8 WINKA DUBBELDAM'S SYNTHETIC NATURES

Figure 8.1 Archi-Tectonics, Asian Games, Hangzhou, China, 2022: The scheme for the 2022 Asian Games, an invited competition, by Archi-Tectonics, with Thornton Tomasetti and landscape firm !melk was selected in 2018. The design team worked over the next four years to implement their vision for seven buildings within a 47-hectare Eco Park during fluctuations in labor markets, significant increases in the cost of raw materials, and a global pandemic. Through efficient use of BIM technologies, the design and contracting team were able to save 1,130 tons of steel and shortened construction time by 20%.

Winka Dubbeldam, a Dutch architect, originally trained in sculpture and architecture in Rotterdam prior to attending the post-graduate architecture program Columbia. She has been committed to working with manufacturers to develop more innovative building and façade systems to ensure that her design goals can be implemented. She formed her practice Archi-Tectonics in 1994, and the firm has steadily employed 12 to 15 designers since.

Archi-Tectonics' rich history of manufacturing engagement goes back to early commissions, such as its 80,000 square foot building at Greenwich Street, in 2000, where folded glass panels, manufactured in Spain, were assembled as a unitized system in just three weeks on site. The project also served as an early example of a digital workflow, where three-dimensional computer files were transmitted to the glazing manufacturer, a subcontractor that produced custom-extruded aluminum mullions. The façade's varied directionality lets residents more readily experience weather conditions such as a soft rain drumming on the diagonal glazing panels, and provides more views to the sky than a conventional façade. The late-critic Herbert Muchamp referred to the building in the *New York Times* as a "para-building" in which Dubbeldam "crystallizes urban complexity within the discrete architectural object."[1]

Archi-Tectonics has stated that innovation in architectural design and its structures requires a revolutionary change in the thinking of how architecture is conceived. They have reimagined the notion that a building is composed of standardized elements such as columns, floors, and walls, in favor of assemblies of mass-customized generative components. These components are more "organic" and resemble the human body in its complexity and natural fit. From a construction standpoint, smart components require a level of prefabrication, but prefabrication as pure repetition of standard elements is an outdated mode of operation; mass-customized components are evolving as a series of heterogeneous elements, defined by an analysis of specific performance requirements. A component's design intelligence is more akin to automobile and aircraft design than to conventional architectural design, and is more systems-based. This more systematic way of thinking is common for scientists and industrial designers but is relatively new for architects. Such operations are not only changing the way buildings are designed, manufactured, and assembled, but essentially allows an innovative path for architecture to develop in years to come.

Another way to frame the work of Dubbeldam's office is in the scale of buildings it undertakes. While remaining a generalist practice, the firm understands that innovation can be evaluated and prototyped more easily in smaller projects, including exhibitions and objects. The work varies from these "proto-projects" to the larger scales of buildings or master plans. Dubbeldam refers to the flow of ideas between their projects as "open source."[2]

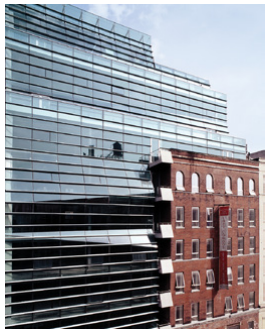


Figure 8.2 Archi-Tectonics, Greenwich Street Building, New York, NY, 2000. Folded double glazing with a solar film allows the glass façade to perform specifically for the New York climate. The glazing allows for solar penetration from the low winter sun, providing passive solar energy, while the solar film protects from the harsher summer sun, removing solar glare. Such an example of form-as-performance, articulated by Manuel DeLanda and others, was an early goal of architects engaging the digital.

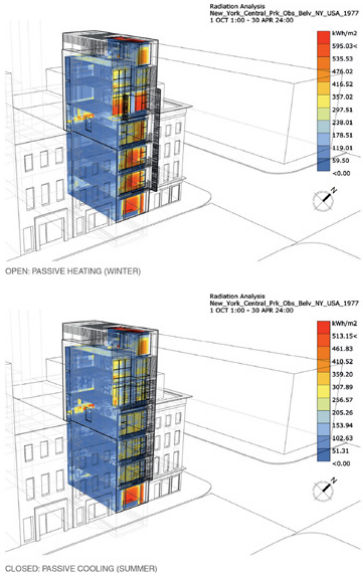
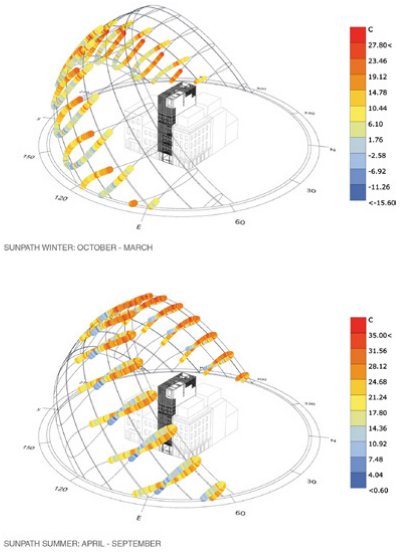


Figure 8.3 Archi-Tectonics, 512 GW Townhouse, New York, NY, 2019: Environmental plug-ins for Rhinoceros 3D have enabled architects to better understand weather, or the effects of local climate on their buildings. Dubbeldam and Archi-Tectonics use such tools to further simulate façade performance. A façade system of operable panels, a 3D trellis, creates a micro-climate around their 512 GW Townhouse project, allowing for shading, natural ventilation and exterior spaces, all wrapped in the 3D trellis volume.



Dubbeldam considers the consequences of the anthropocene the largest and most important project we will work on as architects. Human activities have impacted the environment enough to constitute this distinct geological change, in which human subjects have become the dominant influence on climate and the environment. The United States, which contains about 5% of the total human population on Earth, alone uses 25% of the world's resources, including 25% of oil and coal and 27% of natural gas, causing 30% of the world's pollution. Still, recycling and composting have prevented 85 million tons of material from being deposited into the waste stream, up from 18 million tons in 1980 – a 470% increase.

Though we are slowly and collectively realizing that steps must be taken to address these metrics, Dubbeldam, like many architects, feels that we can do more, especially since the consequences, such as flooding due to increased rainfall, are being experienced at more regular intervals. These climate events have displaced thousands of people and caused billions of dollars in damage to private structures and public infrastructure. The costs associated with Hurricane Harvey, in the fall of 2017, are approximately $125 billion, second only to Hurricane Katrina in 2005.

Dubbeldam also believes municipal governments need to better acknowledge climate change by supporting an increase of flood zones and climate-event preparedness in general, which in turn would mobilize more architects. She believes "in this next wave of the anthropocene where

climate change and environmental challenges threaten our and other species' existence, architecture needs to transform into a pro-active productive system, a body that has agency on its environment." Buildings will need to learn from nature's intelligence, by hybridization and symbiotic relationships with natural systems, becoming "synthetic natures" themselves. Buildings with such agency can foster positive feedback by, for example, absorbing carbon and emitting oxygen to their environment, and cleaning and filtering air and water. In this sense, Dubbeldam feels the role and scope of the architect has expanded, and the impact of our profession can become even more important to both ecology and building. She sees this as a challenge to architects working in the twenty-first century, which positions the projective optimism of the architectural project against the pessimism associated with much eco-criticism today – an opportunity to both "help and cause change." To this end, since the early 2000's she has thought pro-actively and holistically about buildings and building environments, adopting strategies for the adaptive reuse of structures or materials, and seeking siting solutions that can minimize energy use and maximize energy savings, either through passive solar heating or insulation. These ideas have also fostered early, and continuing, explorations with simulation software for climate-related study.

2022 ASIAN GAMES PARK, HANGZHOU, CHINA

Despite its boutique size, Dubbeldam's firm is increasingly becoming involved with larger-scale work. In 2018, the firm won the Asian Games 2022 competition for a 47-hectare Eco Park, a 1.6 km long green space containing seven new buildings, including two hybrid stadiums.

By understanding that the digital realm blurs boundaries between disciplines Archi-Tectonics proposed for the competition an equal responsibility-sharing team of experts, as opposed to a conventional organization of the architect as lead with engineering and landscape consultants. In collaboration with structural engineers Thornton Tomasetti and Dutch landscape design firm !melk, they not only felt this team of equals would be better positioned to win the competition but also believed it is an important model of future collaboration, where group intelligence is more relevant than that supplied by each firm, applying a part-to-whole approach.

The park design by !melk also implements what Dubbeldam refers to as a "sponge city" strategy by incorporating and restoring wetlands, creating islands in a waterway that bisects the site, and through the introduction of porous pavement that will enhance the site's hydrology. A reintroduction of local vegetation assists in restoring the natural biome. By focusing on the landscape structures built in the site, Archi-Tectonics' scheme not only conserves nature, but creates new hybrids that form symbiotic alignments between organisms and inorganic matter, assigning the latter organic qualities and a more significant ecological agency.

The two primary structures within the park, a field-hockey stadium/open-air cinema and table tennis stadium/concert hall, are both designed as smart, hybrid structures. The former includes a 125 meter free-span roof; and the latter, the intersection of two ellipses, features a massive suspendome roof, which makes the building adaptive and column-free. This allows the buildings and green spaces to transition from the Asian Games into a park and multi-use structures for the city of Hangzhou.

Dubbeldam recalls the design process, with decision-makers in each of the companies coming together to examine what she feels is one of the most interesting problems we face: creating a "green lung" in the middle of a city of 10.36 million people, based on a 2019 estimate. The hybrid structures for the Asian Games are developed with the city's legacy in mind. By understanding the stadia's fundamental duality, which allows them to function as a concert hall and event spaces for Hangzhou after the games, the buildings transform the park into a constantly evolving, dynamic environment, rather than creating static, representative objects that would become "white elephants" after the two-week Asian Games contests. Learning lessons from Beijing in 2008, with its structures largely unused today, Dubbeldam felt strongly that the park should have an anticipated purpose following the games. Looking at a wide array of potential users, the park would be both ecologically sustainable and programmed to ensure its continued use in the future.

Figure 8.4 Archi-Tectonics, Asian Games, Hangzhou, China, 2022: The site strategy provided by the client was rejected by the design team, favoring one that allowed both a formal and programmatic linkage between two stadiums planned for the site. A green pedestrian valley, with retail spaces on each side traverses the site at the lower level, connecting the stadiums via an outdoor walk and green space with green-roof glassed façade pavilions and long solar-paneled wings that shade visitors.

The site was bisected by a road and waterway at its center, and the competition required the two stadium buildings to flank either side. This conventional planning approach would have organized two halves of the park as the rear yards of the stadia. The team studied a series of other options and landed on one that pushed the stadium structures away from the center of the site and created a green "shopping valley" – a pedestrian mall that linearly connects both stadia while going *under* the street and waterway that bisect the site. While the design team felt this was the best site organization, they recognized that the massing strategy contrasted the stated rules and the planning goals initially set forth in the competition. The risk paid off, and the design team's concept, which better activated the park and utilized the stadia as attractors that set up the retail corridor, was endorsed – the competition sponsor and various government officials understood both the strategy and the passive environmental opportunities it afforded.

EARTH-BUILDING

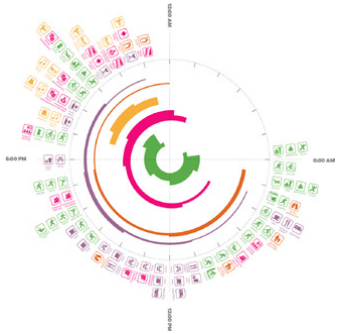
Dubbeldam recognizes that crossing under the body of water and an eight-lane road required intensive civil engineering, but the significance of the site, and event, was important to the client. The result was a 503-meter-long shopping valley, allowing the retail units themselves to be nested into the earthwork, providing both insulation and green roofs. The bisected park is also connected by two pedestrian bridges. On one end the arcade terminates at the field hockey stadium, which is also used as an outdoor concert venue and cinema. The building is technically notable for the 125 meter free-span roof, which overhangs and provides shading to the 5,000-seat arena. At the other end is sited a 35,000 square meter hybrid concert hall and table tennis stadium.

As the overall section developed, so did the nesting strategies for the buildings set within the site, these became hybrid landform/buildings. The zero-earth strategy allowed excavated earth to be relocated on top of several of the buildings that were sunk into the ground. Skylights, which provide daylighting as well as ventilation, are playfully dispersed within the parking and other underground structures, creating a visual relationship between the earth and the synthetic constructions below it. The pedestrian bridges contributed by !melk, the landscape architect, allowed for overall vantages of the site as well. These bridges received LED lighting, which are powered by the photovoltaic arrays on "solar wings." Other important structures, such as the boomerang shaped exhibition center, were also nested in the landscape, allowing for relationships between buildings as well. This structure is essentially underground with two facades that emerge from the landscape and sit in front of the field hockey stadium.

The recently completed design had a strict government stipulation for 85% park, quite the challenge to place

Figure 8.5 Archi-Tectonics, Asian Games, Hangzhou, China, 2022: The massing plan nested buildings within the rolling landscape, with wetlands utilizing vegetation that naturally filters nearby river water. Small archipelagos were introduced to speed local water flow, assisting with the natural filtration, and increasing oxygen content. Indeed, non-human species were included on the design team's list of "new users." Once the site strategy was established, relationships between earth and building features were explored.

Figure 8.6 Archi-Tectonics, Asian Games, Hangzhou, China, 2022: A diverse group of human and non-human users were considered for the site, a concept that guided both ecological strategies as well as post-games use. Incumbent in this was an understanding of legacy, both for the Asian Games and Chinese land development, and a dynamic user environment that included green spaces, as well as active and passive event spaces.



the required seven buildings in the landscape. The team's "zero-earth-strategy" reuses excavated earth from reconstituted wetlands and the new shopping concept, called the Valley Village, to create a hilly landscape that effectively dampens urban sound and creates a serene park landscape. As buildings merge with the landscape, their 64,000 square meter combined green roofs act as an agent of environmental change by releasing an estimated 83,408 kg of oxygen and absorbing 114,846 kg of carbon dioxide per year, according to Dubbeldam. Understanding that the entire assemblage had to perform comprehensively as a "synthetic nature," the design team was very interested in reactivating local passive land strategies such as wetlands and bioswales. All walkable surfaces are paved with porous pavers, ensuring the "urban sponge" functionality. There is also an overall drainage and water-carrying schema, and many of the surface treatments are designed to allow for the absorption and recharge of stormwater – water management was key to the site organization. The team also created a series of archipelagos within the waterway, which helped control speed and flow, while providing natural filtering of the water. This drains off excess stormwater, while maintaining water on site during dry periods.

The buildings partially function through their connection to the surrounding nature; water is extracted from newly reconstituted wetlands, preserving energy while cooling the seats of the stadia. Natural ventilation and lighting are

maintained through operable vent windows and a central skylight – the buildings literally breathe.

Understanding the post-games use of the site influenced the ecological strategy as well, with a pool of both human and non-human users being considered. Outdoor recreation features, such as a skatepark, playgrounds, and outdoor seating, are seamlessly integrated within the landscape. The rolling configuration allowed for natural shading, air movement, and sound attenuation, so spaces for reading or meditation are as readily accessible as playing fields.

EARTH-BUILDING, BY REMOTE CONTROL

Site and building construction occurred at the height of the COVID pandemic, with physical site visits being limited halfway through the construction period. The team relied on real-time drone flythroughs and weekly video conferences. Through the initial site visits, it became clear to the design team that some of the building intelligence developed during the construction documentation phase was better served by building information modeling (BIM), especially for the construction of the 125 meter roof of the field hockey stadium, and the table tennis stadium, the suspendome structure. The design team initially conveyed their intentions through three-dimensional models to a BIM team, after which design-detail sessions followed on Zoom. This significantly reduced costs, as well as material use and the project's overall schedule. Through this virtual process, 1,130 tons of steel were removed and construction time was cut by 20%.

Prior to the pandemic, the design team made several trips to Hangzhou to make the case for the technical solutions they proposed. On an early trip, Dubbeldam passed the site to find construction fences adorned with renderings of the project – construction had already started, enforcing what became a self-imposed deadline for completion of construction documents. This effectuated what became a kind of enhanced information exchange, fostered through modeling in Rhinoceros and Autodesk's Revit, and the Dynamo interface, on more complex aspects of the building form and structure, and even some landform aspects of the project. This workflow is notable for its optimizations, not only in terms of building components but in the means of construction.

Dubbeldam notes the idea of sharing is intimately linked to sustainability. Sharing implies a co-relation of humans and things as elements of one interconnected system. She believes a sharing economy is becoming relevant again today. As we continue to deplete natural resources, the need for reduction of production and waste – and for hybrid buildings that generate energy, clean air, and water – is increasing.

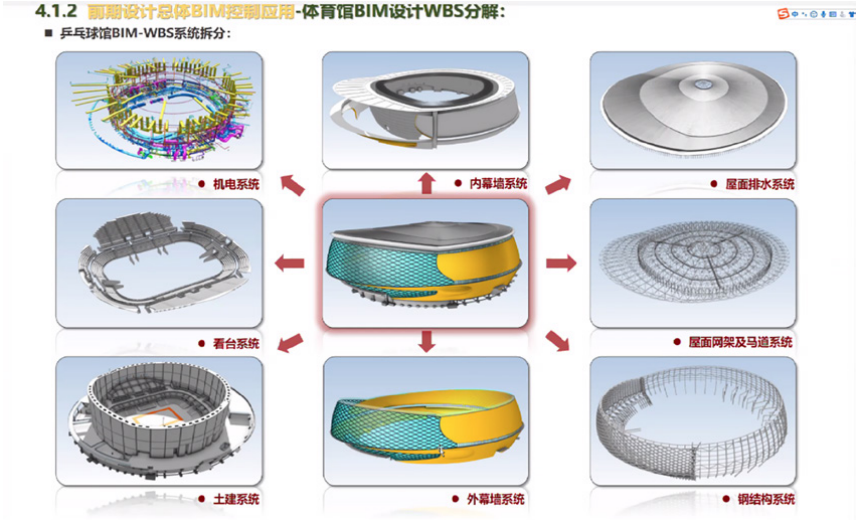


Figure 8.7 Archi-Tectonics, Asian Games, Hangzhou, China, 2022: Dubbeldam's team, in collaboration with BIM consultants in China, created a highly detailed drawing set that was transmitted directly to the general contractor. That drawing set, which details a series of cross-linear intersections that set forth the bounding dimensions of both stadia were critical to the successful delivery of the park and structures.

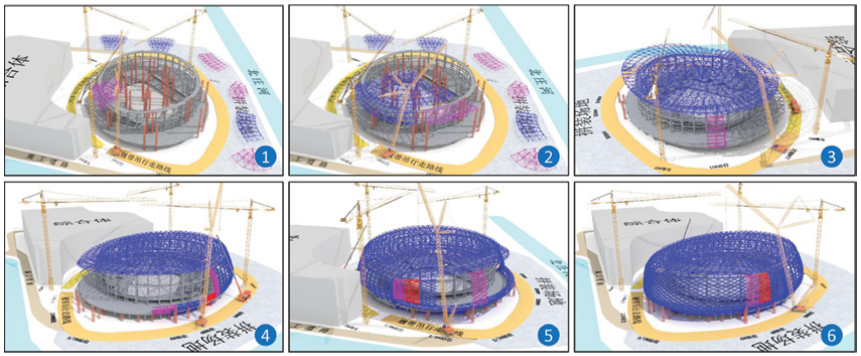


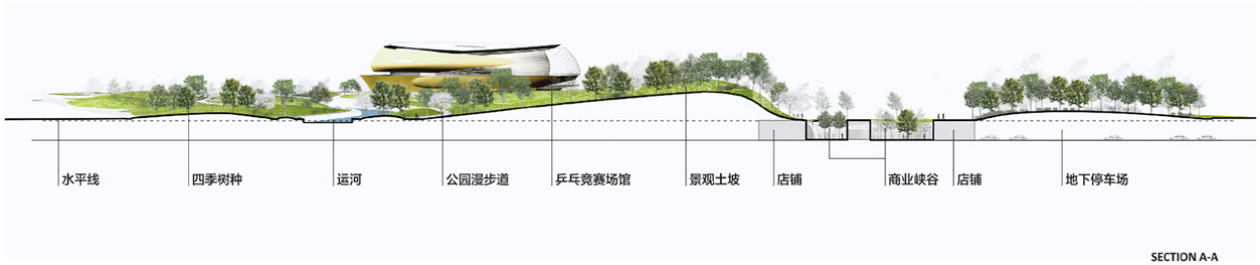
Figure 8.8 Archi-Tectonics, Asian Games, Hangzhou, China, 2022: In promoting ability over size, the contracting team deployed a fleet of smaller cranes which were quickly moved around the 47-hectare site. This ultimately proved more efficient than utilizing a single, larger, crane sized to lift the largest possible load. Dubbeldam feels this type of thinking greatly increased the speed of construction, ultimately allowing the park and its buildings to be finished ahead of schedule.

Figure 8.9 Archi-Tectonics, Asian Games, Hangzhou, China, 2022: Perspective showing the varied topography of the Asian Games Park supporting storm water absorption. Much of the planted earth was first bermed as part of a zero-earth strategy to redeposit soil mass within the site boundaries. The result was a gradually sloped synthetic nature – a hybrid landform/building that created diverse view corridors while passively channeling light and air within the constructed section of the site.

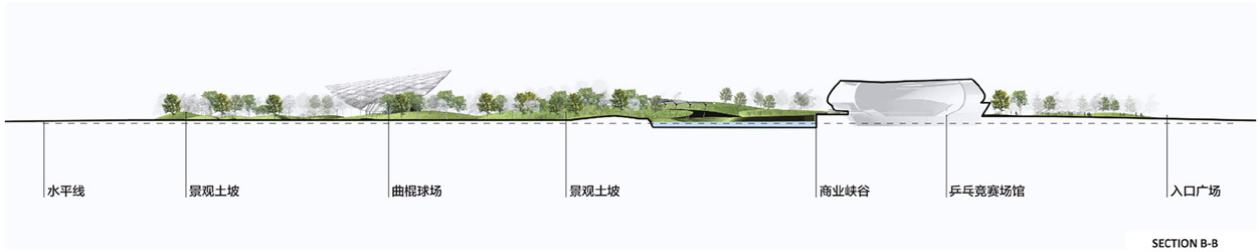
Figure 8.10 Archi-Tectonics, Asian Games, Hangzhou, China, 2022: The slope of the park, captured in a site section, allowed for a varied topography with structures nested into the landscape, thereby diminishing the perceptions of individual building heights and presenting an assemblage of both ecology and building. This synthetic nature is tuned to passively ventilate and drain, while holding the second largest multisport event in the world. Dubbeldam calls this synthetic valley the "inner sanctum" where there is complete quietness between the earth berms.

剖面 – 南公园

Section - South Park



SECTION A-A



SECTION B-B

The extensive level of information sharing, including the electronic transmission of both two- and three-dimensional information, facilitated this collaborative approach and eroded the conventional division of labor, ultimately ensuring a clear understanding of intentions in the project delivery. Unlike a traditional construction project, for which the smallest crane possible to lift the largest loads would be scheduled for the shortest duration, the contracting team, aided by temporal simulation, deployed multiple smaller cranes to different parts of the site. Such a strategy gave the contractors the agility to move horizontally across the site, relocating the cranes to complete both interior and exterior construction.

Over a short period of time, the 47-hectare site was "rewilded" per the design team's intent, with foundations quickly being set for buildings through this process. The "valley village," or retail spine that was planned to connect the main stadia, was also connected to two underground parking structures. These garages are naturally ventilated, with the rolling landscape forming green roofs above. Additional daylight control was achieved by winged platforms Dubbeldam refers to as "solar wings," which were covered in photovoltaic arrays. The shape of these components helped guide prevalent winds down into the recessed portions of the park. The arrays in turn provided power to light the park, and specifically the retail corridor, in the evening – a time of high pedestrian volume for shopping.

STADIA

The centerpieces of the project are two stadiums that flank the ends of the sunken retail corridor. The first, the field hockey stadium, has 5,000 seats and is contained within the 125-meter free span truss. The tension ring needed for such a span is over 1 meter thick. Further blurring the boundary between building and landscape, the playing field was inset 5 meters into the park and is anchored by two large site cast concrete abutments that anchor the roof. The playing field, which the spectator seats are oriented toward, is set level, and the park banks up around it, creating a slope to nest the seating under which spectators enter through a lobby. Dubbeldam is fond of saying "nothing is flat," which supports her interest in hybrids, suggesting that the building is not just a merger of structure and landscape but of two different assembly typologies, an arena and a theatre.

The table tennis stadium is a 5,000-seat, 35,000-meter concrete structure with a curved glass façade that sets up an entry sequence and VIP areas. This hybrid concert hall/stadium takes its inspiration from history, and specifically an object called a *cong*, which is a vessel with a circular tube subtracted from its center and a square outer section. The object can be traced back some 3,400 years in ancient China and is still used in ceramics and metal

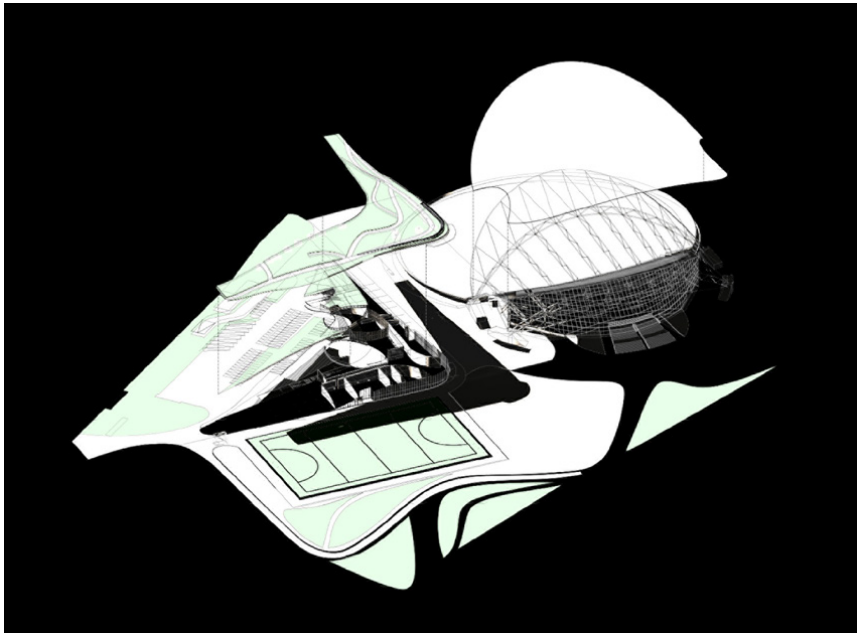
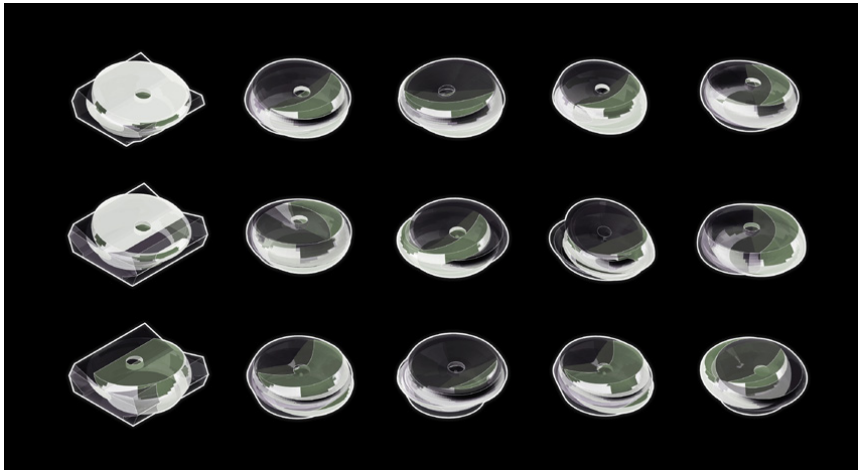


Figure 8.11 Archi-Tectonics, Asian Games, Hangzhou, China, 2022: The field hockey stadium contains a directional trussed roof spanning 125 meters. Anchored by site-cast concrete abutments, the building is set into the landscape to blur the relationship of building and site.

Figure 8.12 Archi-Tectonics, Asian Games, Hangzhou, China, 2022: Inspired by the *cong*, the architects initially studied various ways to intersect a cylinder and cube. Aware that many stadia have a direct relationship between outside and inside shapes, they intended to challenge this notion and create a geometrically hybrid building.



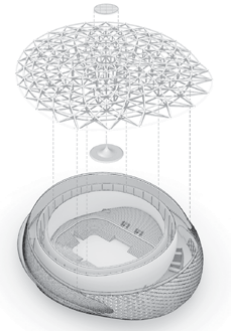


Figure 8.13 Archi-Tectonics, Asian Games, Hangzhou, China, 2022: The roof of the stadium is a large-span structural solution called a suspendome, which is widely used in sports buildings. The roof is prestressed to have much influence on the translation of internal forces.

Figure 8.14 Archi-Tectonics, Asian Games, Hangzhou, China, 2022: The 125-meter roof span of the field hockey stadium is dramatic, and covers the entire spectator seating area, which is organized on one side of the playing field. The field itself is set 5 meters into the ground to further blur the relationship of landscape and the structure, and contains large concrete abutments to anchor the large span roof.

work today. While there is some evidence to support the premise that the object had ritualistic purposes, its specific use is unknown, making it a strange hybrid, both historically and geometrically. Not unlike the cong, the building needed to be easily converted from an event space to a concert hall to a stadium, while still meeting all criteria required for the Games.

Moving away from the cylinder-cube intersection, the architects eventually began studying the asymmetrical intersection of two cylinders, which they were able to describe in terms of a radial relationship to two centers – like an ellipse – that also set up relationships between seating and stage or field. The zones that were created could be at once inside the contained volume but outside of one of the original cylinders, creating an irreducible shape that lent itself to a concert hall typology. Dubbeldam refers to the building organization as a "set of wobbly rings" that is asymmetrical and constantly negotiating inside and outside with itself – an *object with/in an object*. She contends the building is *in*stable, as opposed to being fixed as either stable or unstable, a kind of both-and condition that furthers the hybrid logic of the project.

The building's material logic is formed around the asymmetrical rings, which have a variable relationship to one another. The building's geometry was originally massed in Rhinoceros, but the intersections ultimately needed a higher level of constraint. This was furthered by Dubbeldam's insistence that the stadium needed to be a column-free space. In addition to blocking primary views

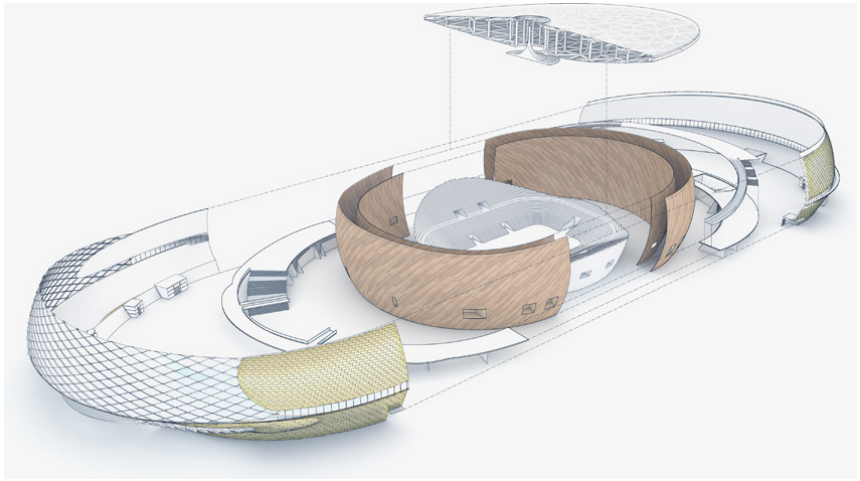


Figure 8.15 Archi-Tectonics, Asian Games, Hangzhou, China, 2022: The object with/in strategy allowed the design team to deploy a hybrid seating organization so that both stadium- and arena-type events could be held. Dubbeldam was very conscious of the structure's post-Asian Games use, so the building would not become a "white elephant," an underutilized piece of urban infrastructure in the city of Hangzhou.

Figure 8.16 Archi-Tectonics, Asian Games, Hangzhou, China, 2022: The entry sequence of the table tennis stadium dynamically expresses the relationship between the center bowl, which is clad in wood and forms a hybrid theatre/arena seating arrangement, and the eccentrically hung façade, which is clad with solar glazing and brass-finished shingles.

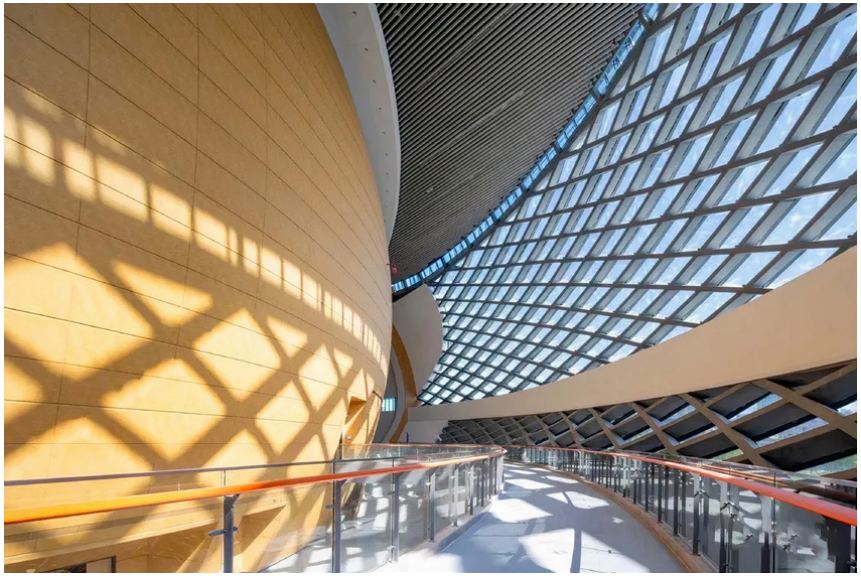
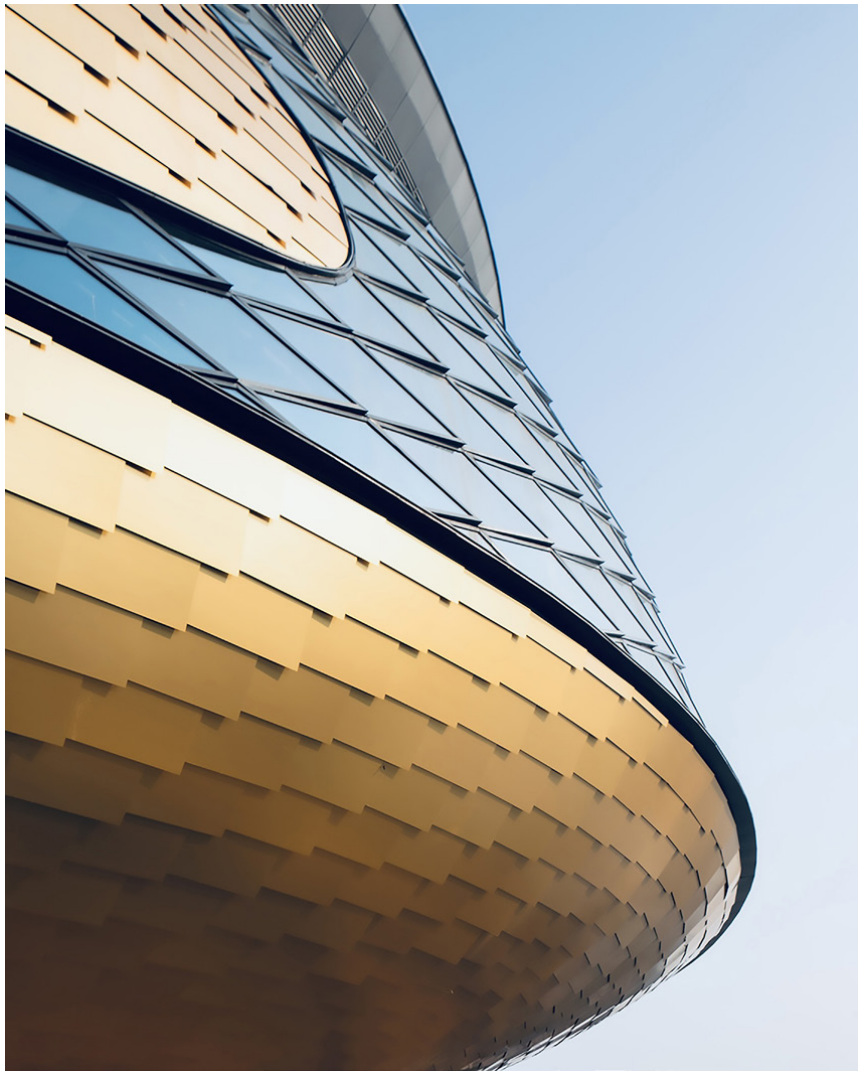


Figure 8.17 Archi-Tectonics, Asian Games, Hangzhou, China, 2022: By extruding a variable (triangular) frame for the façade glazing system of the table tennis stadium, the design team was able to use planar glass panels; no curvature was needed. The scale of the panels was studied with respect to the overall building to ensure the appearance of soft curvature was achieved.

from spectator to stage/field, columns would preclude the hybrid uses imagined for the structure.

The team's structural roof solution – the suspendome – is a sort of hybrid space frame with an inner and outer ring used in the arena design that is deepest at its center and has a series of tensile members that tie the deep structure back to an inner bowl, which is circular and gives form to the stadium seating. The outer ring is cantilevered



and elliptical in shape and provides support for an exterior façade, which is hung. Dubbeldam calls it a "big mushroom suspended from above." This solution allowed for a seating hybrid as well, so that both area and stadium seating organizations could be utilized, while still meeting all competition requirements set forth.

The suspendome features a massive skylight for daylighting as well as passive ventilation, drawing hotter air up and out of the structure. The edges of the structure also have smaller horizontal windows, controlled by temperature sensors, allowing them to open during periods of high heat and humidity while providing indirect natural lighting.

A large diagrid facade, hung from the roof, wraps the building at its most eccentric point. This façade is clad in glass panels, organized into 5 × 7 meter sections. Given cost-saving efforts, the architects found ways to achieve the overall curvature of the façade with flat materials. More specifically, the design team conceived a system of tapered eyelets created by the intersection of aluminum frames that would allow for a variable nesting surface for glazing panels. The system followed the overall curvature of the roof above and was fit with planar glass panels. The costs saved by not curving glass went into the performance of the panels themselves – double glazed panels with a solar film were used and still translated into a savings of several million dollars.

The building is so large, at 35,000 square meters, that the 5 × 7 meter proportion for the eyelets is appropriate and allows the planar glazing panels to follow the curvature of the roof, giving the appearance of a subtle bending even though the panels are flat. The building seems delicate in this way. This is gently contrasted by a series of intersecting rings clad in brass shingles laid in a diagonal pattern. The shingles, which number some 8,000 units, were also optimized through a BIM routine, allowing there to be only 85 unique shapes.

The workflow arrived at using BIM led to a series of novel optimizations. First, the roof structures were made incredibly light. At the beginning of the 2020s, the global availability of steel was low and demand was high, making its cost considerable. Using as small a volume as possible while still achieving the desired spans was a challenge. The reduction of structural volume brought other efficiencies as well, specifically, modularity. The roof of the suspendome was imagined as six discrete structural pieces that were fabricated off site and craned into place.

Dubbeldam compares the effect of the roof to a sundial sitting on the inner bowl that houses spectator seating, and delicately carries the façade that reinforces the

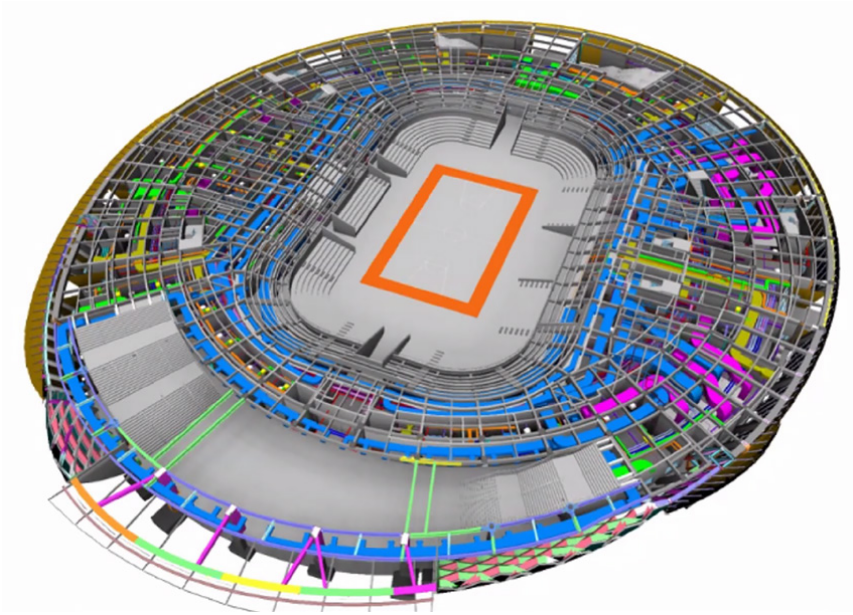


Figure 8.18 Archi-Tectonics, Asian Games, Hangzhou, China, 2022: Once the COVID pandemic of 2020–2022 effectively halted travel, architects looked to more sophisticated virtual means to ensure design intent. Working with a BIM specialist that mediated between the design and contracting teams, optimizations were found in the trussed roof structures housing the table tennis and field hockey stadia – the two principal buildings located within the park.

building's curvature. The shapes of the buildings are perhaps most notable at night, when their illuminated silhouettes are most prominent in the rolling landscape.

Adjacent to the buildings, and joined via an underground linkage is a sports complex with three Olympic-sized pools and training fields. The underground spaces, which have abundant sky lighting above, were all formed with cast-in-place concrete. Circulation through these spaces meanders, being coordinated with the gently rolling slopes of land and the structures nested within.

Indeed, the buildings will meet their hybrid goals; following construction but prior to the commencement of the games an event was held in the table tennis stadium for 2,500 university faculty and students.

ENDNOTES

1 Herbert Muschamp, "A Pair of Crystal Gems Right for Their Setting," *The New York Times*, January 14, 2001.
2 Winka Dubbeldam, *Strange Objects, New Solids and Massive Things*: Archi-Tectonics (Actar, 2022).

IMAGES

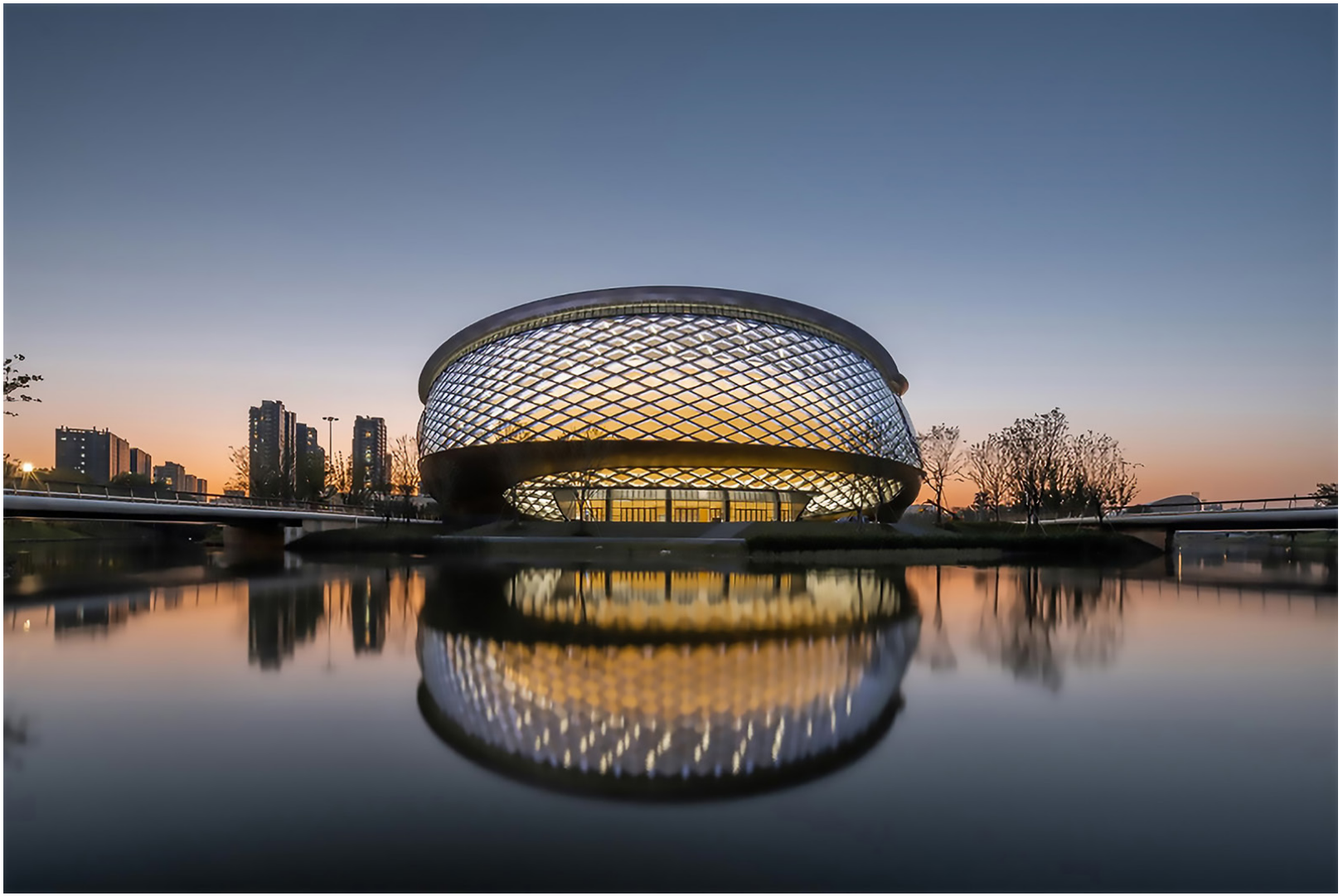


Figure 8.19 Archi-Tectonics, Asian Games, Hangzhou, China, 2022: Although the table tennis stadium is some 25 meters tall, the strategy of nesting the large structure into the rolling landscape of the park gives the project an overall feel of horizontality, with land bridges forming an intricate play with the waterway, connecting various programs within the site, including shopping, playing fields, and spectator sports, with passive ecological strategies including the placement of wetlands and bioswales.