With the majority of Earth's population now residing in urban areas, city-makers have an obligation to forge a more viable, sustainable urban habitat, with increased urban density playing an important role. Tall buildings need to be seen as integrated pieces of urban infrastructure, dedicated to improving quality of life in the city as a whole. This requires a cohesive, multi-disciplinary response.

Providing a global overview of dense urban development, this book explores the projects, technologies, and approaches currently reshaping skylines and urban spaces worldwide. In this edition, innovations in the constituent disciplines that bring tall buildings to life, and even extend their lives—construction, the engineering of façades, fire & risk, geotechnical engineering, interior space, MEP, renovation, and structural engineering—are all explored.

The Tall Buildings + Urban Habitat book is produced annually by the Council on Tall Buildings and Urban Habitat (CTBUH), the global authority on the inception, design, construction, and operation of tall buildings and future cities.
The projects profiled in this book are those submitted to the Council on Tall Buildings and Urban Habitat’s 2020 Global Awards program. See page 314 to learn more about this program.
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53 West 53
New York City, United States

The unique form of 53 West 53 is a modern expression of the Manhattan skyscraper archetype, initially crystallized by pioneering designs like the Chrysler Building and Empire State Building. These New York City icons continue to be referenced in tall building concepts because the fundamental driver of the form of tall buildings in Manhattan remains the sky exposure plane, providing light and air to the public on surrounding streets and sidewalks. The building’s silhouette tapers to a sharp edge as it rises to its distinctive terminus. The site is mid-block, irregular in plan, and falls in three different zoning districts, each with different floor area and massing limits. The formal emphasis naturally flows to the north and south street façades, where the zoning setback requirements are followed without compromise. The resulting form of the tower represents the angled, tapering zoning setback requirements with sleek angled surfaces, not the rectilinear setbacks often employed to comply with the underlying zoning. Located on a formerly vacant lot that adjoins the Museum of Modern Art in Midtown Manhattan, the building’s lower floors allow visitor circulation from the newly renovated MoMA complex to the east.

The tower’s signature tapering geometry is reserved for the north and south façades, while the east and west rise in perfect sheer verticality. The particularities of the three different zoning districts and ground plot drove the form to a multi-apex iteration, where each of the three peaks is distinguished with a color treatment—gold, black and silver—further emphasized by the gradient transition of each pinnacle’s hue. The wind and seismic bracing, expressed in a diagrid, generates a very rigid, highly efficient structure—so efficient that most interior columns are eliminated, and the proportion of clear views is greater than in a traditional rectilinear column arrangement. The entire structure is executed in reinforced concrete. Detailing of the intersecting floors, columns and diagrids required the development of innovative custom steel reinforcing nodes in 47 locations, which allows the pure irregular and three-dimensional geometries to be achieved. Finally, low-iron glass is framed in a rectilinear curtain wall grid, juxtaposing the tapering north and south façades.

This was the first building in North America to use triple glazing (with two air spaces) throughout. In order to ensure comfort with floor-to-ceiling glass in a New York City climate, the elimination of drafts conventionally calls for the introduction of a heat source at the base of the exterior wall. In this case, computer modeling demonstrated that triple glazing would allow the project to eliminate the addition of perimeter heating. The cost of triple glazing was offset in part by forgoing the perimeter heating, and the net additional cost was deemed a reasonable tradeoff for the acoustical side benefits arising from the glazing system. Ultimately, the need to create more than 5,000 different, irregularly-shaped custom window panels for the project out of low-iron glass made for a compelling exterior wall composition, particularly when consideration is given to the irregular geometry.
The particularities of the three different zoning districts resulted in multiple apexes, with each peak distinguished with a color treatment—gold, black and silver—further emphasized by the gradient transition of each pinnacle’s hue.
Opposite Left: The tower’s three peaks each feature a distinctive wash of color.

Opposite Right: A plan of floor 62 demonstrates the tapering of the structure, showing the location of diagrid wind bracing along the perimeter.

Left: Thanks to the highly-efficient structure, most interior columns are eliminated, allowing for a greater proportion of clear views and floor-to-ceiling windows.

Below: The richly-hued building lobby adjoins the famous Museum of Modern Art (MoMA).
Singapore’s green spaces weave horizontally throughout streetscapes and vertically into architecture by way of skygardens and green walls. The design for 18 Robinson enhances the physical and cultural context that defines contemporary Singapore by incorporating interior and exterior greenery. The site is dramatic, the terminus of an acute "V" shape, defined by Market Street and Robinson Road. Because of the unusually high visibility of the site, the location mandated a strong, recognizable architectural object that would both maximize the site’s commercial potential and serve as an important public amenity. The tower is a transformative addition to its location, offering office and boutique retail spaces.

The tower is vertically separated from the podium, opening up a large, stepped terrace garden that is visible from the street. Breaking 18 Robinson into two volumes is a marked variation from the surrounding buildings, which are generally singular extrusions. Facets in the tower function to increase natural light within the podium and mitigate direct views into adjacent buildings. The facets also reflect light to create the effect of a crystalline tower floating above the gardens. Separating the tower from the podium increases the building height to provide better views and enables the addition of low-level garden space, creating a more porous urban realm. Hovering above the street, the podium acts as a frame for the entrance plaza and atrium garden. This design move enhances spaciousness and the fluidity of the interchange between indoor and outdoor space. The atrium forms the nucleus around which the office lobby, retail, and restaurant spaces are organized. The site’s small size is maximized with seven floors of retail, restaurants, and gardens. Floor plans are open, with an offset core to the west, maximizing preferred marina views and limiting solar heat gain.

The design focus for the tower was primarily on visibility, connectivity to its surroundings, and on the possibilities inherent in adding public green space. The working environment of Singapore tries to ensure that all projects are as beneficial for society as they are for the owner; thus, the new regulations for this Landscape Replacement Area—an answer to land lost due to development—were debated and negotiated with the relevant agency within the Urban Redevelopment Authority of Singapore. The URA also weighed in on the appropriateness of the massing proposal for the site and its nighttime lighting strategy. Issues of glass reflectivity and specular reflections of non-glazed materials of the building façade were negotiated by the Building Control Agency, which acts on behalf of the public. In order to meet the requirements for the Landscape Replacement Area mandate, three types of gardens punctuate a seamless circulation system that eases movement through the podium and culminates at the rooftop gardens. The terraced gardens provide a variety of important environmental benefits, including passive air filtration. The elevated gardens are publicly accessible, increase porosity, light, and air at ground level, boost water efficiency, decrease heat gain, and provide enhanced views.
Located in the heart of Brisbane’s Royal National Agricultural and Industrial Association of Queensland’s (RNA) Showgrounds, 25 King’s 14,921 square meters of space makes it one of Australia’s tallest and largest timber commercial buildings. The site anchors one end of King Street, a burgeoning precinct in Brisbane that is working to prioritize sustainability and well-being through design. The building’s expression—marked on the exterior by its ground-level timber colonnade and “verandah” south façade—nods to the Showgrounds’ historic pavilions and traditional “Queenslander” buildings. Inside, the large floor plates encourage movement and collaboration, and the exposed timber engenders warmth and familiarity. Floor-to-ceiling glass brings the outdoors inside, enabling natural light and greenery to filter throughout the building.

As a singular gesture, 25 King represents a viable return to timber design and construction, pushing for widespread solutions beyond concrete and steel in commercial and mid-scale office developments. Its basement and ground-floor structure are concrete, resistant to dampness and termites. Above the ground floor, however, the entire structure was constructed in timber. A simple, 6-by-8-meter system of glue-laminated (glulam) beams and columns work with cross-laminated timber (CLT) floor planks and core walls to support a flexible floor plate. Short spans adjacent to the core and façade allow major services to reticulate without compromising floor-to-floor heights.

Architecturally, the building highlights its floor plates and use of timber through its glazed transparency, street-level timber colonnade, and interior warmth, which was created by leaving the wood and other raw materials exposed. The use of natural materials in the interior—as opposed to concrete, steel, and plasterboard—better connects occupants with nature, which has been linked to fostering a happier and healthier workplace.

One of timber’s major advantages is its ability to sequester carbon dioxide: the design achieves a 74 percent savings in embodied carbon, when compared to a typical steel-and-concrete building. The building minimized its environmental impact during the construction phase via off-site fabrication of the timber elements, which helped to reduce construction waste. Pre-construction of these elements also helped achieve significantly shorter construction times. Each level was built in 11 days, with construction time totaling 15 months.

Natural daylighting to the interior lessens the demand on indoor lighting systems, while low-temperature HVAC and aluminum sunshades reduce heat gains, helping to whittle down overall energy usage by 45 percent. Photovoltaic (PV) panels with metering and monitoring supplement the energy systems without further carbon emissions. Water usage is also reduced by 25 percent, through the use of rainwater harvesting.
The Brunel Building was conceived in response to the need to intensify the use of London’s urban spaces, while also opening a previously inaccessible canal-side site to public access. The brief called for the replacement of the existing low-rise 1970s warehouse with a new development that reflected the importance of the location. The site was particularly challenging, with very tight geometry and the added complication of two tunnels of the Bakerloo Tube Line running below. These challenges required a different way of thinking about the form of the building. The diagrid exoskeleton mitigates those challenges, while providing column-free floor plates and 20 percent shading to the façade, helping to reduce energy demand. This allows for improved natural light in the workplace. Improving the public realm was also central to the project’s objectives. For the first time since Paddington Basin was opened more than 200 years ago, the public has access to a new, tree-lined canal towpath that links the Basin with Little Venice in nearby Maida Vale. Restaurants and bars have populated the south-facing terrace and large, motorized hangar doors open to reveal the building’s reception to the canal-side.

The building’s exoskeleton was derived from a desire to reference both the Great Western Railway, as well as the wider engineering heritage of Paddington Station. Combined with its aesthetic appeal, it also serves an engineering function in supporting the building over the two subterranean tunnels of the Bakerloo Tube Line, while helping to create flexible column-free interiors. The ground floor was designed to present a large sense of scale, driven by a desire to provide a permeable space for users and visitors. The high entrance between the diagrid feet and orange steelwork has been designed to help direct people into the building from alongside the canal and North Wharf Road. The 9-meter-high reception area also makes a dramatic welcoming statement and contains clusters of informal zones for meetings and visitor gatherings.

Low environmental impact was a high consideration in the building’s development, and a range of passive measures have been included in the design. Complex detailing to the external diagrid was required due to the over 400 thermally-broken structural penetrations through the façade. The shading provided by the exoskeleton allows for thinner, clearer glass, improving daylight diffusion and thermal performance. The integrated exposed concrete core and soffits provide thermal mass to the building, improving occupant comfort and reducing the need for forced-air heating. A detailed embodied carbon assessment was completed as part of the design process, leading the building to achieve a 7.5 percent reduction over a typical new office building in the United Kingdom.

The design process took advantage of the latest digital technology, with 3D modeling, building information modeling (BIM), and virtual reality (VR) being utilized to optimize the diagrid formation to balance an open arrangement with structural function, architectural form, and construction logic. In addition, over 50 studies, concerning design concepts and their practical applications to the building’s geometry, were undertaken to optimize the spandrel patterns for the façade.
At the heart of the Jumeirah Village Circle, a family-oriented residential community 16 kilometers outside of Downtown Dubai, the cylindrical tower of FIVE Jumeirah Village rises—in a continuous rotating form—above the landscape of mid-rise and low-rise developments. This hospitality and residential project expresses its unique revolving design as a result of a newly-devised, innovative structural framework. The novel "breathable architecture" plan, which has been patented in 186 countries, provides every unit with penthouse-style views and configurations, even on the lower floors. The "revolving" void allows for each unit to have three fully-open window sides, as opposed to conventional apartments that have three enclosed walls and one outside-facing wall for windows. Floor-to-ceiling windows offer panoramic 200-degree vistas over Downtown Dubai or the surrounding desert landscape. Additionally, each residence incorporates a fully-landscaped terrace with its own private swimming pool.

The open space provisions allow sunlight to shine through to the central core of the 61-story tower, while a vertical micro-climate—with over 45,000 square meters of plant life—helps to naturally maintain an even temperature. The tower applies the organizing structure of a tree trunk and its branches as the paradigm. To create the revolving form, each floor has three individual wings that are connected only to the core, but not to each other. To minimize columns and increase open space, specially-designed cantilever slabs were created for the building’s structure. In order to achieve structural stiffness, while also providing for a continuous void space to revolve throughout the floor slabs, each level has three columns—120 degrees apart—that connect to outrigger beams. This solution is repeated at the next level, but revolves 30 degrees, so that at every fourth level, a sort of "ladder" is formed by the core, the outer columns, and the outrigger beams.

The revolving void creates a natural cooling system that decreases the temperature by 2 to 3 degrees compared to conventional building approaches. Double-paned glass windows and specially-created shades that face the terraces decrease solar heat gain and naturally balance indoor temperatures. Unlike a typical hotel or residential high-rise buildings, where mechanical, electrical and plumbing services are dropped through a shaft at the nearest column, the absence of conventional vertical shafts requires all services to flow below the horizontal slabs on each floor, and connect through the central core of the building, which transfers services to and from the ground level. With 156 pools and 134 Jacuzzis, waterproofing was an important consideration. A polyurea solution, which is four times more efficient than conventional waterproofing systems, was sprayed directly onto the concrete surface. The project's "green community" concept of a high-rise tower with integrated, densely-planted terraces allows for seven times more green living space than the land that was lost to construction. Its emphasis on multiple indoor-outdoor experiences presents an increasingly tranquil high-rise residential lifestyle, with indoor spaces that work in conjunction with, and complement the outdoor spaces.
Single-Site Scale

Tall buildings cannot exist as silos in cities, or else they do a disservice to the people who live and work in and around them. The most successful examples of urban habitats related to a single tall building are designed as places of engagement at the human scale, creating quality insertions into the public realm, and serving as more than just an intermediary between sidewalk and building. By using strategic greenery, adequate lighting, and other services and amenities, well-integrated, walkable urban habitats ultimately make density more approachable for everyone. The “Single-Site Scale” refers to a building or set of buildings and its immediate adjacencies, such as the streets closest to the site.

AND Pastel, Istanbul, Turkey
The site on which AND Pastel sits was formerly occupied by industrial facilities, which prevented the area from being utilized for public benefit. Today, 20 percent of the land is open space, with a retail passage, convenient access to Istanbul’s southern neighborhoods, and a new subway line. The design also allows the social infrastructure of the project to be accessible to the public, with a health center, kindergarten, pharmacy, and supermarket. This infrastructure, together with the linked public transportation, opens to a new public square that all residents can enjoy.

Each residential unit in the project is designed to benefit from direct or indirect sunlight, natural cross ventilation, and a range of views. More than 70 percent of the flats are designed to have at least two façades facing different directions. The project features an efficient central heating system, a decentralized cooling system, and a comprehensive water management system, ranging from greywater use to recycled landscape watering. The three green courtyards are extensively planted with local trees and other botanical life. Since the underground parking was designed to be concentrated only under the buildings and hardscape areas, tree roots are unencumbered by the structure, and will be able to reach their maximum depth. These trees, which will reach some 20 meters in coming years, will also provide privacy for the adjacent residential units.

A multicentered, interconnected courtyard system was developed with a hardscape private plaza and interactive water feature in the middle (see Figure 1). The courtyard’s borders are defined by four high-rise buildings, which allow access to three green, elevated courtyards. Three lower blocks define the borders of these green courtyards, which are designed to connect the entire site through pedestrian circulation (see Figure 2). A playful pedestrian “river” serves as the backbone of a network of brick-walled landscaped “rooms,” set amongst dune-like hills.

Assuta Bauhaus Village, Tel Aviv, Israel
Assuta Bauhaus Village, one of Tel Aviv’s newest developments, aims to integrate into an existing urban fabric, while at the same time significantly improving not only the
project site itself, but also the adjacent urban realm. The design reconnected the former hospital site to surrounding streets and urban activities, to the benefit of pedestrians (see Figure 3). It lies within the city’s White City zone, which has a large concentration of Bauhaus-style buildings. In-depth preservation work of the existing buildings was carried out, converting them into residential buildings and constructing a new residential tower and public kindergarten.

The soft and hard landscaping materials are part of the concept of formal and informal areas in the plan. The informal area is characterized by free geometry, naturalistic stone paving, grass, and herbaceous vegetation, while the formal area is characterized by straight lines. Old ficus trees were maintained, forming the baseline for green infrastructure for garden planning. The preserved buildings had all their built modifications carefully removed, exposing their original Bauhaus design. The residential tower’s delicate and elegant appearance includes two masses connected by a transparent atrium. The proportions relate to the surrounding buildings’ scale and color, as it is clad in white aluminum panels and articulated openings.

Figure 1: A central plaza defines the approach to AND Pastel.
Figure 2: The courtyards of AND Pastel are planted with local trees and, since parking is only under the buildings and hardscape areas, tree roots will be able to reach maximum depth, allowing their tops to reach 20 meters in coming years.
Figure 3: The Assuta Bauhaus Village plan reconnects the former hospital site to surrounding streets and urban activities, to the benefit of pedestrians.
What the tall building offers in compactness of footprint, it more than makes up for in sheer materials required to build, stabilize, and insulate it, up to hundreds of meters into the sky. It is for this reason that, despite the advances of new construction, the most sustainable approach to tall building design is sometimes working with existing building stock. Renovation can present myriad challenges—outdated floor plans, materials that are eroded, corroded, and in some cases, toxic—but it also brings with it potential of hidden treasure. Centuries-old masonry with intricate detail might encapsulate the stylistic trimmings of a bygone era, while salvaged light fixtures and a fresh coat of paint might allow the building to lend personality, context, and functionality to its updated use. The projects here exemplify successful adaptive reuse and renovation concepts that have not only managed to skirt demolition, but create new projects that stand as character-rich, fully modern destinations in their own right.

Hanwha Headquarters, Seoul, South Korea
As it is owned by a leading producer of photovoltaic (PV) panels, the renovation of the 1980s-built Hanwha Headquarters (see Figure 1) saw its façade receive a major update that included embedding solar technology into its exterior cladding to reflect the firm’s emphasis on renewable energy as its engine of growth. Influenced by the sun’s patterns and the natural environment, the responsive façade integrates into a holistic building-wide restructuring that prioritizes employee well-being and comfort. The modern aesthetic it establishes reflects the pace of rapid expansion taking place throughout the greater Cheonggyecheon area, a major cultural and historical hub with growing business and financial activity (see Figure 2).

The project aims to enhance well-being for employees by improving the indoor environment to support physical...
comfort. The outdoor garden design extends into the lobby, acting as a visual pathway into the building, blurring the lines between inside and outside. The use of natural materials and plantings, guided by studies in light and materiality, is coupled with a subtle color scheme and wood furnishings to build a calming respite (see Figure 3). The inclusion of coffee nooks throughout the north and south lobbies facilitates social interaction, further contributing to the livability dimension of the workspace. To minimize operational interruption, the renovation took place while the building remained occupied by the tenant. To achieve this, only three to four floors were emptied of employees at any time during construction.

The existing façade was replaced by clear, insulated glass and aluminum framing to accentuate views and daylight, while the geometry of the framing is further defined by solar orientation to ensure interior user comfort and reduced energy consumption. By varying the placement of the façade panels, several program-related openings are created. The north façade opens to enable daylighting within the building, but the south façade becomes more opaque where the sun’s rays are strongest, avoiding excessive heat gain. PV cells are placed on the opaque panels at the open zones, where there is an optimal amount of direct sunlight, and energy can best be generated (see Figure 4).

**Hudson Commons, New York City, United States**

To rebuild, or reposition? This is the fundamental question every developer must grapple with when acquiring a site with existing conditions. In New York City’s ephemeral urban fabric, large developments often lean towards a tabula

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Figure 1: The Hanwha Headquarters was built in the 1980s and the company felt it no longer reflected their aesthetic.

Figure 2: At Hanwha Headquarters the renovated façade’s contemporary update reflects its location in a major business and cultural hub.

Figure 3: Natural and light-colored materials create a calming effect throughout the workplace at Hanwha Headquarters.

Figure 4: The exterior of Hanwha Headquarters is outfitted with clear insulated glass and aluminum framing that is embedded with PV cells in strategic locations.
With the majority of Earth’s population now residing in urban areas, city-makers have an obligation to forge a more viable, sustainable urban habitat, with increased urban density playing an important role. Tall buildings need to be seen as integrated pieces of urban infrastructure, dedicated to improving quality of life in the city as a whole. This requires a cohesive, multi-disciplinary response.

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