Title: **Modern Tower, Ancient City: Ronesans Tower**

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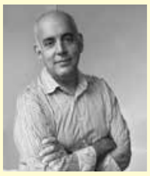
# Modern Tower, Ancient City: Ronesans Tower

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Dan Kaplan's passion and preoccupation is sustainable city building. He is widely recognized for integrating design excellence, sustainable innovation and an urban point-of-view into noteworthy architectural and urban design projects. Throughout his twenty-seven-year tenure at FXFOWLE, Dan has principally served in a design and leadership capacity for many of the firm's significant projects–from individual buildings to large scale urban plans. He leads the firm's commercial and residential practice, and is adept at creating large-scale high performance buildings and urban design. He continues to evolve his design vision through architectural investigation, creating commissioned work, and teaching.

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Stephen DeSimone focuses on the design of mixed-use and high-rise towers, specializing in computer modeling of complex formed structures. In this pursuit, he has developed several techniques that enable complex surface information to be migrated from one computer application to another. Other areas of expertise include wind engineering, the use of composite systems and the design of high-rise concrete structures.

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Fatin Anlar has more than 20 years of experience in all aspects of architectural design, and has led the design and management of a variety of commercial projects, including office, hotel, residential, retail, and mixed-use projects throughout the United States, Europe, Asia, and the Middle East. He works on many high rise buildings and complex projects with a special focus on enhancing the urban experience and the performance of the buildings. He provides project leadership throughout all phases of the design process, from master planning through construction administration.



## Abstract

*In this era of globalization, societies and cities struggle with the need to modernize and remain competitive against the desire to show deference to historical context. This paper will present a Case Study on Renaissance Tower (Ronesans Tower) in Istanbul, Turkey as an insight into the challenges and synergies that arise when executing local projects in a global context, and how a design approach must address technological limitations, economic constraints and cultural differences. Influence for the Ronesans Tower comes from across the world yet the design and technologies conform to the country's ideals.*



**Keywords: Culture, damping, design process, façade, performance based design, seismic**


### Istanbul: Modern Metropolis - Layered History

"Culture is mix. Culture means a mix of things from other sources. And my town, Istanbul, was this kind of mix. Istanbul, in fact, and my work, is a testimony to the fact that East and West combine cultural gracefully, or sometimes in an anarchic way, came together, and that is what we should search for." - Orhan Pamuk (sic)

Typically defined as a bridge between East and West, Istanbul's condition is more accurately described as the pivot point between four regions. In addition to the above noted Europe (west) and Asia (east), it is equally a link between the Slavic world (north) and Arab world (south). As the surrounding regions, along with Turkey itself, have evolved in the post-Cold War period, Istanbul has re-emerged as a true crossroads of trade, capital, and ideas. With Istanbul's population fast approaching 15 million, there is pressure on the city's aging and non-seismic-resistant building stock. Coupled with a young population (the average age is 29) and a generally vibrant economy, the overall conditions have been ripe for high-rise development.

Istanbul's rich and layered past is a backdrop to this growth and renewal. It is an ancient city that has served as the capitol of the Roman, Byzantine, and Ottoman Empires. The city's planning, monuments, and architecture reflect these periods. The late modern architecture in Turkey typically generated monotonous, systemized buildings, much of their form predetermined by highly restrictive codes. Adding to the mix and contributing greatly to its sense of place, is Istanbul's natural environment: the landscape, the Bosporus and the Marmara Sea (see Figure 2, 3).

Out of this milieu was born Allianz Tower. A new 42 story office tower marking the eastern entrance to the city, it was intended to be a singular, headquarters quality, high performance tower; simultaneously world-class and reflecting its unique locale.

Figure 1. Allianz Tower: View looking south to Marmara Sea and Princess Island (Source: FXFOWLE)

Figure 2. Bosphorus and Marmara Sea from Topkapi Palace (Source: FXFOWLE)

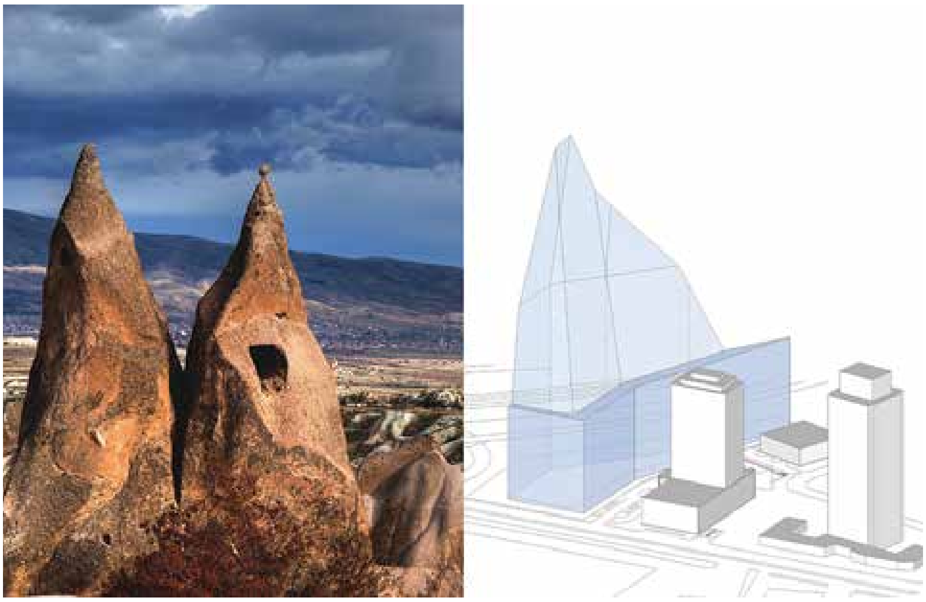


Figure 4. Historic landscape of Cappadocia in Central Turkey was an influential reference in sculpting the form of the tower (Source: FXFOWLE)

## Architectural Concept: Culture and Climate Synthesis

Istanbul's Allianz Tower draws its design from a cultural reading of place. The region offers a limitless territory of ornament and expression. The designers looked beyond superficial analysis of this fertile domain to the realm of deeper interpretation. The office tower brings together sculptural massing, which is rooted in place and landscape; a solar-responsive skin, which alludes to Islamic tradition; and numerous green spaces. Like Istanbul itself, the building is culturally specific yet internationally resonant; it operates locally and also within a larger field of worldwide architectural concerns.

Istanbul is divided by the Bosporus, a narrow strait. The Old City is situated on the western, European side; Allianz Tower is on the Asian side, ten kilometers to the east, at the intersection of two major highways. It's the first tall building that visitors to the city encounter from the east enroute from Sabiha Gökçen Airport to the city center. This condition as a regional marker influenced the tower's "obelisk" form.

Early in the design process, design strategies were sought to anchor the massing into both cultural and solar contexts, while addressing more normative functional and regulatory issues. The unique geographic and historic landscape of Cappadocia in Central Turkey (see Figure 4), tower-like habitations emerging from rock formations, were an influential reference in the sculpting of the form, as was the more general reference to Islamic geometric ornamentation. Working within the sky-exposure planes generated by the irregular site also proved formative; maximizing the usable area of the upper floors as the planes converged was especially challenging (see Figure 5). Rotating the building on the site by approximately thirty-three degrees increased the floor plate size by 10%, improved the core-to wall dimensions, and reduced the height of the building by 4 floors, all making the building more efficient. It had the added benefit of modestly reducing the solar isolation (2%) (see Figure 6). All these influences – cultural, sustainable, and functional – were integrated into the basic chiseled figure of the tower.

Figure 3. Nightime, Istanbul Mosque, typical silhouette (Source: FXFOWLE)

It is useful to highlight the role of insolation modeling during the early design phases. Office buildings in this climate are generally "cooling dominant"; they use more air-conditioning due to the size of the floors and the intensity of people, lights, and equipment within. There is also the desire for large expanses of glass for enhanced occupant experience. This adds up to an imperative to increase passive shading of the building's skin, preventing solar energy from hitting and penetrating the glazing. Using SEFAIRA and Ecotect modeling software, the design team iteratively tested various orientations and massings. As noted above, the massing was rotated in part to optimize solar response.

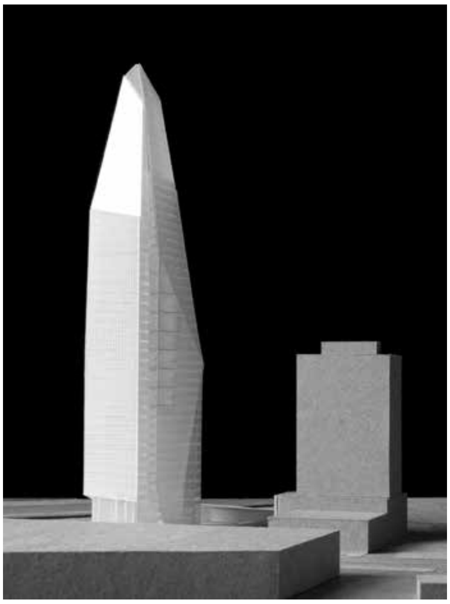


Figure 5. Sculptural development during design phase (Source: FXFOWLE)

Beyond the rotation of the building, a more robust passive shading regime was needed in order to achieve the conflicting desires of transparency through ample glazing (approximately 80%) and ambitious energy reduction goals. Islamic vernacular architecture was a departure point for resolving this contradiction. Geometrically ornamented Islamic mashrabiya (see Figure 7) screens both temper direct sunlight and limit views from the street into residences. The designers sought to replicate the qualities of the mashrabiya on the building skin. The solution, a stippled golden scrim that drapes over the glass surface of the building, incorporates ornament-like patterning, is tuned to the solar orientation, and reduces heat load. Among the wide-ranging sources (see Figure 8) for the sunscreen were the

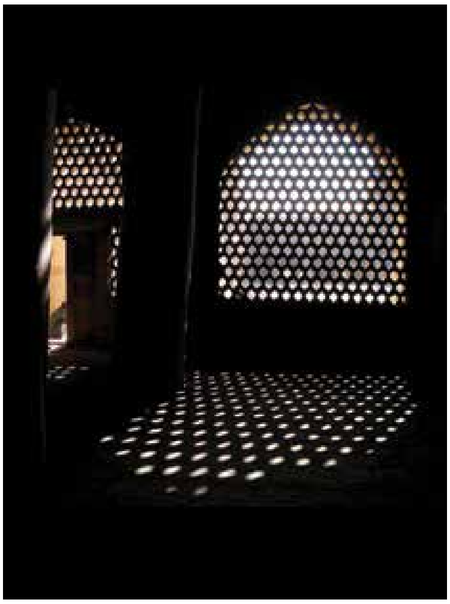


Figure 7. Typical geometrically ornamented Islamic mashrabiya screen (Source: FXFOWLE)

sensibilities of the "exotic Orient," where gold and bronze are metals of sophistication; the innovative garments of Paco Rabanne; and the cloak in Klimt's iconic painting The Kiss. The building skin represents a merger of cultural and climatic goals, an incorporation without pastiche.

Green spaces laced through the tower embody the environmental emphasis. Three groupings of sky gardens are positioned at key exposures. These two-story gardens provide a thermal buffer between exterior and interior, access to fresh air, and places of relaxation for office workers. A larger garden with a weave of planting and architectural elements, crowns the tower. These green areas temper the verticality and closed environment inherent to any high-rise building.

Allianz Tower unites opposites in new forms of synthesis. The building is a modern skyscraper, but it is imbued with a textural richness and ornamentation appropriate in the East. The exterior skin controls the sun, but it creates transparency. The skin expresses the local culture, but it also refers to a larger aesthetic vocabulary (see Figure 9).

## Innovation and Performance

Allianz Tower incorporates a variety of significant, high-performance strategies – many a first for Istanbul - to make the building more comfortable and enjoyable for its occupants and have a lighter touch on the environment. It is the first tower in Turkey to achieve LEED Platinum certification.

### Exterior Solar Shading

A stipped golden scrim shades the glazing, reducing the solar load. Based on computational analysis and iterative design studies, the scrim needed to be most heavily deployed on the south elevation (almost 50% coverage). The amount of the screens are gradually reduced on the east and west, finally disappearing on the north façade.

The scrim is composed on varied sized perforated panels, held off from the primary exterior glass surface by 300mm (see Figure 10). The panels themselves are integral to the larger unitized curtainwall panel, allowing for efficient erection. The panels were fabricated from aluminum sheet, 50mm thick, with round perforations at a density of 50%. In order to resist oil-canning and deflection under wind loads, the panels

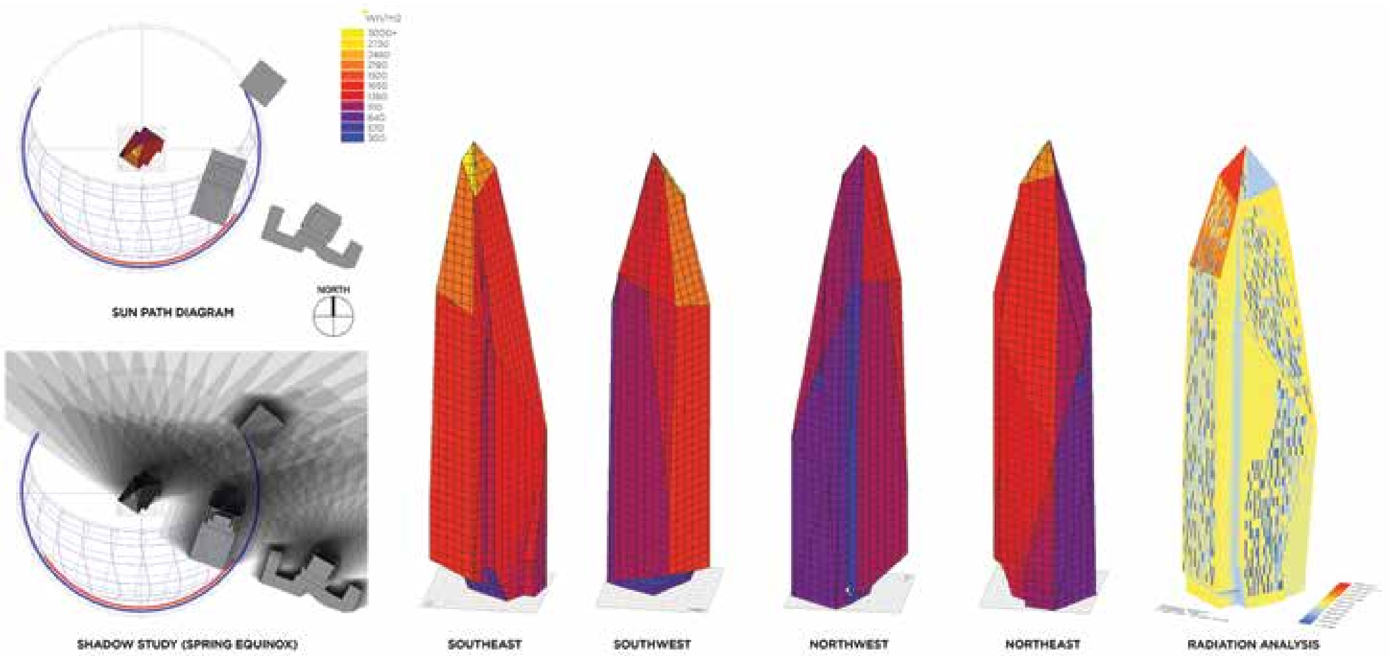



Figure 6. Ecotect and radiation analysis (Source: FXFOWLE)

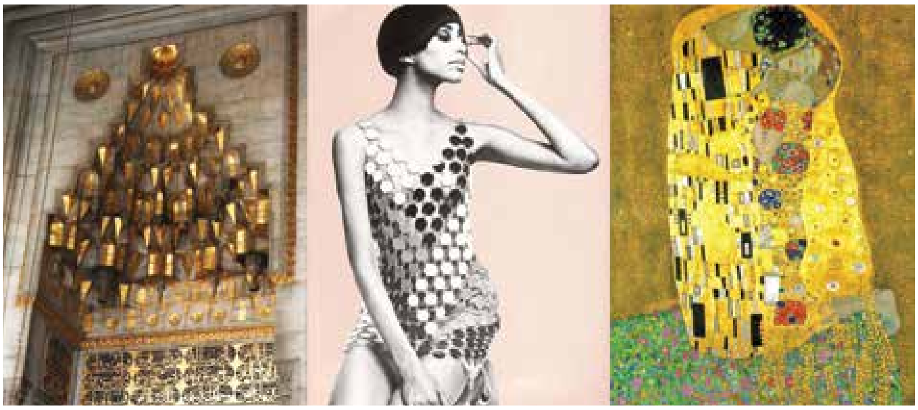


Figure 8. Combination of historic architectural elements with Modern art (Source: FXFOWLE)

incorporate larger (2cm x 6cm) "eye-lids". This configuration, formed by cutting slits and then pressing the surface outward, was arrived at through a process of trial and error with the fabricator. The panels then received a powder-coated finish in two shades of golden-brown. This solution balanced the need for both strength and shading properties on the one hand and through-transparency on the other. The final design maintains the 50% perforation and reduces overall insolation by approximately 18%.

It is worth noting that the façade was designed and conceived of in 2010, during the project's design phase. At that time, the MEP engineers were not sufficiently confident of the shading benefits, both overall and at peak-load periods, of the panels. The design team relied on some modeling, however not robust or accessible enough to overcome the concern. Since then, advances in rapid shading modeling (Cornell University's SUSTAIN, to cite one) are allowing more precise and reliable calculations.

To reduce the heating and cooling loads further, the curtainwall incorporates four-sided structurally glazed unitized curtain wall. Glazing has a low-E coating along with ceramic frit for additional sun shading.

Together, these enable the incorporation of floor-to-ceiling, un-tinted glass while simultaneously achieving ambitious energy efficiency goals. Due in part to the shading strategy, the energy model demonstrates a 26% improvement compared to the baseline building performance of ASHREA 90.1.

It is a significant accomplishment that Allianz Tower is Turkey's first building to receive LEED Platinum Certification, receiving 81 out of a possible 110 credits. For Energy, the building achieved 19 credits of 37 possible; for Sustainable Sites; 11 out of 12 possible for Indoor Environmental Quality and all 10 points available for Water Efficiency. Interestingly, 80% of the tower meets the criteria for Regional Materials, four times more than the amount required to achieve maximum points.

### Skygardens: Social Spaces in the Tower

The skygardens are an integral part of the building concept. These two-story spaces laced through the office floors allow occupants to enjoy natural light in a multifunctional area within the workplace. Socially, they form focal points for offices, providing places to talk with colleagues, hold informal meetings, eat lunch, drink coffee and relax during breaks. Each skygarden acts as a "buffer zone" into which conditioned indoor air "spills" before being exhausted from the building.

The municipality encourages "social" spaces, allowing up to 10% of a given floor to be deducted for this use. Taking this as a departure point, the designers developed four principles:

- They should be two stories in height, allowing all occupants to be no more than one level away (preparation for connecting stairs are incorporated);
- They should be directly accessible and visible from the elevator lobby on each floor, promoting "public" character and orientation;
- They should not be overly grand, so they remain a comfortable, informal space (about 100m$^2$);
- They should occupy a building corner so that there is perception of volume. These have largely been incorporated into the final design (see Figure 11, 13).

### Rooftop Garden: Greenspace Gets The Best Space

A common frustration with tall buildings is that mechanical services equipment often occupies the most visible and privileged

Figure 9. Allianz Tower: View from south east (Source: FXFOWLE)

Figure 10. Allianz Tower, façade detail (Source: FXFOWLE)


Figure 11. Allianz Tower. Sky garden and roof deck. (Source: FXFOWLE)

part of the tower: the top. Given the environmental aspirations of the building, it was appropriate that the crown of the building be programmed with a unique exterior garden space. The top mechanical floors are capped with a roof deck; the obelisk profile is maintained by sloped extensions of the curtain wall, providing shelter from the wind. At the very top the glass gives way to an open steel frame. The rooftop has minimal equipment, being served by a mini-core containing a shuttle elevator, egress stairs, and a small toilet room. The remaining area (450m$^2$) will be landscaped (see Figure 12).

Several planning strategies were implemented to realize this favorable arrangement. This site was large enough to allow the building's cooling towers to be located at-grade in the podium structure. This prevented the noise, plume, and bulk from spoiling the experience of the garden. Similarly, the exterior maintenance rig was located below the roof garden level. Several approaches were studied at length, including a central telescoping boom mounted on a central pole. The ultimate solution included a custom-designed rig parked inside the floor between the garden and mechanical floor. Retractable doors integrated into the exterior wall system are positioned on the four facades, allowing the unit (with an 18 meter reach, 170 meter vertical run capability) to serve the entire building.

## Daylight and Views

The principal characteristic of the tower is transparency and attendant access to daylight and views from the interior. The views, particularly to the south and east, are dramatic with unfettered sightlines to the Marmara Sea, Princes' Islands, and the Sultanahmet Peninsula. Despite a relatively small floor plate (1350m$^2$) the central core configuration was implemented to allow 360 degree access to the exterior. Consequently, the lease spans are relatively

Figure 12. Allianz Tower. Landscape observation deck. (Source: FXFOWLE)

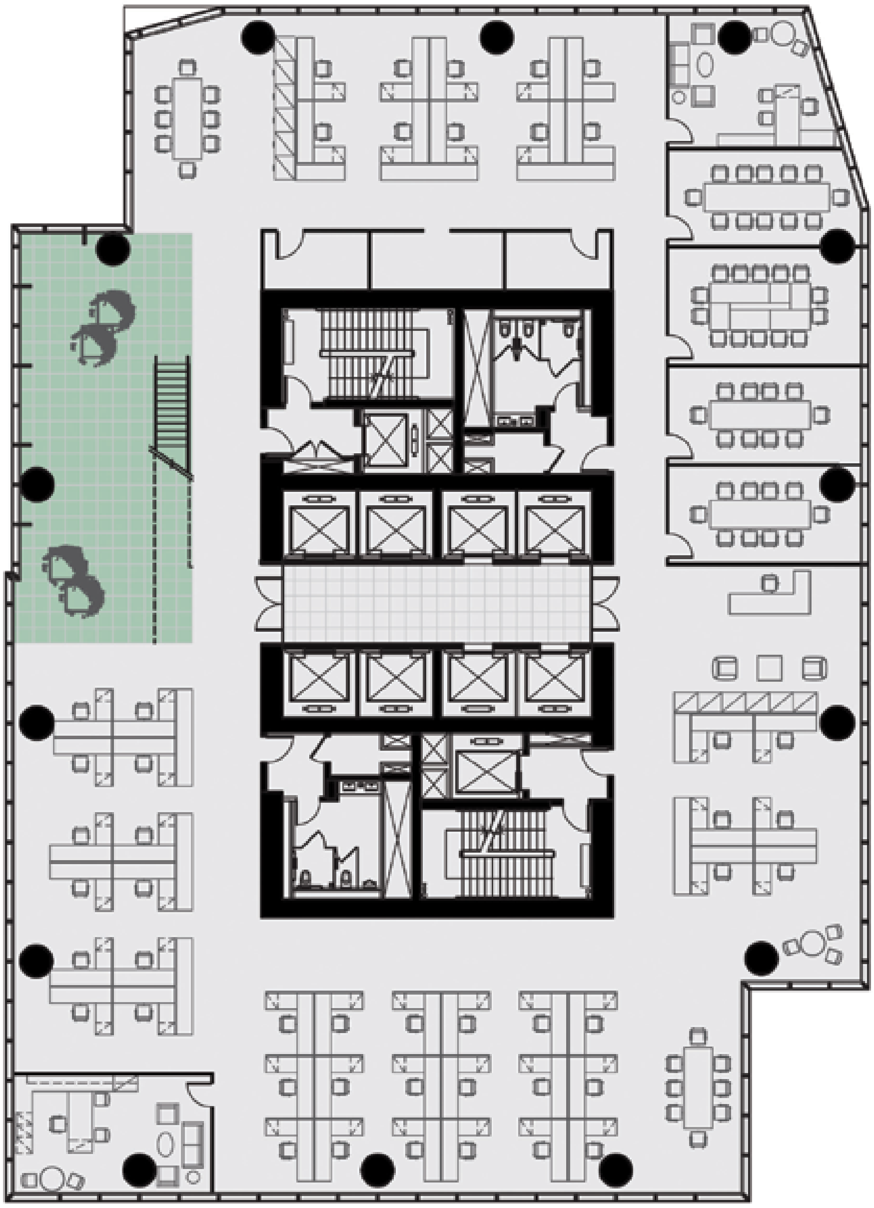


Figure 13. Allianz Tower. Top floor plan with observation deck. (Source: FXFOWLE)

low, around 10m typically, resulting in a large proportion of the perimeter zone (see Figure 13). The exterior wall features floor to ceiling glazing, with an 80cm "step-up" at the head resulting in 320cm-tall glazing. The combination of narrow floor plate and ample glazing allows for 90% of regularly occupied spaces to have access to views and 75% to be naturally day-lit.

**Underfloor Air Distribution for Flexibility and Energy Efficiency**

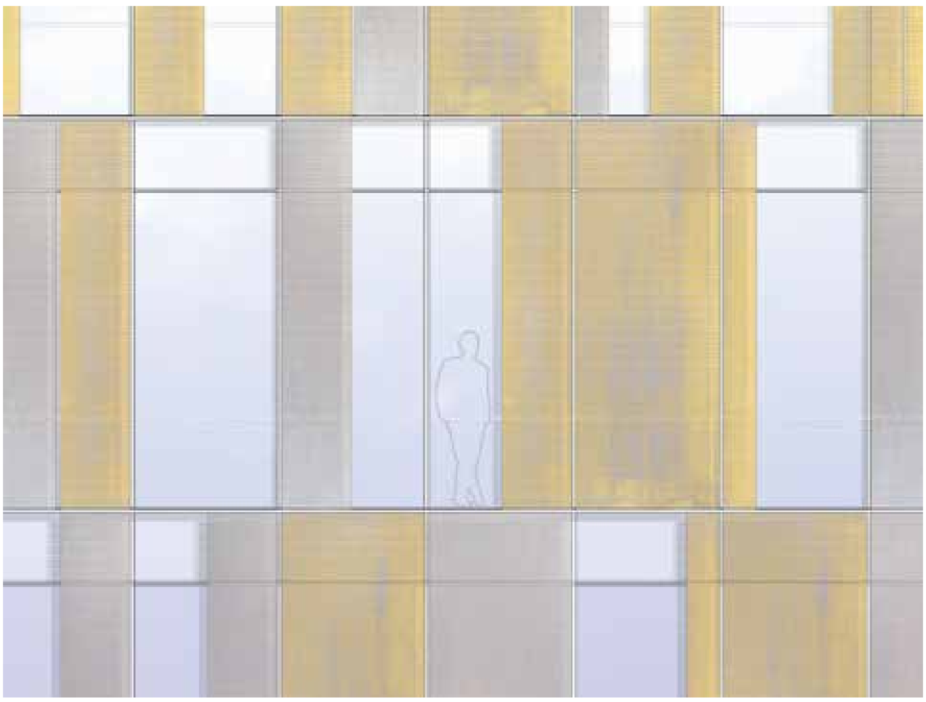
A raised floor system permits easy customization and incorporates an energy-efficient displacement ventilation system (see Figure 14).

Supply air is introduced to the space via floor diffusers; perimeter heating and cooling is provided by low profile four pipe fan coil units located in the floor plenum. As the air warms, it rises and pollutants are carried toward them. Rather than mixing the air within the entire space, fresh air is provided to the breathing zone.

Under floor air distribution system has significant energy savings when compared to overhead air systems because of lower fan static requirements. Economizer hours of operation will increase energy savings as well.

## Structural Innovation

Like the building itself, the structural design of the Allianz Tower needed to address technical limitations, economic constraints, and cultural differences all while striving to create a world class building. The result is the construction of Turkey's first truly modern skyscraper.



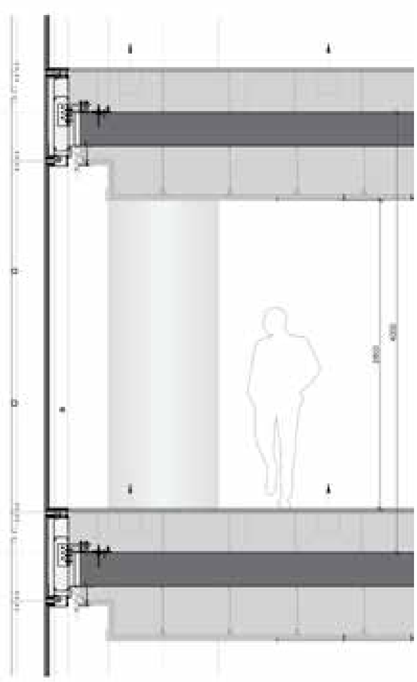


Figure 14. Allianz Tower.  Rendering of façade detail (Source: FXFOWLE)

Figure 15. Allianz Tower. Buckling restrained braces–located in the middle of the tower. (Source: FXFOWLE)

From a structural perspective, it is imperative to note that Turkey is in a seismically hazardous region and is materially impacted by activity from the North Anatolian Fault Zone. The 1,200km long, very active fault accommodates the relative motion between the Anatolian and Eurasian plates. One of the largest recent events was centered in Duzce, outside of Istanbul and measured a magnitude 7.2. The Government of Turkey has invested heavily in disaster mitigation as well as earthquake research. The Turkish Municipalities were particularly interested in embracing the state of the art in seismic analysis and design in an effort to minimize economic loss.

Situated within this "seismic context," Istanbul is susceptible to extreme ground shaking. As seismic forces are proportional to building weight, the use of a steel frame was initially considered. The lack of expertise and local availability made the use of steel impractical and as such, a concrete frame was chosen. Recent advances in the design of high rise concrete structures in regions prone to severe ground shaking provided a guideline for the design of the Renaissance Tower. The use of Performance Based Design (PBD) in lieu of the prescriptive code requirements was chosen as the code based design was simply impractical to construct. Based on previous design experience with high rise concrete towers in regions of severe ground shaking, 301 Mission in San Francisco and the Shangri-La Tower in the Philippines, the design team was comfortable undertaking this approach.

The design team sought to produce a consensus approach that followed the requirements as outlined in the Seismic Design Guidelines for Tall Buildings developed by PEER and the Istanbul Seismic Design Code for Tall Buildings developed by Bogazici University. While both documents are based on similar research and thinking there were some significant differences that needed to be resolved as part of the development of the Basis of Design.

In addition to producing a more reliable design, PBD allows the designer to ignore the prescriptive requirement that a dual lateral resisting system be utilized. Specifically, the code requires the use of moment frames in addition to shear walls. While the use of a dual system is not a drawback per-se, the code requirement that the frames be proportioned to resist at least 25% of the overturning moment produces unusually large perimeter elements. Moreover, the aggregate lateral capacity exceeds nominal demand by 25%.

Once the need to utilize a dual system was eliminated, the design team chose to eliminate all of the beams and utilize a flat plate system. The traditional concrete floor framing system in Turkey is a beam and slab system. Beams were replaced with a 300mm cast concrete flat slab, providing more flexibility in services layout and enabling the 80cm "step up" at the head of the curtainwall.

The lateral system for the tower comprises a concrete core wall with outriggers. To improve the performance of the building, the outriggers were replaced with Buckling Restrained Braces (BRB) (see Figure 15). Unlike a traditional outrigger, the BRB is capable of developing yield forces in tension and compression without buckling. This behavior provides reliable and quantifiable ductility as demonstrated by tested hysteretic curves.

## Performance Based Design

For a Performance Based Design Project, the PEER Report seeks to satisfy the following objectives:

- Demonstrate that the structure will be capable of essentially providing elastic response with limited damage under the Service Level Earthquake ground motions having a return period of 43 years;
- Demonstrate with high confidence that the structure will respond to MCE level ground motions without loss of gravity load carrying capacity; without inelastic straining of important lateral force resisting elements to a level that will severally degrade their strength; and without experiencing excessive permanent (residual) lateral drift or the development of global structural instabilities.

ASCE41, which is referred to by the PEER guidelines, provides acceptance criteria in terms of deformation and force demands on individual structural components. Other global demand parameters (especially story drifts) are also important indicators of possible damage to nonstructural components and overall building performance. For the Allianz Tower, it is assumed that lateral columns would remain elastic under axial loads and that shear walls will remain elastic under shear demands. Nonlinear behavior would be limited to the shear walls in flexure, link beams and outriggers. Axial strain in core walls, outriggers and rotation of link beams are assumed to be deformation controlled actions whereas the ISDCTB2008 document requires Collapse Prevention Performance Levels for the structure when subjected to the Maximum Considered Earthquake ground motion intensity.

ASCE41 defines Collapse Prevention Limit as: ensuring a small risk of partial or complete building collapse by limiting structural deformations and forces to the onset of significant strength and stiffness degradation. The MCE level earthquake is taken as an event with a 2% probability of exceedance in 50 years (2475 year return period). The purpose of this evaluation is to check demands on the structural elements in terms of their capacities and deformation limits states given in ASCE 41 and ISTBCD 2008 documents.

After several iterations using various ground motions the acceptance criteria as set forth in the PEER and Turkish based design guide were met with little in the way of modifications to the design.

## Team and Process: International Players - Local Milieu

The project's organizational design and managerial tone was critical to achieving its innovative features and overall level of quality. It fostered the marriage of local know-how and the application of international best practices.

This fusion started at the top, with the developer-builder Renaissance (a.k.a. Ronesans). Renaissance is the 2nd largest developer-builder in Turkey with far-ranging projects throughout the country. This project, its first significant high-rise in the capitol, serves both as conventional real estate development as well as Renaissance's "calling card", highlighting its ability to develop and construct world-class vertical buildings.

Critical to the success of the project was Renaissance's deep experience working on projects outside of Turkey. Its in-house design, construction and development teams were formed in the crucible of working on high-rises in Russia, the Middle East and in the Turkic-speaking countries of Azerbaijan and Turkmenistan. Due to the logistical and managerial complexities of executing these types of projects abroad, the developer's teams developed useful skill sets applicable to the tower. Foremost was the mastery of the "choreography" between international design team, local professionals, global and local subcontractors, and the municipal agencies responsible for entitlements. The team – including many trained architects and engineers - well understood the procurement and management of architectural and engineering services, including the interface between international and local professionals.

Mr. Serdar Biznet, a board member and structural engineer, provided crucial support and insight during the first-ever performance-based review of a high-rise structural frame in Istanbul. Renaissance had a seasoned and sophisticated purchasing department, experienced in the procurement of large subcontracts: curtain walls, elevators, superstructure, HVAC and the numerous specialties found in the high-rise typology.

The international professional team was similarly well-suited to the task. From Four Times Square and the New York Times Building (with Renzo Piano Building Workshop) to Eleven Times Square and 3 Hudson Boulevard, FXFOWLE has been in the design leadership of ground-breaking tall buildings in New York City. Further, the firm has had an active presence in the MENA countries, including several innovative tall buildings at the King Abdullah Financial Center. This dual-pedigree was helpful in bringing best practices and innovative technologies to the project. For instance, Allianz Tower's screens, integrated into the unitized curtain wall, owes much to the research and development of the terracotta baguette screens of the New York Times building. FXFOWLE was helped immensely by its Project Architect, Fatin Anlar, a Turkish trained and registered architect. Mr. Anlar practiced in Istanbul, lending a critical architectural, cultural and linguistic bridge.

The local architectural firm Fehmi Kobal Design complimented FXFOWLE. Trained at the University of Virginia and MIT, Mr. Kobal was familiar with US architectural norms, processes and culture. In addition, Kobal was the executive architect for the very successful "Kanyon" tower and shopping center in Istanbul designed by the Jerde Partnership. That project's analogous level of complexity was a strong foundation for Kobal's work on Allianz Tower.

Of the engineering consultants, structural engineer DeSimone had the most difficult task; Renaissance Tower was the first tower to go through Istanbul's performance-based structural review. DeSimone and local Structural Team (APCB) worked in close collaboration with Dr. Mustafa Erdik, a professor and Chairman of Earthquake Engineering Department of Bogazici University, who reviewed the structural design and oversaw the approval process with the local agencies. Educated at METU and Rice University, his deep knowledge and experience with designing buildings in sensitive seismic areas was instrumental for the project.

A similarly close collaboration between local and global on the MEP Services engineering side with Cosentini and Okutan Muhendislik as well as with Façade Engineering. Okutan's engineering expertise and local knowledge has been an important factor selecting the best and most efficient systems not only for typical high rise buildings but also for the building in this region. Axis façades offices in New York, Los Angeles, Istanbul, Seoul and Shanghai brought their expertise from different parts of the world and provided full time attention to the project through their experienced local team.

Through it all, and adding in no small measure to the outcome, was an esprit-de-corps fostered by the owner's positive outlook; the message was that the team was engaged in something extraordinary. Like most high-rises, Allianz Tower was designed and constructed based on the "Hollywood Model," where groups of firms come together around a project. They are mutually dependent and need to be in close coordination. However, to achieve the levels of innovation and quality evident here, the firms and individuals needed to transcend the day-to-day working method and succeed at real collaboration. At the beginning, there were no strict targets or limits in order to achieve certain performance, sustainability level, or grading system but rather an overriding goal to 'do the right thing.' Understanding that the project would be a signature for the developer and the city, knowing that the performance of the building was paramount - not "business as usual" - and recognizing that the regulatory hurdles would be high, all lent a sense of urgency resulting in heightened attention. Complimenting this "transactional" side was a "relational" aspect. The individuals truly liked and respected each other, which lead to a level of trust. In the mixing of organizational skills, can-do spirit, and attention to hospitality, this modern international group was quintessentially Turkish.