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The 8x8 Tower: Sustainable Citizenship for the 21st Century

8x8 高楼：21 世纪的可持续居民

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A partner of Pei Cobb Freed & Partners, **Michael W. Bischoff** has led the design of a wide array of projects, from space-shaping buildings on academic campuses to tall buildings in urban contexts. His projects thoughtfully engage with the physical, social, and cultural realms in which they are built.

Mr. Bischoff leads his firm's efforts advancing sustainable design and further promotes these core issues within the academic community as a design critic. He received his bachelor's degree from the University of California, Berkeley, and his master's degree from Harvard University.

Michael W. Bischoff 是 Pei Cobb Freed & Partners 的合伙人，主导了多种不同类型的项目设计，从校园中的空间塑造建筑到都市的高楼大厦，应有尽有。他的作品细致地考虑了建筑所在地的自然、社会和文化特色。

Bischoff 先生领导他的公司致力于可持续的设计，并作为设计评论家在学术界进一步提倡这些核心议题。他获有加州大学伯克利分校的学士学位和哈佛大学的硕士学位。

Abstract

While there may be little consensus regarding the problems to be solved in our increasingly populated, dense and vertically extruded urban environment, we do know this:

- More families are choosing to live in urban areas, so dwellings should integrate indoor and outdoor living spaces to maximize user access to biophilic features, even in high-rise environments.
- Workplace conventions are evolving, with more people working away from a traditional office environment, suggesting that flexible live-work commercial facilities should be integrated with or placed in close proximity to housing units.
- The potential long-term effects of climate change and global warming make it evident that energy and resource-efficient building technologies must be developed to help reduce our carbon footprint.

As envisioned, the 8X8 Tower addresses these challenges by creating a socially and environmentally sustainable residential community in a memorably iconic form appropriate for the twenty-first century.

Keywords: Community, Sustainability, Vertical Garden, Public Space, Solar Orientation, Residential

摘要

虽然在关于日益渐增的人口、居住密度、垂直延伸的城市环境这些亟待解决的问题上难以达成一致，但我们知道：

- 越来越多的家庭选择生活在市区，所以住所应整合室内外生活空间，让使用者即使在高楼大厦中也有更多机会接触自然。
- 常规的工作场所正在进化，越来越多的人不在传统的办公环境中工作，所以建议灵活的生活—工作—商业设施应整合或接近住宅单位。
- 气候变化和全球变暖的潜在长期影响表明人们需要开发节能、节约型建筑技术，以帮助减少碳排放。

和设想的一样，8X8 高楼以令人过目不忘的标志性形式打造了适合 21 世纪社会和环境的可持续居住区，从而解决了以上问题。

关键词: 社区，可持续发展，垂直花园，公共空间，太阳朝向，住宅

Cities around the world will face dramatic population growth in the coming decades. New York City alone is predicted to add one million residents by 2040 (Kusisto 2013). One of the challenges of creating a sustainable vertical urbanism is to provide cost-effective and environmentally sensitive building solutions that meet these anticipated residential needs. As architects, we must find and employ building solutions that address these needs with commercially sustainable architecture, reflecting an evolving global community. Envisioning vertical residential communities that incorporate spatially diverse and environmentally rich natural ecosystems is a critical component of meeting this challenge.

在未来数十年，全球的城市都面临人口急剧增多的问题。单单纽约市预计到2040年就会增加一百万居民 (Kusisto 2013) 。打造可持续的垂直都市生活遇到的挑战之一是，如何提供具有成本效益且对环境无害的建筑解决方案，才可以满足这些预期的居住需求。作为建筑师，我们必须寻找并采纳能满足这些需求的建造方案设计商业可持续建筑，从而反映全球社区的发展趋势。构思垂直居住区，结合空间多样性和环境中丰富的自然生态系统，是解决这一难题的重要因素。

通过 Pei Cobb Freed & Partners Architects、Guy Nordenson and Associates (结构设计) 、Jaros、Baum & Bolles (MEP) 、Lerch Bates (垂直运输) 和 Atelier Ten (可持续性) 的共同努力，设计出了 8X8 高楼，

A collaboration between Pei Cobb Freed & Partners Architects, Guy Nordenson and Associates (structural design), Jaros, Baum & Bolles (MEP), Lerch Bates (vertical transportation) and Atelier Ten (sustainability), the 8X8 Tower was originally conceived as a design-competition proposal in response to Metropolis magazine's call for architects and engineers to "share their vision for multi-use residential towers for the 21st century." The brief stipulated the use of a structural steel framing system and a unitized curtain wall exterior enclosure system. While it also mandated that the proposal be site-specific and located within one of the five boroughs of New York City, this paper is presented to the CTBUH 2014 Future Cities Conference as an acknowledgement, indeed an affirmation, that the issues posited by Metropolis reflect global concerns and the fundamental need to address broad social and environmental patterns of both residential living and architectural production on a wider scale worldwide.

While there may be little consensus regarding the many problems to be solved as we seek to meet the residential needs of the increasingly populated, dense, and vertically extruded urban environment, we do know this:

- More families are choosing to live in urban areas, so dwellings should integrate indoor and outdoor living spaces to maximize user access to biophilic features, even in high-rise environments.
- Workplace conventions are evolving, with more people working away from a traditional office environment, suggesting that an increasing percentage of flexible and diverse live-work commercial facilities should be integrated with or placed in close proximity to housing units.
- The potential long-term effects of climate change and global warming make it evident that energy- and resource-efficient building technologies must be developed, employed, and promoted by the global community to help reduce our carbon footprint and consumption of fossil fuels.

The 8X8 Tower

In response to the question "What does a sustainable future look like, and what is the role of the architect in helping society move toward it?" the political philosopher Melissa Lane has advanced the idea of "sustainable citizenship" (Lane 2013). Within the context of the Future Cities Conference—that of vertical urbanism—this concept challenges us to conceive new physical and social relationships within an increasingly populated and vertical urban environment that will make high-rise living increasingly engaged with the natural environment while being economical, commercially diverse, and socially sustainable.

The 8x8 Tower addresses these challenges with a continuous vertical garden that joins eight multi-story communities and eight distributed public spaces (see Figure 1). The resulting memorably iconic form is appropriate to its site in Lower Manhattan, just south of the Brooklyn Bridge and two blocks from the East River Esplanade (see Figure 2).

The 8X8 Tower freshly reinterprets and provides for the programmatic needs of urban residential living to project an image that is boldly emblematic for the twenty-first century (see Figure 3). On each of the tower's four sides, multistory voids, edged on one side with hanging gardens, offer public and private outdoor terrace spaces and enliven the exterior by providing an opportunity to divert the residential-volume floor spandrels diagonally in such a way that each becomes part of

最初它是作为Metropolis杂志设计比赛的参赛作品，该比赛呼吁建筑师和工程师"分享 21 世纪多用途住宅楼的愿景"。摘要规定了使用结构钢框架系统和单元式幕墙围护系统，且作品位置被指定在特定区域，即在纽约市的五大区之一。但由于意识到Metropolis假设的议题体现了全球的关注以及要探讨全球范围的居住生活和建筑产品中广泛的社会和环境模式的基本需要，本文同时也提交给CTBUH 2014"未来城市"大会，作为一种主张和宣言。

虽然在关于日益渐增的人口、居住密度、垂直延伸的城市环境这些亟待解决的问题上难以达成一致，但我们知道:

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- 气候变化和全球变暖的潜在长期影响表明人们需要开发节能、节约型建筑技术，以帮助减少碳足迹和化石燃料的消耗。

8X8 高楼

作为对问题"可持续发展的未来是怎样的，建筑师在帮助社会实现这一目标中担任什么角色?"的回答，政治哲学家Melissa Lane提出了"可持续居民"的概念 (Lane 2013)。"未来城市"大会提出的"垂直都市主义"概念让我们开始构思在人口日益增多的垂直都市环境中新的自然和社会关系，这让高楼大厦中的生活方式在实现经济化、商业多样化和社会可持续化的同时，越来越多地融入自然环境。

8x8 高楼利用连续的垂直花园，加入八个多层社区空间和八个分布于各处的公共空间 (见图 1)，解决了这些问题。这一令人难忘的标志性式样非常适合曼哈顿下城，即布鲁克林桥以南和东河步道 (East River Esplanade) 附近的两个街区 (见图 2)。

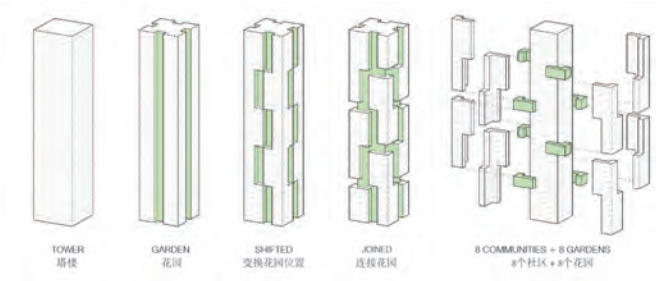

Figure 1. Tower form generation (Source: Pei Cobb Freed & Partners)
图 1. 高楼形式生成 (出自: Pei Cobb Freed & Partners)

Figure 2. Lower Manhattan site, outlined in red, just south of Brooklyn Bridge (Source: Google Earth)
图 2. 曼哈顿下城，用红线画出，在布鲁克林桥以南 (出自: Google地图)

Figure 3. Perspective from north (Source: Pei Cobb Freed & Partners; studio amd)
图 3. 从北看的透视图 (出自: Pei Cobb Freed & Partners; studio amd)

a continuous ribbon expressive of the uplifting energy of the tower's eight interlocking gardens and communities. Sheathed in a unitized curtain wall composed of alternating bands of back-painted spandrel glass and energy-efficient insulating glass, the tower's distinctive system of interlocking L-shaped volumes allows for variation in the vertical dimension of the ribbon-window spandrels as they move diagonally from one residential volume to another so as to calibrate the façade with respect to solar orientation. Comprised of three prototypical curtain wall unit modules, the façade's continuous ribbon window incorporates increasingly thicker floor spandrels that provide additional building insulation at the north-facing frontage. East, west, and southern exposures benefit from an incrementally higher percentage of vision glass and an enhanced potential for passive solar heating during the critical heat-loss winter months (see Figures 4 and 5).

The tower's main entry, with a vehicular drop-off on Pearl Street, leads into a two-story lobby providing access to a dedicated public amenity-floor lift and to the residential lobby on the more private raised plaza level. On each of the residential floors, a central lobby open at both ends facilitates entry to six units of various sizes: two studios, two one-bedrooms, and two two-bedrooms. Vertical elements of the structure's innovative steel frame are located 14 feet inboard of the exterior wall, to align unobtrusively with the interior corners of the braced frame core and allow for ample, nine-foot ceilings and maximum penetration of daylight at the primary living spaces that define the perimeter of each residential unit. Smaller support spaces occupy the inner zone—defined by a lower, eight-foot-high ceiling—of each residential unit (see Figure 6a).

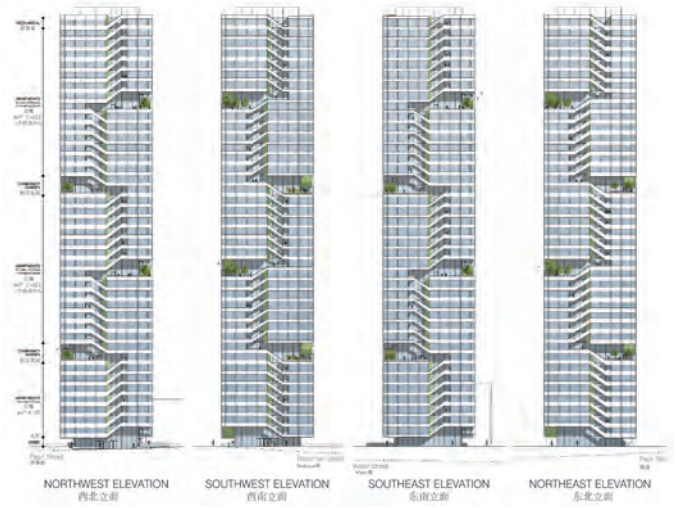

Figure 4. Eight-story vertical gardens and semi-enclosed balconies and terraces are among strategies that enable a dynamic sense of community (Source: Pei Cobb Freed & Partners)
图 4. 八层垂直花园和半封闭的阳台和露台等策略有助于实现社区的动感 (出自: Pei Cobb Freed & Partners)

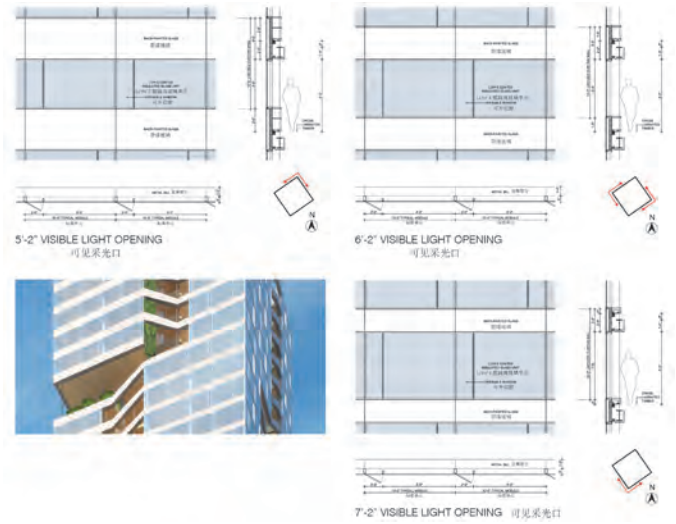

Figure 5. Curtain wall details showing façade's response to solar orientation (Source: Pei Cobb Freed & Partners)
图 5. 幕墙细节展示了外立面可根据太阳方向作出反应 (出自: Pei Cobb Freed & Partners)

8X8 高楼重新诠释并满足了都市住宅生活的纲领性需要，为21世纪描绘了一幅大胆的象征性景象 (见图 3)。 在高楼四面的每一面，即多层空隙中，都带有空中花园，提供了公共和私人的户外露台空间，通过对角线改变楼层拱形设计，从而使建筑外观变得活跃起来，通过这种方式，每一面都形成连续的纽带，八个环环相扣的花园和社区表现出令人振奋的力量。覆盖着的单元式幕墙由背面上漆的拱形玻璃和节能绝缘玻璃以交替的带状形式组成，高楼独特的环环相扣 L 形空间系统使纽带窗拱形在垂直上有了变化，它们沿着对角线从一个居住空间延伸至另一居住空间，根据太阳方向调整外立面。由三个原型幕墙单元模块组成，高楼外立面的连续纽带窗构成逐渐增厚的楼层拱形，为建筑北面提供更多的隔热效果。东、西、南三面有更多的观景玻璃，即使在热量流失严重的冬季，也能获得足够的太阳能供暖 (见图 4 和 5)。

从Pearl 街道上的下车道进入大楼的主入口，可以通往二层楼高的大厅，乘坐大厅中的公共休憩层专用电梯可直达更加私密的空中住宅大厅。在每一个住宅楼层，中央大厅对两端开放，可进入六个不同户型的单元: 两个单间公寓、两个单卧室公寓和两个双卧室公寓。具有创造性钢架结构的垂直构件置于外墙内侧14英尺的位置，与室内角部核心支撑框架平齐，形成宽敞的9英尺高天花板，保证周边主要居住空间有充分的日照。 较小的辅助空间位于住宅单元的内部区域，天花高度为8英尺 (见图 6a)。

Figure 6a. Typical plans at residential floors (Source: Pei Cobb Freed & Partners)
图 6a. 住宅楼层的标准层 (出自: Pei Cobb Freed & Partners)

Figure 6b. Typical plans at lower and upper levels of double-height amenity spaces (Source: Pei Cobb Freed & Partners)
图 6b. 双层休憩空间上下层的标准层 (出自: Pei Cobb Freed & Partners)

Supporting the 8X8 Tower's 35 typical-unit floors, flexible amenity and commercial program spaces are located on every eighth tower floor, vertically distributing activities that are typically associated with the ground plane to both diversify and complement the residential community within the building. These suites, served by both typical and dedicated passenger lifts, combine with public gathering areas to provide access to double-height common areas with access to exterior terraces that link the vertical community gardens on each façade and offer views of the neighborhood and the East River beyond. Decentralized mechanical rooms, also located on the communal floors, provide for fresh-air intake within the hanging gardens to serve air handling units within all common and amenity spaces and minimize shaft areas required for vertical duct distribution to the adjacent residential floors, four floors above and below (see Figure 6b).

From its high point on Pearl Street, the site's gently sloping topography invites the development of a waterproof podium base with water-tight service-entry provisions off Water Street and the incorporation of rapidly installable aluminum and steel flood protection barriers at the main entry and lobby. The resulting ground planes integrate seamlessly into the fabric of the neighborhood while also providing 100-year storm-surge mitigation measures that are critical to maintaining a resilient housing stock within coastal urban areas, such as lower Manhattan and Shanghai, that might be impacted by flooding due to changing weather patterns and rising sea levels (see Figure 7).

Figure 7. Site plan and perspective from south reflecting flood-protection site strategy (Source: Pei Cobb Freed & Partners; studio amd)
图 7. 从南看的总平面和透视图 (体现了防洪策略) (出自: Pei Cobb Freed & Partners; studio amd)

The solar calibration of the curtain wall glazing system is one of numerous passive and active features that make the 8x8 Tower a model of sustainable living. Among those illustrated are well-insulated Low-E vision glass, featuring triple glazing and thermally broken mullions, and ample ceiling height with an economical floor-to-floor dimension and a shallow plan that maximizes daylight penetration into the primary living spaces while minimizing heat loss and solar gain; operable windows; energy-efficient fan coil units incorporated into the lower, support-space ceiling to provide heating and cooling to all occupied spaces; and supplemental hydronic heating integrated with cross-laminated-timber (CLT) structural flooring. Indoor air quality and space saving are further enhanced by the delivery of ducted ventilation air to each residential unit from localized mechanical equipment rooms adjacent to the hanging-garden voids in each façade. These multilevel exterior spaces also offer opportunities for the development of community gardens, food production or otherwise, to be cared for, shared, and appreciated by the tower's residents and commercial users (see Figure 8).

Figure 8. Community gardens and shared public space at amenity levels (Source: Pei Cobb Freed & Partners)
图 8. 休憩层的社区花园和共享公共空间 (出自: Pei Cobb Freed & Partners)

Structural Design

Gravity and Lateral System

The 40-story steel tower, which forms a perfect square in plan, is supported vertically by a steel-framed core and eight, steel mega-columns. The mega-columns are set in from the perimeter of the building to keep the perimeter free of vertical structure and allow for greater transparency at the façade. Together, the concentrically braced frame core and the mega-columns provide lateral stiffness and resistance of the tower to wind and seismic loads.

Typical Floor Structure

Each floor level has a simple and nearly identical structural framing plan consisting primarily of W14 steel girders located along each gridline in the north-south and east-west directions. These girders cantilever from the mega-columns located midway between the core and perimeter. At the perimeter, slender tension rods at the corners of the building and at intermediate points along each face tie multiple floors together to control deflection and vibration (see Figure 9).

The steel girders in turn support an 8-inch-thick CLT floor that spans in two directions, thereby eliminating the need for infill framing. The floor structure is omitted in four bays on each floor to allow for multi-level interior gardens. The locations of the gardens are staggered through the height of the building. At intermediate amenity levels throughout the tower, the double-height gathering areas are created by omitting the corner framing of the floor.

Within the core and in the inner half of the floor plate, eight-foot-high ceilings conceal the structural framing and allow for the distribution of mechanical ductwork through the steel framing via web penetrations and notches. In the outer zone of the floor plate, where mechanical distribution in the ceiling is not required, the structural beam configuration is expressed and the underside of the CLT floor is exposed to allow for generous ceiling heights at the building perimeter.

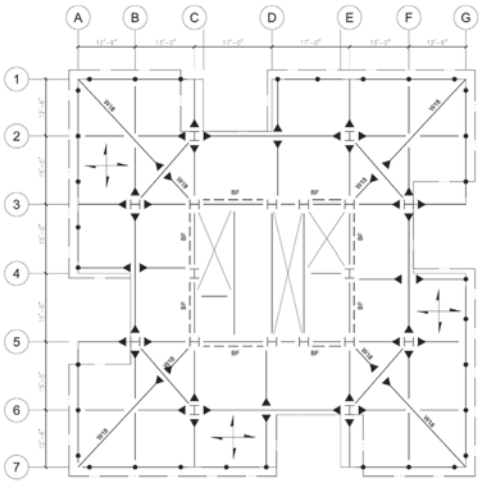

Figure 9. Typical structural steel framing with cross-laminated timber floor (Source: Guy Nordenson and Associates)
图 9. 使用交叉层压木地板的典型结构钢框架 (出自: Guy Nordenson and Associates)

Mechanical Systems

State-of-the-art mechanical systems integrate with the building's structural and architectural design while remaining affordable and simple to operate.

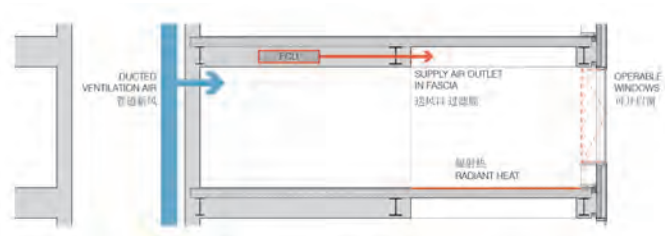

Figure 10. Ducted air supply, return-air plenum, and hydronic radiant heating at residential units (Source: Pei Cobb Freed & Partners)
图 10. 住宅单位中的管道空气供给、空气回流室和液体循环辐射供暖 (出自: Pei Cobb Freed & Partners)

Residential Units

In response to the relatively severe climate of New York City, a fan coil unit solution provides space heating and cooling to all occupied spaces. Each apartment is served by multiple units, located above the suspended ceiling between the central core and ring of mega-columns. Ducted connections from each fan coil unit extend to supply air outlets located within the vertical face of the ceiling soffit to serve the outer zone of each floor. The above-ceiling cavity functions as a return air plenum via architectural openings from the spaces served by each fan coil unit (see Figure 10).

The fan coil system may be implemented in a 2-pipe or 4-pipe configuration, or alternatively as water-source heat pumps, depending upon the development objectives and target market of the project. In addition, hydronic radiant heating is provided at perimeter zones with the highest percentage of vision glazing in order to maintain thermal comfort during the winter season.

MEP Infrastructure

A central chilled water plant, located within a basement or penthouse, provides chilled water to the air handling and fan coil unit systems. The plant is high efficiency and electrically driven, with multiple variable-speed refrigeration compressors. Hot water for space heating is provided by multiple condensing hot water modular boilers located within a penthouse MER. Domestic hot water is generated by direct gas-fired hot water heaters.

Consistent with the requirements of "near future" residential spaces that provide a high degree of thermal comfort and indoor environmental quality in a sustainable manner, the project includes state-of-the-art infrastructure such as:

- An electrical closet on each floor for electrical sub-metering or direct-metering devices
- A telecommunications riser closet on each floor with backbone infrastructure for multiple IT providers
- Ultra-high-efficiency particulate filters (MERV 16) in all outside air intake ventilation systems
- Gas-phase activated carbon filtration for all outside air intake ventilation systems
- Toilet rooms with low-flow toilet fixtures, adequate for market-rate occupancy levels
- Rainwater capture and storage tanks for use with irrigation and building maintenance

All incoming utility services are located above the design floor elevation or are dry flood-proofed within below-grade mechanical rooms. The entire project is fully sprinklered in accordance with New York City code requirements.

为了服务 8X8 高楼 35 个典型单元楼层，每八层就设计了一个灵活的休憩和商业空间，垂直分布了通常位于地面层的活动设施，以此丰富并补充了大楼内的住宅社区。这些套间可使用标准电梯和专用乘客电梯到达，结合了公众聚集区，连接带有户外露台双层高度的公用区，户外露台连接了每一面的垂直社区花园，提供附近及东河的景色。分散的设备间也位于公用层，为空中花园提供新风，并为所有公用和休憩空间提供空气处理设备，从而缩小连接上下四层住宅的管道井尺寸 (见图 6b) 。

站在 Pearl 街的高处看，地势有轻微倾斜，因此建造了一个防水的矮墙基座，具有防止Water街流下的水流淹没服务功能， 并在主要入口和大厅设置了可快速安装的铝钢防洪障碍。由此产生的地平面完美融入附近建筑，也提供抵御百年一遇大风暴的措施，这对维持沿海城市地区住宅的复原能力至关重要，例如曼哈顿下城和上海，可能由于气候变化和海平面升高而遭到洪水袭击 (见图 7) 。

幕墙玻璃系统的太阳校正功能是一大主被动结合的特色功能，使8x8大楼成为可持续生活的典范。在图中可见到良好隔热低辐射的观景玻璃，特色是安装了三倍的玻璃和隔热竖窗，充足的室内净高提供了经济的楼层到楼层空间，浅平面使阳光最多地穿透进主要生活空间，同时减少热损耗和太阳照射; 便于操作的窗户; 节能的风机盘管设备安装在更低的支撑空间顶棚，以便对所有使用空间供暖和供冷; 补充的液体循环供暖整合了交叉复合木材 (CLT) 结构地板。每一面邻近空中花园空隙处有机械设备室，从这里向每个住宅单元提供管道通风，提高了室内空气质量，节约了空间。这些多层外部空间也提供了建设社区花园，食物生产等活动的机会，让大楼居民和商业用户可以照看、分享和欣赏 (见图 8) 。

结构设计

重力和横向支撑系统

这座40层高的钢铁大楼在平面图上形成了完美的空间，由一个钢铁框架核心和八个钢铁巨型柱直立支撑而起。巨型柱从建筑周边架设，使周边不受垂直结构的约束，建筑外立面有更好的透明度。同心支撑框架核心和巨型柱共同提供了横向刚度，可以抵抗风载荷和地震载荷。

经典的楼层结构

每一层都使用几乎一样的结构框架平面，主要由 W14 钢铁大梁编织成横向和纵向的网格。这些大梁从核心和周边中间的巨型柱中延伸出来。在周边，建筑物拐角和每一面中间点的细长张力杆连结了多个楼层，共同控制挠曲和振动 (见图 9) 。

钢铁大梁依次支撑跨越两个方向的 8 英寸厚的 CLT 楼层，因此无需填充框架。每一层的四个隔区都省略了楼板结构，以形成多层的内部花园。花园的位置由于建筑物高度不同而错开。在大楼的中间休憩层，省去楼层拐角框架创造了双倍高度的聚集区。

在中心和楼面板内部中间，8英尺高的天花板隐藏结构框架，可以在钢铁框架中经由网状渗透和槽口配置机械管道系统。 在楼面板外，无需在天花板里配置机械，CLT 地板下方暴露的横梁结构使建筑物外围拥有更多室内高度。

Sustainable Living: Social and Environmental

In summary, the 8X8 Tower is a comprehensive sustainable ecosystem, responding to, and engaging the built and natural environment through the careful integration of multiple design strategies.

Porosity

The simple building form and subtractive massing are conceived to allow for an interactive relationship between the occupants and the natural world. At each of its four façades, the building invites and incorporates the natural environment into the larger volume through a system of eight-story vertical gardens, shifting from one side to the other of a central vertical axis. Carved out of the building's simple square volume, the network of voids gives residents, through a rich array of public and private semi-enclosed balconies and terrace gardens, the ability to enjoy naturally ventilated yet protected outdoor areas and a dynamic sense of community within a high-rise living context (see Figure 11).

Energy Efficiency

The building's well-insulated prefabricated façade minimizes heat loss and solar gain with an optimized curtain wall that responds to solar orientation. Similarly, employing regional mass manufacturing and building standardization improves quality control and associated thermal

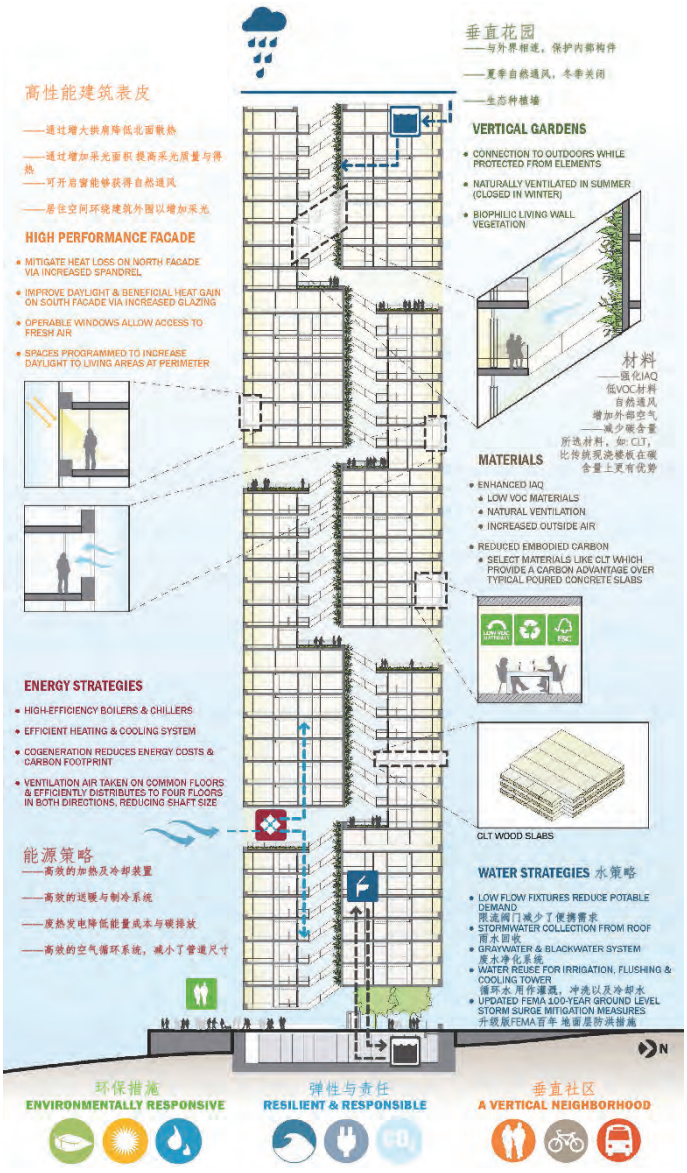

Figure 11. Summary of sustainable design strategies (Source: Atelier Ten)
图 11. 可持续设计策略摘要 (出自: Atelier Ten)

机械系统

最先进的机械系统结合了建筑物的结构和建筑设计，同时价格实惠，易于操作。

住宅单位

为了适应纽约市严峻的气候，风机盘管设备解决方案为所有使用空间供暖与供冷。每个公寓都配有多种设备，他们位于中心和巨型柱之间的吊顶上。每个风机盘管设备的管线连接延伸到天花底垂直面内出风口，为每层的外部区域服务。天花上层空间作为回流空气室，经由建筑开口从风机盘管设备提供的空间排出 (见图 10) 。

风机盘管系统有 2 管或 4 管的配置，或者使用水源热泵，这取决于项目的开发目的和目标市场。此外，在周边区有带最高百分比的观景窗玻璃的液体循环辐射供暖，以维持冬季的温暖舒适。

MEP 基础设施

位于地下室或阁楼的中央冷冻水厂为空气处理和风机盘管设备系统提供冷冻水。该机组效能高，以电力驱动，拥有多个可变速的制冷压缩机。在阁楼设备间内有多个冷凝热水模块锅炉，为供暖提供热水。生活热水由燃气热水器直接提供。

为了符合"接近未来"居住空间的要求，即以可持续的方式提供较高的温暖舒适度和室内环境质量，本项目采用了最先进的基础设施，如:

- 每一层的配电间，为电力分表或直表设备提供服务
- 每一层的电信供应间，拥有多个IT供应商的主干网设施
- 所有外部通风系统的超高效微粒过滤器 (MERV 16)
- 所有外部通风系统的气相活性碳滤网
- 盥洗室装有节水冲厕装置，且足以满足市场水平的使用率
- 雨水收集池，用于灌溉和建筑物保洁

即将到位的公共服务设施都将位于设计室内地面标高以上或防洪的地下机械室内。整个项目全面覆盖符合纽约市法规要求的喷洒系统。

可持续生活: 社会和环境

总的来说，8X8大楼是一个综合可持续生态系统，通过对多种设计策略的精心整合，将建筑和自然环境完美结合。

多孔性

简洁的建筑形式，去粗取精，使使用者和自然世界建立和谐的互动关系。建筑物共有四面，每一面通过 8 层高的垂直花园系统，从中心垂直轴的一面转换到另一面，把自然环境融入更大的空间。建筑物中简洁的正方形中空形成的空隙网络，通过大量公共和私人半封闭阳台和露台花园，使居住者享受到自然通风，又有户外区域的保护，也可以在高楼生活中欣赏社区的动态风景 (见图 11) 。

能源效率

建筑物高效保温的预制外立面，结合按照太阳角度优化的幕墙设计，减少了能源损失和阳光照射。同样地，采用当地的大规模制造和建筑标准提高了质量控制和相关的热力性能，同时减少了在构件制造、运输方面的能源消耗，也缩短了建筑工期。

performance while also reducing the energy consumption associated with component fabrication, shipping, and building erection time.

Resiliency

The building is a responsible and resilient steward of natural resources. Rain water is captured from the roof to irrigate the vegetated green walls that define one side of each vertical atrium, bringing a sustainable biophilic focus to the primary living spaces of each residential unit. Additional gray water strategies and the specification of low-flow plumbing fixtures further reduce residential water consumption. Cogeneration of energy, storm surge protection, and passive solar heating and cooling, including operable windows for all residential units, make the building more resilient and, along with the use of highly renewable materials such as CLT floor slabs in lieu of concrete (a large source of carbon pollution), further minimize carbon emissions and the building's overall carbon footprint.

Connectivity

Within the building, community floors located at eight-floor intervals provide and integrate public services as a means of socially and physically joining the building's interlocking residential communities. A greater number of common amenity spaces, occurring at frequencies within the tower's vertical organization (not solely at the bottom or top of the building), promotes the use of stairs and fosters the creation of a localized pedestrian-oriented social fabric. Similarly, the dedicated elevators linking the ground-level lobby and "public" amenity floors allow commercial services, normally confined to ground-level spaces, to exist within the more rarefied upper-level sanctums. By better connecting such floors with the public realm of the city, the building's public program and community gardens break down the notion that public space stops sharply at the property line or traditional front door. Instead, community space is distributed throughout the tower, fostering the creation of a spatially rich and socially diverse vertical community.

The 8x8 Tower is an integrated architectural response that addresses, in an urban setting, the challenges brought on by population growth and climate change. Through inventive design strategies to increase porosity, energy efficiency, resilience, and connectivity, the tower proposes a rich ecosystem that represents a critical, if not fundamental, step toward a sustainable vertical urbanism.

复原力

本建筑对自然资源负责，具有自我复原能力。从屋顶采集雨水，用于灌溉每一个垂直中庭面的绿色植物墙，给每一个住宅单元的主要生活空间带来了可持续的生命气息。此外，中水策略和节水卫浴间设备规范进一步减少了居民用水量。废热发电、大风暴防护和非主动太阳能供暖与供冷，包括所有住宅单元的易于操作窗户，使建筑物更具复原力，同时使用高度可再生材料 (如 CLT 地板) 代替混凝土 (是碳污染的一大来源)，进一步减少了碳排放以及建筑物的整体碳足迹。

连通性

在建筑物内，位于每八楼层的社区楼层，以社会性和自然性的方式连接建筑物环环相扣的住宅社区，提供并整合了公共服务。在大楼垂直组织中有许多公共休憩空间 (不仅在建筑物底部或顶部)，促使人们使用楼梯，培养小范围步行的社会习惯。同样地，连结底层大厅和"公共"休憩楼层的专有电梯把通常位于底层空间的商业服务提升到更高层的场所。通过把这些楼层与城市的公共区域更好地连结在一起，本建筑物的公共计划和社区花园打破原来公共空间线状排列或位于传统前门的观念。取而代之的是，社区空间分布在大楼的各处，形成了垂直社区在空间和社交功能上丰富多样的变化。

8x8大楼是一个综合性建筑设计，解决了都市中人口增长和气候变化带来的困难。通过使用创新的设计策略，增加多孔性、能源效率、复原力和连通性，大楼打造了一个丰富的生态系统，标志着向可持续垂直都市生活迈出了关键 (如果不能算是根本) 的一步。

References (参考书目):

Kusisto, Laura. 2013. **City's Boom Spurs a Need for Housing**. Wall Street Journal, June 10.

Lane, Melissa. 2013. **Sustainable Citizenship**. Lecture, Architectural League of New York, October 29.