
Bjarke Ingels Group (BIG Architects)
New York, NY

Structural Engineer:
DeSimone Consulting Engineers, Miami, FL

General Contractor:
Facchina Construction of Florida, LLC
Miami, FL

Concrete Contractor:
Capform, Inc., Miami Gardens, FL

Reinforcing Bar Fabricator & Placer:
Titon Builders Inc, Lake Park, FL

Total Project Size:
890,000 sq ft

Floor System:
Post-tensioned flat plate slab

Framing System:
Cast-in-place reinforced concrete

Award:
2016 CRSI Award Winner–
Residential Building Category

Photography:
DeSimone Consulting Engineers
Bjarke Ingels Group (BIG Architects)
Facchina Construction of Florida, LLC

Terra Group teamed with celebrated Danish architect Bjarke Ingels, of BIG Architects, to bring modern luxury to historic Coconut Grove, Miami's oldest neighborhood. Terra and Ingels envisioned a residence that would evoke luxury, but also fuse it with distinctly contemporary design. Grove at Grand Bay is a 310-foot, 23-story condominium building located in Coconut Grove, Florida. It is the first truly twisting towers in the United States with floor plates that rotate every three feet up to 39° at every elevation from the 3rd to the 17th floors, and includes 40-foot interior spans with up to 20-foot cantilevers. The core consists of composite shear walls to resist the torque generated by the sloping columns.

Ingels' design creates two gracefully twisting towers that appear to be turning to capture the view as they rise to the sky. It is also the first structure in Coconut Grove to have achieved LEED Gold Certification.

UNIQUE STRUCTURAL AND/OR ARCHITECTURAL DESIGN FEATURES

The true twisting nature of the columns posed a number of structural challenges that demanded a fresh, innovative approach. The foremost challenge was to resist torsion generated in the tower core due to the sloping column geometry. The horizontal component of the gravity load in the columns is resolved in the slabs by transferring it to the interior core shear walls, which are the only consistently vertical structural elements in the building. Additional horizontal thrust from all columns rotating in the same direction creates a large shear force in the tower cores. The magnitude of shear-forces in the tower cores due to self-weight was considerably higher than that generated by the design hurricane wind loads. To minimize the total horizontal shear force transfer into the core walls, a "hat truss" was introduced at the roof. The hat truss is comprised of a series of beams cantilevered from the cores and connected to all the columns. The hat truss collects superimposed dead load and live load delivering the "suspended" loads directly to the core as a vertical load component. This alternate load path reduced torsional forces in the core by approximately 30%.

The magnitude of the combined horizontal shear force from the building self-weight and the hurricane wind loads would require conventionally reinforced concrete shear walls to be 6' thick. In order to regain valuable real estate, a composite concrete shear wall and link beam system was introduced. The composite action between steel and concrete allowed a substantial wall reduction to 30" thick. Internal steel plates with thicknesses of up to $3\frac{3}{4}$" (3.75") were required to achieve the overall wall thickness. The plates extend vertically for 15 floors with normal reinforcing steel continuing to the roof. To compensate for the considerable horizontal displacement, the tower floor plates are cambered rotationally as much as a $\frac{1}{2}$" relative to the floor below for 75% movement due to the building self-weight. This allowed the tower to settle back to the design coordinates just before the hat truss reaches design strength.

For maximum flexibility of the unit layouts, column-free interiors were provided. Resulting spans between the core and perimeter columns ranged up to 40' and balconies cantilevered up to 16'. A structural scheme was proposed with an 8-foot wide, 16" thickened slab around the core to allow a 10" thick post-tensioned slab to span the remaining distance. and provide a 12-foot clear ceiling dimension.