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Case Study: Gate Towers, Abu Dhabi

An Elliptical Introduction, A Curving Embrace, & A Bridge in The Sky



Gurjit Singh



Hossam Eldin Elsouefi



Peter Brannan

The Shams Abu Dhabi district is a newly-created land mass, formed as an extension of the Central Business District of Abu Dhabi, UAE, on what was formerly exposed tidal sands within a fringe of mangroves. Set at five to seven meters above sea level, Shams is gradually developing at a high density and growing in prominence. The Gateway complex occupies a narrow strip of land at the far side of Al Reem Island, which forms the neck of the isthmus leading to the wider Shams development.

The Gateway forms one of the Middle East's largest developments, signifying the entrance to Shams. The developer, Aldar, set forth a challenge: create an unmistakable introduction to a larger development, that would also serve as a landmark on its own. The brief called for a unique mixed-use development on a complex site. This involved demanding standards for innovation, quality, and schedule.

to good use in value engineering and refining the construction process.

Design Concept

The Gate's architecture announces the arrival at, and forms a welcoming statement for, Shams Abu Dhabi, Reem Island.

In August 2005 the architects, Arquitectonica, began designing the project. The concepts were developed in close cooperation with the developer under a tight schedule, and were approved in March 2006. The project was officially launched on April 2, 2006. The engineering was prepared in parallel with the architecture to facilitate an early construction start and save costs.

A series of residential gateway towers act as pillars supporting the skybridge, a large-scale lintel that creates a monumental portal, defining the threshold to the island. The lintel, containing penthouses, glows at night and serves as a marker, visible from miles away. An oval courtyard containing residential and hotel towers, sits behind the gateway towers and serves as a foyer; this contained space acts as a monumental room. It provides an unexpected event on the road, intended to calm both traffic and the human psyche, similar to how a square amidst the rush of the city does. The first half of the oval has been built; the second half will be built at a later date.

The complexity of the project required phased construction. The first phase began with the Sky and Sun towers, a pair of elliptical buildings; the second involved the Gate, a three-tower group with a connecting, curved skybridge. The economic crisis in 2008 slowed construction slightly, but the modest downturn was put

The role of the site is to act as the gateway to the larger development of Shams Abu Dhabi.

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Gurjit Singh is the Chief Development Officer of Aldar Properties PJSC. Previously, he served as Chief Operating Officer of Sorouh Real Estate PJSC. He has been internationally active in the real estate industry for 29 years, and has been involved in the development and asset management of resort, commercial, retail, leisure, and residential township developments in the Middle East, North Africa, Malaysia, and Singapore.

Hossam Eldin Elsouefi managed the design, pre-construction, engineering, and construction of both Sky and Sun Towers and Gate Towers. He has also managed the design and construction of a number of iconic projects in UAE, such as Aldurrah Tower in Dubai and Al Bustan complex in Abu Dhabi. In Egypt, he was the Architectural Manager for Snohetta-Hamza Consortium and was responsible for the execution of the Bibliotheca Alexandria between 1997–2003.

Peter Brannan led The Gateway team as Project Director since its inception in 2005. He has worked on a number of high-profile projects in Asia and the Middle East, including Cyberport in Hong Kong, TaiKoo Hui in Guangzhou, and the International Finance Centre in Seoul. Based in Hong Kong for 25 years, Peter is responsible for managing the practice's work and expanding new business across Asia, China, and the Middle East.





Figure 1. The Sun and Sky towers rise alongside the Gate. © Neil Roberts

The design was enacted to carry that message. The composition seeks to assign meaning to forms, telling a story about the purpose and location of the buildings.

The Sky and Sun Towers

The first phase of the development consisted of two tall and slender glass ellipses, the Sky and Sun towers, which rise alongside the Gate like welcoming torches (see Figure 1). Clinging to their sides, a series of crystalline structures sparkle and reach to the sky like three-dimensional light beams. The Sky Tower contains Grade "A" office space in its lower half and luxury residential apartments in its upper half. The Sun Tower exclusively contains luxury residential apartments.

The first phase of the development consisted of these two elliptical torch-like forms. The Sky Tower, at 74 floors and 293 meters in height, is the tallest structure, announcing the island from afar. The Sun Tower, at 65 floors and 232 meters in height, is slightly shorter. The towers' cylindrical forms make them multidirectional icons, intended to be seen from land and sea, city and island. The Sky Tower's cantilevered bay windows stack vertically and are staggered in their placement around its circumference. The Sun Tower's cantilevered bay windows wrap horizontally around the elliptical form, in juxtaposition to the vertical emphasis of the Sky Tower (see Figure 2).



Figure 2. The Sun Tower's bay windows wrap horizontally around the elliptical form.

The towers rise from a pedestrian plaza that marks the arrival into the complex. A podium forms the base, containing shops facing the wide, shaded sidewalks of the boulevard. The retail experience is carried to the center of the block, where an atrium engages a second level of shops. Several levels of car park lead to the residents' landscaped deck. The deck's height affords a unique vantage point for observing the Gulf and the new city. An infinity pool visually links the two towers. Cabanas, tennis courts, a lap pool, a yoga lawn, and children's playground are all part of the elevated deck offering. A fitness center and party room share the floor and view.

On the ground floor, the separate residential and office lobbies are accessed from separate *porte-cocheres*, each with its own décor. The residential lobbies are warm in tonality, with rich woods and earth-tone stones and fabrics. The ground-floor office lobby, accompanied by a lower office lobby for registration, is

elegant and more attuned to corporate tastes, finished in stones and leathers with cool tones. Escalators lead to an upper elevator lobby that connects to the retail atrium.

The residences are designed for maximization of views. The façade curvature emphasizes the panoramic perspective. Expansive windowed areas flood the spaces with natural light. Rooms flow gracefully into each other, minimizing the need for circulation corridors and supporting a contemporary lifestyle.

The central core arrangement and elliptical plan provides a unique office floor plate with an excellent ratio of window to usable space.

Gate Towers

The second phase of the development centers on the Gate Towers, which contains 3,533 apartments. Its towers are arranged in a

“The skybridge spans approximately 87 meters between each of the towers and cantilevers 45 meters from the easternmost tower. Containing penthouses with indoor pools overlooking the city, elliptical oculi also punctuate the skybridge between the towers ceilings.”

gentle concave curve facing the rest of the island and the city. They are rectilinear in plan and section, as a counterpoint to the elliptical plans of the Sky and Sun towers (see Figure 3). The Gate Towers' floor plans offer a more regular apartment layout and support the development by offering a wider product range (see Figure 4).

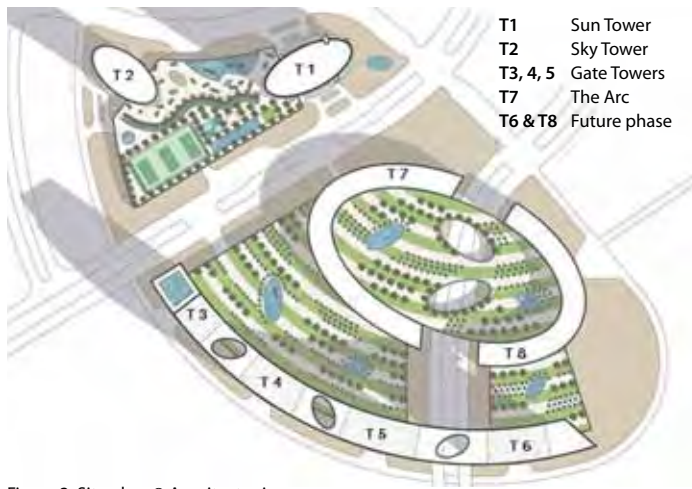


Figure 3. Site plan. © Arquitectonica

The Gate Towers taper vertically in opposite directions (see Figure 5), each providing an inverted silhouette against the sky. The façades are composed of glazed curtain walls with irregular patterned "speed stripes," which add to the horizontal articulation of the gateway. The Sky and Sun towers can be glimpsed through The Gate from different angles as one approaches the entrance to the development, creating an effect of drama and anticipation.



Figure 4. The Gate Towers, tapering shapes.

The Gate Towers are connected by a two-story "virtual lintel," or skybridge. The skybridge spans approximately 87 meters between each of the towers and cantilevers 45 meters from the easternmost tower (see Figure 6). The skybridge contains penthouses with indoor pools overlooking the city. Elliptical oculi punctuate the skybridge between the towers (see Figure 7). The oculus draws the eye to the heavens and emphasizes the sense of elevation. The shapes respond to the forms of the other towers and buildings in the composition.

Construction

Structural Engineering

The Gate's structural design is a reinforced concrete system. The foundation is a continuous raft extending over the full plot area of 67,447 square meters and sits on top of 4,076 piles.

The typical flooring system is made of reinforced concrete for the podium and post-tensioned flat-plate slab system for the upper floors. Beams have been provided where necessary for preventing critical punching of the slabs and for controlling the long-term deflection of long spans. This choice of system has given maximum flexibility to the MEP system, maximized the floor-to-floor height, and resulted in a clean

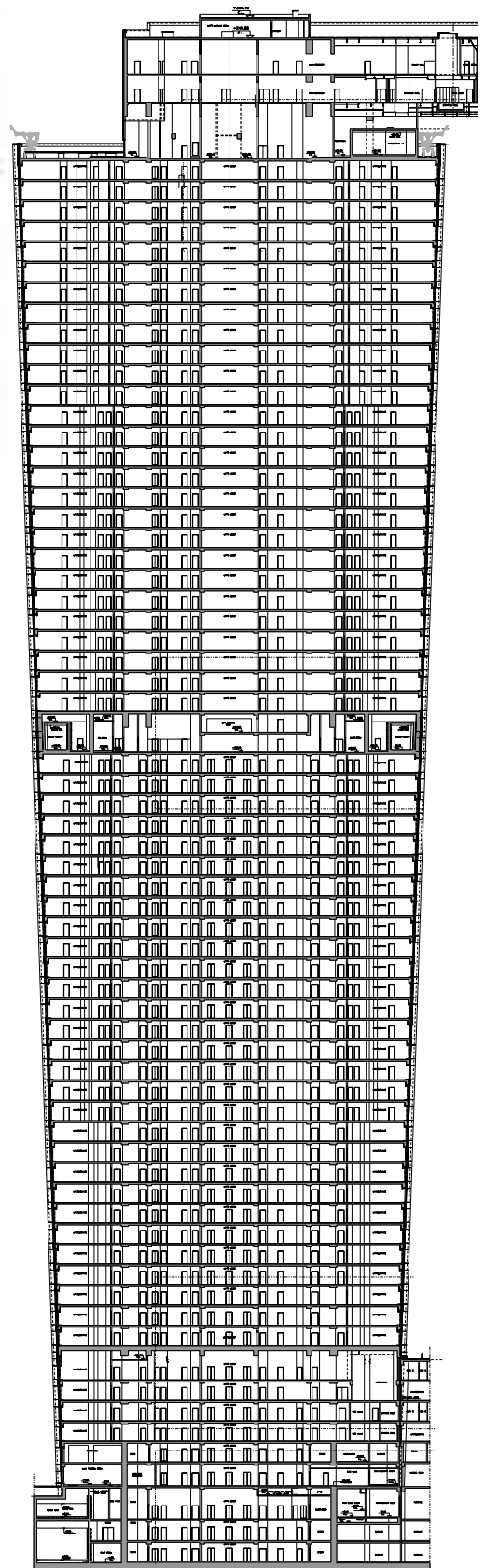


Figure 5. Tower 3 typical section.



Figure 6. The two-story skybridge.

soffit, thus eliminating the necessity to provide false ceilings. Reinforced-concrete columns and shear walls have been used to transfer floor loads to the foundation.

The lateral-load-resisting system is a moment-resisting frame system composed of columns and shear walls framing together and coupling with beams and/or flat slabs. The frames have been designed and detailed as intermediate moment-resisting frames in accordance with UBC97/ACI 318.

Glazing and Cladding Systems Engineering

The repetitive pattern of the towers' curtain wall and the scale of the project lend themselves to be more suitable to unitized systems. Ventilation screens are integrated into the curtain wall at the parking areas.

High-reflectivity glass gives a solid, lifeless look to a building, despite its superior thermal properties. Due to the residential function of The Gate Towers, low-reflectivity glass was placed to the outside and faces the interior. A light transmittance, above 40%, was used to allow for natural lighting. The outer panes are heat-strengthened, to minimize the possibility of spontaneous breakage. The inner panes are fully tempered, as specified by ANSI Z97.1 requirements for safety glazing.

The glass has a U-value of 1.9W/m²K and 0.30 shading coefficient, which satisfies UAE authorities' requirements. Insulation of building glazing by using low-e coating has reduced the heat gain, and subsequently the cooling loads of the building.

Additionally, for the first 20 floors of the towers, the glass has been treated and

increased in thickness to reduce street noise transmission to the lower part of the towers.

The Skybridge

One of the most distinctive elements of the project, the skybridge, connects all three towers, housing 21 breathtaking duplex penthouses. Sixteen of the penthouses have an indoor pool, overlooking the city.

The skybridge length is approximately 300 meters, extending beyond the edge of the East Tower (Tower 5), which was placed from above by travelling gantries.

Two main trusses, one on each face of the bridge, carry loads in the circumferential direction of the structure. Each of the two main trusses is composed of complex chords, formed by trussed members connected the main diagonals spanning between the chords. Roof and floor trusses carry loads in

the radial direction between the main trusses and around the oval openings in both radial and circumference directions. Extensive computer models and thorough checks were made for structural movement, mode shapes, block work movement, cladding, and glazing movement, in order to study every possible combination of wind loads and seismic movements (see Figure 8). This was then checked by two third-party accredited reviewers.

The portion of the skybridge above the towers was built in place above Level 63, whereas the portion between the towers was assembled on a platform extending from the podium at the fifth level and was then lifted into place.

To complete the skybridge, the infill structure, weighing 750 metric tons, measuring 40 (W) x 31 (D) x 12.5 (H) meters, was lifted by strand



Figure 7. The skybridge oculi.

“The lifting of the Gate skybridge was the heaviest and highest lift ever attempted for a real-estate project to date. The lifting of each section took approximately three days at a speed of 18 meters per hour.”

jacks to Level 64, at a height of 238 meters. This was the heaviest and highest lift ever attempted for a real-estate project to date. The lifting of each section took approximately three days at a speed of 18 meters per hour. All strand jacks were synchronized to ensure the safety of the lift. Extreme precision and accuracy of survey were the key factors in ensuring that the lifted portion of the skybridge fit exactly into place (see Figure 9).

Once the bridge section was in place, the Dubai rope-access company Megarme installed an innovative system of tension cables to provide an underside working platform for installing soffit panels and abseiling (rappelling) hooks. Tension cables were strung between two towers at three-meter centers, with periodic connections into the structure above, and nylon nets were stretched between them.

The Gate Towers has introduced the concept of skybridges to real estate development in the UAE, as well as the region, through proven construction technology and methodology. The payoff is most obvious when taking in the view from one of the skybridge’s 21 luxury penthouses. A panoramic view from Abu Dhabi Island to the Arabian Gulf is revealed from each room.

The Arc

The other major outcome of the project’s second phase is The Arc, a semicircular mid-rise building ringing the pool

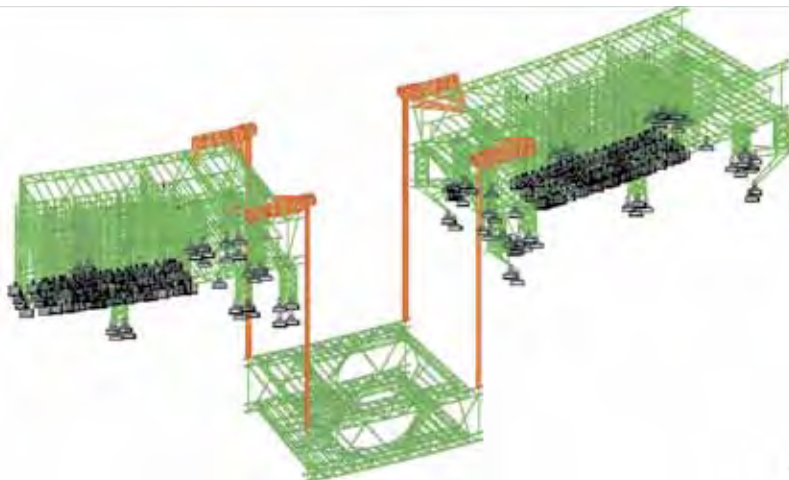


Figure 8. Computer Modelling for strand-jacking the skybridge’s oculi. © Eversendai Corporation



Figure 9. Construction photo series showing installation of skybridge spans.

opposite the Gate Towers (see Figure 10). The Arc has a hanging garden feature, which brings small secluded pockets of landscape up to the residential levels of the building. There are 14 hanging gardens in total, each accessible from the adjacent corridor, with its own irrigation system, fountains, and stepped seats.

In a third phase, there are future plans for a mirrored version of the Arc, as well as a fourth Gate tower, which will be connected via an extension of the skybridge.

Conclusion

The Gate Towers were recognized as Finalists in the Best Tall Building, Middle East & Africa category of the 2013 CTBUH Awards. The jury statement in the Awards Book captures the value of both the aspiration and the execution of the project: "The Gate Towers allude to a future in which tall buildings appear at such density that many of the amenities of urban habitat on the ground can and should be replicated at height. While clearly symbolic as an ageless gesture of welcome, the towers also afford a sophisticated experience for inhabitants. Moments of conviviality not normally experienced at height, such as hanging gardens, are cross-pollinated with experiences that could only come from pioneering engineering at height." ■



Figure 10. Aerial view of the Gate Towers and The Arc on the left.

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Project Data

Completion Date: August 2013
Height: 238 meters
Stories: 66
Total Area: 465,871 square meters
Use: Residential
Owner/Developer: Aldar Properties PJSC

Architect: Arquitectonica (design); Khatib and Alami (architect of record)
Structural Engineer: Khatib and Alami (design); Arup (peer review)
MEP Engineer: Khatib and Alami
Project Manager: Hill International, Ltd.
Main Contractor: Arabian Construction Co.; Eversendai Corporation; Orascom
Other Consultants: Exova Warrington (fire); Hill International, Ltd. (cost); Meinhardt (façade); Pelton Marsh Kinsella (acoustics); Thomas Bell Wright International Consultants (façade)

