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How New Generations, Industries and Workplace Paradigms Are Redefining the Commercial High-Rise

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Abstract

This paper will provide a data-driven analysis of building performance from three eras: the early 1900s, mid-twentieth century, and today. This longitudinal analysis will illustrate how buildings from each era speak to a particular aesthetic and specific points in our global culture and economy. At the times they opened, these buildings were groundbreaking designs that defined their eras; work and people have drastically changed since then, and these styles of building no longer enable the work styles most valued by many of today's forward-thinking enterprises.

Technology companies are driven by agile processes and fueled by the demands and lifestyles of younger generations, with an emphasis on collaboration, efficiency, and a sense of purpose. The design of tall buildings must support this new economy with qualities that we know to enhance health, happiness, and productivity – things like greater connectivity, variety, choice, and proximity to natural light, views, and nature.

Keywords: Commercial; Computation; Generation; Office; Technology; Workplace

New York has historically been one of cities leading the way in terms of innovative workspaces. However, given major changes in the global economy, work modes and lifestyles throughout the last century, a large proportion of the city's skyscrapers are based on outdated and inefficient designs.

Dramatic changes in the nature of work puts developers and architects at a threshold as monumental as the shifts in the early to mid-twentieth century skyscraper design. New ways of working, fueled by technology, are rocking the establishment. The largest growth over the next five to ten years is expected in the tech industry, and as tech companies grow as a result of their digital disruption, so too do the opportunities for disruption of commercial development.

Technology companies are driven by agile processes and fueled by the demands and lifestyles of younger generations, with an emphasis on collaboration, efficiency, and a sense of purpose. The design of tall buildings must support this new economy with qualities that we know to enhance health, happiness, and productivity – things like greater connectivity, variety, choice, and proximity to natural light, views, and nature. Businesses are no longer tied to locations by access to technology and equipment; they are tied to locations by people and the collegial experience of work. The paradigm has shifted, and the way the workplace is designed must shift as well.

This paper will provide a data-driven analysis of the performance of buildings from three eras: the early 1900s, mid-twentieth century, and today. This longitudinal analysis will illustrate how buildings from each era speak to a particular aesthetic and specific points in our global culture and economy. At the times they opened, these buildings were ground breaking designs that defined their eras; work and people have drastically changed since then, and these styles of building no longer enable the work styles most valued by many of today's forward-thinking enterprises. Building design and commercial development is now encountering another such threshold of dramatic change.

This study will place these historical exemplars in conversation with contemporary commercial designs, while examining factors that guide responsible, human-centered architectural design, including daylight penetration, visual connectivity, and floor plate characteristics. These analyses will illustrate how New York City's skyscrapers are evolving to meet the changing needs of today's workforce.

The following section will examine what tenants are looking for today and how architects are thinking differently to build the high-rises that meet those needs. Design computation is the intersection of architecture and software engineering, where designers build their own software tools with specific embedded knowledge to improve design outcomes. Design computation allows us to design efficiently, but it also allows us to measure certain key aspects of human performance, based on our understanding of validated scientific research. In particular, NBBJ is using these digital tools to design spaces and experiences that enhance collaboration, productivity, and health, as well as control the impact of buildings on local communities. Design exemplars from around the world will showcase the gains in performance that the industry and NBBJ in particular are achieving relative to the skyscrapers of yesteryear.

First is a look at the historical trajectory of tall buildings and office environments over the last 100 years.

1915: The Tall Building Has Arrived: Woolworth Building

The threshold of tall building development took place in the early twentieth century, a time ripe for innovation. One of the greatest New York skyscrapers built during this time period was The Woolworth Building, the neo-gothic tower which opened in April 1913 on Broadway Avenue (see Figure 1). The project was designed by renowned architect Cass Gilbert. The Woolworth building, made of terracotta, copper, and glass, was 60 stories tall and involved over 5,000 windows ('Study for Woolworth'). Most original skyscrapers were heavy affairs at the base and got more slender toward the top due to structural constraints. Woolworth is exemplary of this, as it consists of an office block base with a narrow interior court. The building housed a variety of budding companies and industries -- tenants included the F. W. Woolworth Company, the commissioner of the project, occupying only one and a half floors of the building at its opening (Postal and Dolkart 2009), the Irving National Exchange Bank, and Columbia Records.

While this building pushed the envelope in terms of what could be done with the skyscraper typology -- it was the tallest in the world for some time and had window openings that were generous for the time period – it would not be considered a particularly efficient or effective design by today's standards. Limited by the stylistic and construction standards of its era, the base has very large floorplates with poor natural light (see Figure 4), minimal window wall surface for light and views (see Figure 5) and heavy interior structural elements that block interior visual access and connectivity (see Figure 6).

Nonetheless, it was a marvel for its age and it suited the old way of working well. Little was known about the relationship of daylighting, views, and visual connectivity to work and health and happiness. So the Woolworth building, with its sensible center-core configuration and impressive height and detailing became the model for high-rise design until the mid-20th century.

1961: The Mid-Century Austere Office Tower: One Chase Manhattan Plaza

In the mid-20th century, New York became the genesis of the International Style movement. The city as we know it was changed indelibly by a new paradigm, the steel and glass tower – these new skyscrapers looked like stripped-down jewel boxes in a sea of neo-Classical ornament. New technologies allowed us to build thinner, lighter structures and open the wall almost entirely to light and views. Industrialized production meant that this would be economical as well, and the modernist aesthetic caught on like wildfire in the commercial development world.

The best early examples were thin, soaring towers that moved the core to the edge and had small floor plates with excellent light and views. The vast majority, however, simply applied the modernist aesthetic to the prevailing center-core typology and used the lighter structures to build bigger and bigger floor plates to maximize usable area for the financial institutions that led their development. Like the buildings of the previous paradigm, mid-century skyscrapers tend to feature a center core configuration with surrounding office space.

Figure 1. The Woolworth Building. (Source: Encyclopedia Structure, photographer Nicolas Janberg)

Figure 2. One Chase Manhattan Plaza, pictured, improves on previous 20th century floorplans by offering an off-center core and a glass façade, both of which improve daylight and visual connectivity (Source: New York City Landmarks Preservation Commission)

One notable example of the New York high-rises built in this era is the One Chase Manhattan Plaza, which opened in 1961 (see Figure 2). Like many peers from this era, the 2.3 million square-foot, 60-story rectangular tower features a steel and floor-to-ceiling glass façade. Gordon Bunshaft, chief architect for the project, describes the Chase Manhattan Bank Tower as such:

[...] When seen from a distance, the bank looks bulky among the slender towers of pre-Depression skyscrapers. Its surface can also appear obtrusive because the earlier building surfaces of brick and stone absorb light while Chase's aluminum and glass reflect it. Seen from ground level, especially from its principal plaza, the building is a commanding presence. (Krinsky 1988 p. 72)

Chase's tall rectangle is actually asymmetrical in plan, with the elevator and service core shifted off center to allow a 45-foot-wide clerical pool on the south and individual offices and a corridor 29 feet wide on the north (Krinsky 1988 p. 72).

The glass façades offered a marked improvement over their turn-of-the-century counterparts, in addition to improvements in views to glass, light at the perimeter, the floor plate size, blocking core, and natural light.

Architects began experimenting slightly with core configurations during this time period, but the austere buildings of the mid-century did not provide much variety in terms of office space configurations. Buildings remained uniform in design from top to bottom, offering companies little flexibility with floor configurations.

Demands for Today's Office Tower

The next two decades will see dramatic change around the globe, with the growth of industry in middleweight and megacities in the West as well as in many developing markets. New York City expects its population to increase 15% by 2030, which translates into approximately 1.1 million new residents. And as a result, from New York to Shenzhen to Dubai, the high-rise workplace is dramatically changing.

Technology industries will continue to drive much of this global development. In fact, among all major industry sectors, the information sector is projected to have the fastest growth rate, 4.7 percent per year, increasing in the United States from nearly $1.2 trillion in 2010 to almost $1.9 trillion in 2020 (Henderson 2012). IT jobs are accordingly expected to increase by 22% by the year 2020 (Bureau of Labor Statistics). Demand for software developers will be the strongest in this period, with increases ranging from 28% to 32%. The ubiquity of bandwidth, low-cost computing, data, and storage has created a new breed of network-based (as opposed to service-based) businesses (Sallomi 2015).

Just over the next five years, the New York State Department of Labor estimates the demand for software-related jobs will rise by up to 41%. At the same time, demand for traditional jobs such as those in the financial services industry could decline up to 2.5%. Also, it is worth noting, that the financial sector is also being swallowed by software companies as mobile technology-based payment systems become more and more pervasive. Essentially, significant increases in demand for software-related jobs will happen over the next five years, while demand for traditional manufacturing and financial services will continue to decline.

Meanwhile, younger, radically distinct generations like Millennials, born beginning in the early 1980s, and Gen Z, born in the late 90s, are coming into the mix with different lifestyles and modes of experiencing places, retail, and the city. These generations, raised in the digital age, tend to lead fast-paced, technology dependent, leisurely, social-focused lifestyles. And despite their obvious technological proficiency, they prize in-person interaction – especially the ambitious young workers seeking global business environments (Hirshon 2015). In our now highly prized sharing economy culture, the new generations of workers occupying dense global cities increasingly appreciate serendipity, collaboration, and the many other material and social benefits offered by being close together.

This is why today's buildings are increasingly valued as brand-builders and recruitment tools by the companies that lease office space within them. In order to attract top-quality talent, tech, fashion, media and software companies focus on marketing their workplaces and headquarters as places where

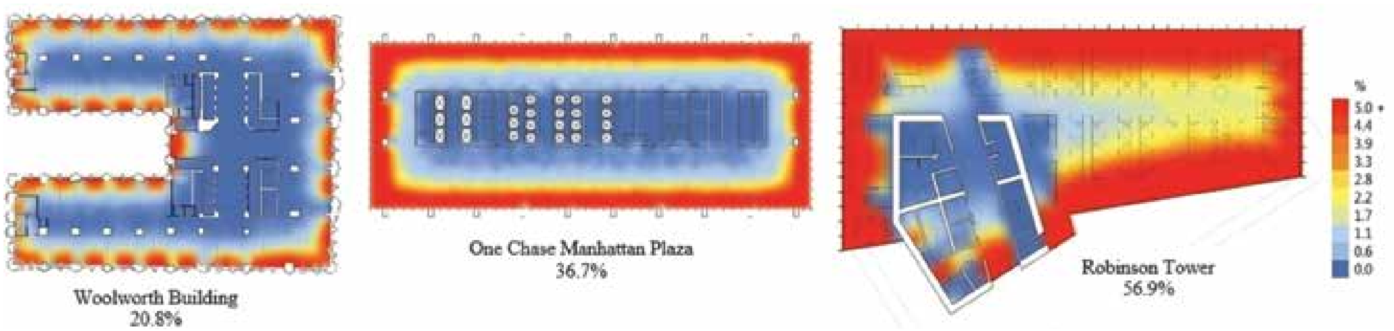

Figure 4. Daylight Factor: A comparative analysis of daylight penetration across buildings built over the last 100 years. (The measure for each building above is the percent of floorplate above 2%.) With regards to workstations, 82.6% of those inside the Robinson Tower perform above 2% (Source: NBBJ)

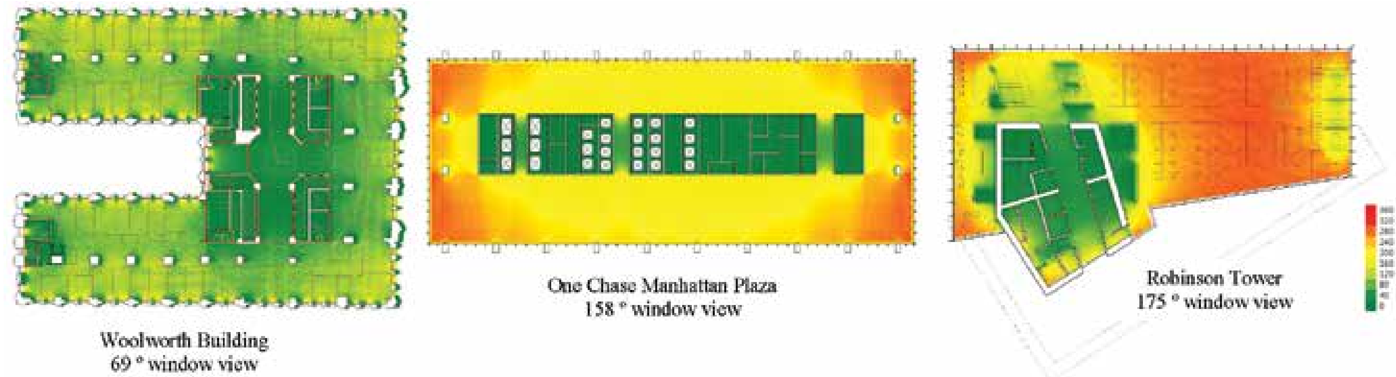

Figure 5. Window Access: A comparative analysis of window access across buildings built over the last 100 years. The amount of window access increases dramatically with each new era's exemplar. Workstations in Robinson Tower averages a 265º window view from workstations (Source: NBBJ)

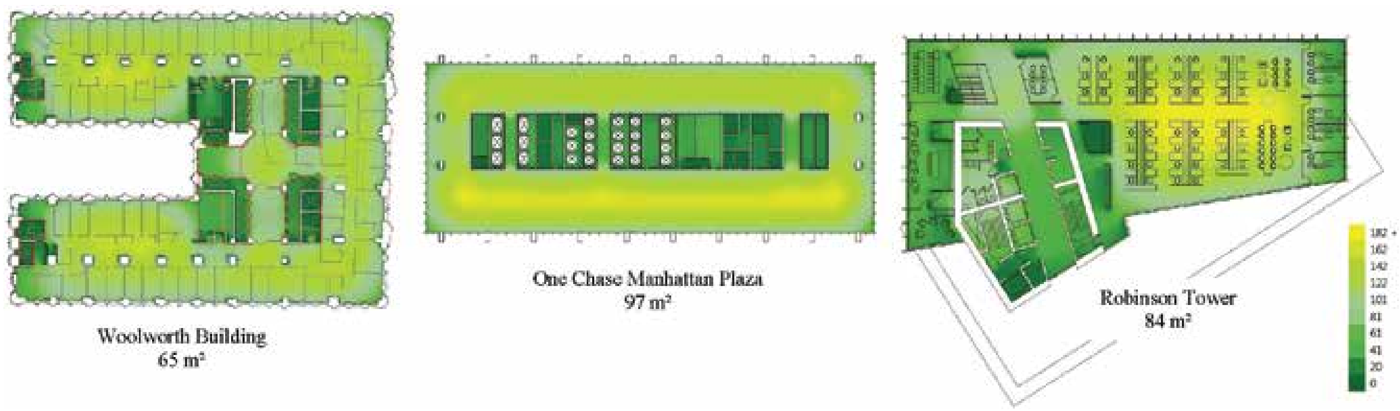

Figure 6. An examination of interior visibility across a 3-building design sample over the last 100 years (Source: NBBJ)

employees are happy and where innovation thrives. Top talent, on the other hand, seeks out companies that offer workplace perks and an amazing experience. Hence, big players as well as growing startups make it a priority to use their buildings and workplaces as major recruitment drivers.

The tech workforce of the 21st century remain as tenants in the 1950s and 1960s era international-style buildings, buildings originally designed to accommodate a primarily services-based economy of accounting, law and finance. Those types of work have historically involved more isolated workflows than those of today's innovation-driven industries. New industries and modes of working overwhelmingly tend to prize spaces that encourage creativity, collaboration and teamwork. It is worth noting that as technology pushes boundaries and threatens the aforementioned traditional service-based industries, those industries will be forced to compete by adopting new technologies and catering to this new mode of workspace productivity as well. The technology industry is merely the leader of this transformation, likely pulling more and more industries into this new paradigm sooner or later.

Architects are rising to the challenge of designing tall buildings not only for new types of work but also for different lifestyles and modes of experiencing places and the city. Spaces that promote the sharing economy that characterizes the 21st century. Spaces that promote serendipity and collaboration are drivers for new commercial tenants in New York City.

How can architects and developers create better office buildings to meet the needs of today?

Architecture 2.0: Design Computation

Until recently, designers and architects have relied almost exclusively on experience and intuition -- essentially the educated guess -- to mentally calculate tradeoffs when making design decisions, particularly when it comes to human experience factors. Clients have generally relied on the abstract notion of expertise to make important decisions, in the absence of any other data.

The contemporary architectural software ecosystem, however, now contains open-source platforms upon which architects and designers

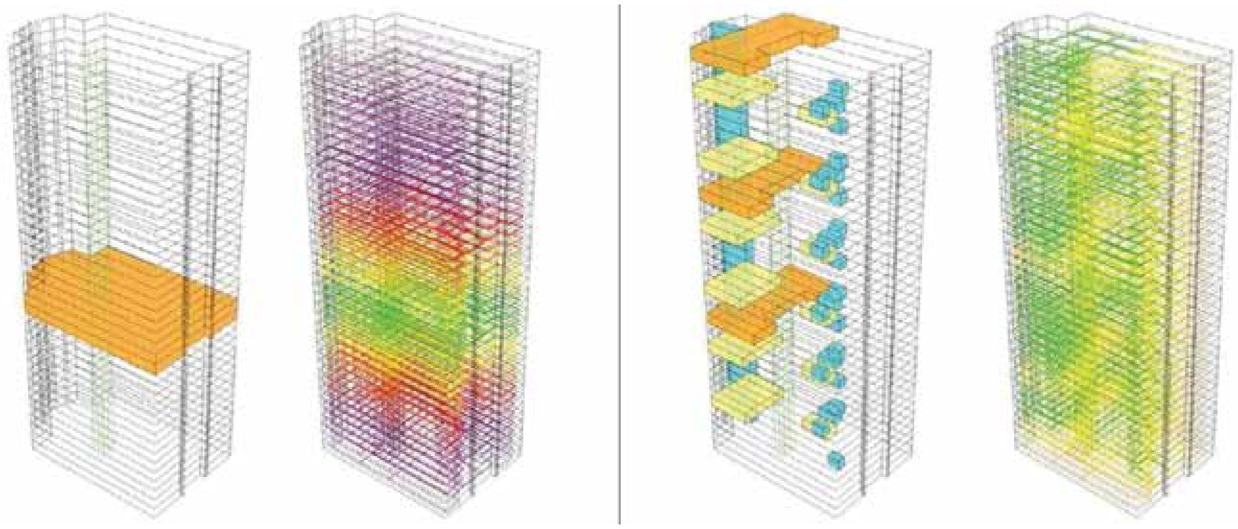

Figure 3. (Left: Centralized amenities) (Right: Distributed amenities) Design computation can help architects visualize and quantitatively test the distance to and benefits of different amenities configurations. Here, we can see that distributed amenities mean that all employees are a relatively short distance from opportunities for rest and stimulation (Source: NBBJ)

can build their own software tools, embedded with architectural intelligence and customized to both proven design philosophies and client needs. A new crop of designers fluent in both design and code is emerging in a practice called Design Computation. Urban planners can use a host of data on populations, cities, markets, and the physical environment to explore numerous variables together simultaneously to make data-driven decisions about urban development. Architects can simulate environmental factors at very early stages of design and can optimize building form for constructability.

Like many firms using design computation to optimize design workflows and rationalize geometry, NBBJ is changing the way we practice and deliver projects. Additionally, and perhaps more importantly, NBBJ is focused on how we can use custom software tools to understand the effects of our designs on human performance, through the application of validated scientific research. By studying a variety of factors simultaneously, we can understand our designs more fully, manage the tensions between opposing variables, and make sensible decisions in the concept phase. This method of early, rapid evaluation leads to greater time for a team to creatively, and collaboratively, determine ideal project outcomes.

Visual connectivity among team members, access to daylight, and visual access to windows are just a few examples of metrics that are derived from research on human performance. Design computation tools, for instance, can also help architects visualize and quantitatively test the distance to and benefits of different amenities configurations (see Figure 3). Using this kind of analysis allows us to design and test new elevator core configurations to improve the human experience while also increasing usable floor area for building developers and tenants. Using design computation tools, we design buildings that provide better access to daylight, more visual connectivity between workers, and smarter, more profitable floor plans for developers.

Thinking Inside-Out

Tall building architects over the last century have primarily focused on how these structures look from the outside. Using computational tools and floor plan designs, we can more accurately than ever measure the potential performance of buildings and people. It's therefore time we consider building design from the inside out in order to design for better building and human performance.

Window and Daylight Access

Visual access to windows and views is highly correlated to the mental performance of workers in office environments. Office workers were found to perform 10% to 25% better on tests of mental function and memory recall when they had the best possible view versus those with no view. Visual access to windows increases white light exposure which in turn improves quality and duration of sleep at night. In a study by the American Academy of Sleep Medicine, workers without windows reported poorer scores than their counterparts on quality of life measures related to physical problems and vitality, as well as poorer outcomes on measures of overall sleep quality, sleep efficiency, sleep disturbances, and daytime dysfunction ('Study … Life', 2013).

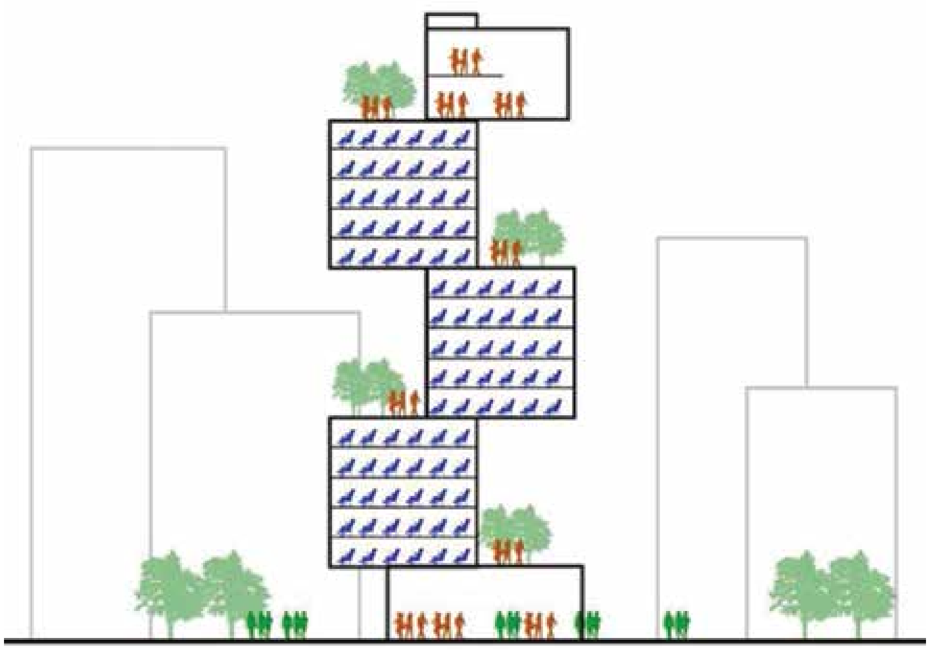

Figure 7. The amenities map for Robinson Tower, Singapore. Amenities are distributed throughout the height of the building to offer choice and create stimulation (Source: NBBJ)

Daylight factor is a measure of the available light in a particular spot. If we can design floor plates, core configurations, and space plans that increase the amount of visual window access and natural light, we know we can significantly improve mental function across the whole organization. The buildings of previous eras indeed do not perform as well as the skyscrapers of today when it comes to daylight penetration (see Figures 4 and 5 for a comparative analysis of Woolworth, Chase and Robinson when it comes to window access and daylight penetration).[1]

Infrastructure and Connectivity

Circulation analysis is about more than just efficiency -- how quickly can you get from point A to point B -- it's also about health, serendipity, collaboration, and organizational performance. Separation by more than 100 feet is equivalent to being in different buildings, if not in different geographical locations. Even within this range, those people nearest to one another communicate more than those at a greater distance. Additionally, the number of turns required to get to each colleague can affect your willingness to engage, and the number of visual connections to colleagues that you can make from your position is positively correlated with collaboration outcomes (see Figure 6 for a comparative interior visibility analysis of Woolworth, Chase and Robinson buildings).[2]

The 21st Century High Rise: Robinson Tower, Singapore

Singapore's Robinson Road project (see Figures 7-9) illustrates how tall buildings can support the new economy by providing greater connectivity, variety, choice and connections to nature.

The Robinson Tower competition challenged NBBJ to design an iconic office tower on a prominent site in the Central Business District of Singapore, directly facing onto the historic Lau Pau Sat market pavilion. Given its significant siting, the owner desired to create a compelling structure that would achieve a prominent position in the dense surrounding urban fabric. The allowable Gross Floor Area was limited to 24,000 square meters, but there was no limit to the height of the tower.

NBBJ's proposal sought to "stretch" the allowable GFA vertically, creating a slender tower that would comfortably contend with its surrounding urban environment. The fact that Robinson has an offset core and only two

Figure 8. A rendering of Robinson Tower, Singapore (Source: NBBJ)

Figure 9. An up-close view of Robinson Tower's unique structure (Source: NBBJ)

1: Daylight factor analysis is typically computed using data collected during an overcast sky, and taken as an annual average.
2: Which metrics are important in any given context, it should be noted, varies depending on the goals of a project. Oftentimes, these factors are negotiated in a series of trade-offs. Having quantitative data allows us to make better-informed decisions, understanding how one design change or concept might affect another.

Figure 10. A rendering of the Shadowless Tower at work (Source: NBBJ)

Figure 11. A view of the design's effects on the ground, where people gather (Source: NBBJ)

columns per floor is particularly unique.

The Daylight Factor (DF) of Robinson Tower is also very high performing, with 86.2% of workstations experiencing above 2 percent (see Figure 5). Daylight Factor measures the percentage of light level indoors compared to outdoors with an overcast sky. DF is not the only important metric to study, but generally a DF above 2 percent is considered ideal for an office typology.

The discrete floor plates would allow for clusters of 'townhouse offices' ranging in size from 22,733 square feet spread over three levels, to 45,466 square feet spread over six levels. Townhouse offices allow smaller corporate tenants to still imprint their identity at the building level, something not possible in standard multi-tenant office towers.

This composition would allow smaller corporate tenants, such as boutique financial services firms, to imprint their identity at the building level, something not usually possible in standard multi-tenant office towers, enabling the kind of flexibility ideal for rapidly changing business and industries in today's economy.

Shadowless Tower: The Next Generation's Community-Minded Skyscraper

NBBJ sought to tackle a different kind of problem with the conceptual design for a Shadowless Tower. Using the same design computation platform that we use to design for interiors, we turned our attention to the exterior conditions of skyscrapers and how they affect their communities. This is increasingly important as development continues in densely populated global cities.

The most common community complaints about tall buildings are related to shadows. About 250 skyscrapers are slated to redraw London's skyline in the near future; increasingly, architects will have to pay attention to and solve problems related to the impact of high-rises on surroundings.

Using parametric modeling, NBBJ analysts and architects came up with a solution: a pair of buildings that reflect sunlight off one another (see Figure 10) to minimize deep shade at ground level (see Figure 11).

The shape of the tower, as well as the disposition of its glass elements, are derived from an algorithm developed specifically to test and iterate for this purpose. The final design features a thin base that expands as it climbs, with one of the buildings functioning as a curved mirror surface (see Figure 12). The glass surface of the northernmost building reflects light down into the shadow cast by its southern partner. And the curved glass enables the reflected light to follow the shadow throughout the day; the effect is a reduction in shade by up to 60 percent.

NBBJ architects designed this particular concept as a potential pair of towers in Greenwich, England, though this model can be used to build skyscrapers in any part and neighborhood in the world. And it will be useful in the urban centers of China, India, Africa and the Middle East, where new skyscrapers are being built at a rapid pace.

Conclusion: The Evolving Skyscraper

We know now that sufficient natural light, views to outside, and connectivity among colleagues can have a significant impact on productivity in the workplace, and yet skyscrapers are still designed around outdated principles all around the world. Today's leading companies are increasingly recognizing the value of optimizing for human health, happiness, and productivity; and while new design principles have begun to transform the corporate landscape at the suburban scale, the high-rise building typology is still lagging behind.

The center core, corporate tower design is the paradigm of yesteryear, no longer ideal for the tenants of today and tomorrow. New metrics and concepts allow us to design buildings with more efficient use of space; where potential tenants are drawn by attractive design features and amenities, and where workers enjoy ample daylight, greater productivity and more opportunities for collaboration. Digital analysis is driving much of the architectural innovation shaping the high-rises of today and tomorrow. And these new tools are helping architects design buildings of tomorrow that respond to increasingly dense urban centers and the needs of surrounding neighborhoods.

Long thin buildings, with glazing all around, and cores out of the way of the center perform best, in nearly all metrics. Singapore's Robinson Tower is an outstanding exemplar of the high-performing modern skyscraper that meets the needs of the increasingly connected, fast-paced urban workforce of the 21st century.

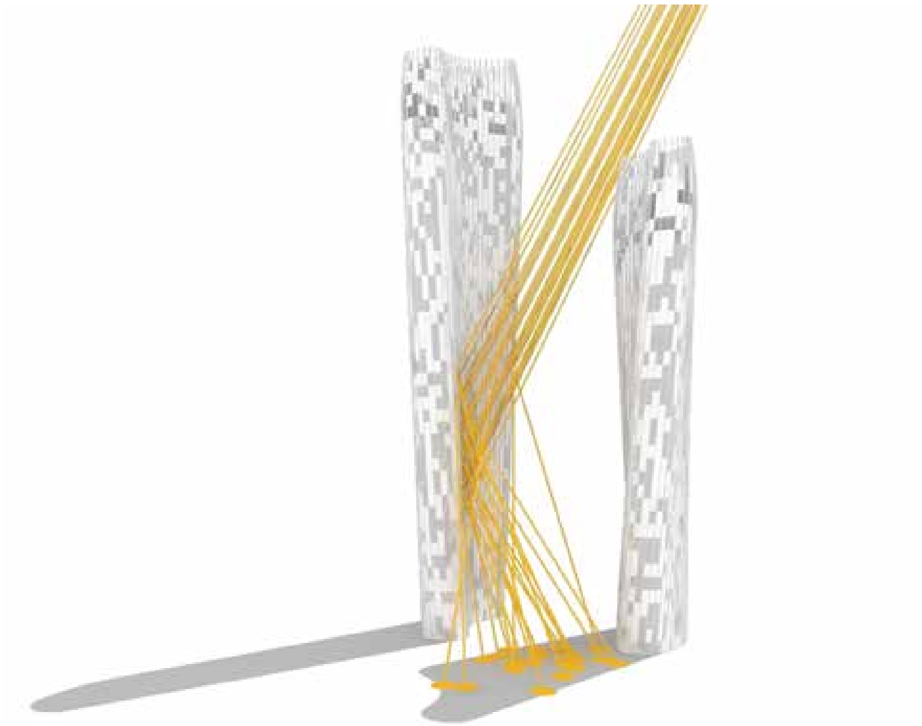

Figure 12. A frame of the animated computational daylight simulation used to develop the Shadowless Tower measurements (Source: NBBJ)

With the aid of technological innovation, and with a lot of ingenuity and inspiration, designers can design buildings that not just perform in terms of cost efficiency and revenue, but also in terms of human performance and satisfaction. With young generations of workers increasingly demanding urban, walkable workplaces, the transformation of the skyscraper mentality is vital to delivering contemporary spaces that maximize the human experience.

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