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Biomimicry Inspired Design for Nine Towers at Central Park in New Songdo City

建筑仿生学与韩国仁川松岛国际城市九栋超高层建筑的设计



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Abstract

The 9 45-60 story towers designed by HOK in New Songdo City along the edge of the new Central Park highlight the integration of high performance buildings, sustainable design and biomimicry while creating iconic architecture. Each set of buildings has its own identity inspired by biomimicry, using nature as an inspiration for design. The completed work illustrates the principles of Sustainable Design, Scale, Repetition and Texture in highrise design.

Keywords: Sustainable, Biomimicry, New Songdo City, Residential, Hotel, Scale, Repetition

摘要

HOK 在松岛国际城共设计了九栋45 到60层超高层建筑, 它们沿着松岛市中央公园, 结合高效能、可持续性发展及建筑仿生学原理, 构成市中心地标型建筑。每栋建筑利用各自仿生特色, 以大自然为楷模, 在整体上明显表现出可持续性发展设计原理, 并在尺度上和材料、质地的重复表现中强调了这一原理在超高层建筑上的利用。

关键词: 可持续性发展, 仿生学, 松岛国际城, 住宅, 大酒店, 尺度, 重复

Introduction

HOK was invited by the developers of New Songdo City to design over 7 million SF of Towers along the newly masterplanned city in Incheon, Korea. The Masterplan (designed by KPF) includes a new Central Park which is lined by towers around its perimeter. The client, Gale International, requested iconic architectural towers along the perimeter of the Park and the focus of the design team was to look to nature for inspiration in order to create bio-inspired sustainable solutions. HOK and the Biomimicry Guild created a strategic alliance to look at how biologists could be brought to the design table to look at building design through a different lens.

Biomimicry is a new way of viewing and valuing nature, based not on what we can extract from the natural world, but on what we can learn from it.

The Triple Bottom Line Model and Fully Integrated Thinking (FIT)

The FIT follows the triple bottom line model with Environment, Social and Economic as the main categories and allowance for the

引言

应韩国仁川市新松岛国际城开发商- 美国盖尔国际开发公司的邀请, HOK参与了超过七百万平方英尺的超高层建筑群的设计工作。此项目的总体开发规划由美国KPF公司设计, 其基本规划是, 在新城中心预留绿化带 - 中央公园, 由公园两侧罗列的塔楼, 定义公园的空间。作为开发商, 盖尔国际要求公园两侧的建筑必须具有高度标准的标志性设计, 并严格应用由大自然启发而产生的设计理念, 以适应坐落中央公园两侧而必须与大自然息息相关的可持续性发展的设计原则。HOK与仿生咨询公司 (Biomimicry Guild) 携手合作共同研讨如何通过生物学家的眼光来让建筑设计更贴近大自然。建筑仿生学提供我们一条新的思路, 即我们不是要去征服和榨取自然, 而是从自然中学会如何与自然和睦相处。

三条底线和全方位集成思维

全方位集成思维沿着三条底线完整地定义了设计思维的范围和细则, 以环境、社会及经济三方面来衡量和引导设计步骤, 并逐步趋向合理化。具体来说, 我们的设计必须符合开发商制定的基本标准:

design team to set parameters and attributes for the project that can be measured and serve as an operational tool for the entire staff and a learning tool for building users. It ensures that the project meets the goals and performs according to the set criteria in the following categories:

- Environmental: Ecosystem, Water, Atmosphere, Materials
- Energy: Food + Waste, Transportation
- Social: Education, Community, Culture, Health
- Economic: Operations, Commerce, Value

Method:

The design methodology for the New Songdo City (NSC) Projects is comprehensive, reaching beyond normal practices and industry benchmarks. The process used is Fully Integrated Thinking (FIT), which has been developed as a fine-grained expansion of the triple bottom line concerns (people, prosperity and planet), and uses performance standards modeled upon nature to challenge existing practices that embody negative externalities or outcomes over time.

FIT Premise

All 30 million species on our planet have learned to live sustainably within the operating conditions of the earth over time by evolving to fit into place, becoming progressively more well-adapted over time. Human designs in recent human history can be characterized as rather mal-adapted for survival within these operating conditions. Using biomimicry as a design ethos for sustainability, we can learn how to be more well-adapted to the planet in the long run. The evolutionarily successful characteristics of all organisms can be summarized by a set of Life's Principles that describe how life is well-adapted across species through time and place. This set of Principles has been used in this design process to create a strategic framework for sustainability, in addition to the other standards and parameters needed for success. All design decisions for the NSC Projects passed through the lenses of the fourteen categories above to inform the design decisions and presentations to the client, Gale International Korea.

- 环境上: 生态, 水利, 大气, 建材
- 能源: 食品及垃圾, 交通
- 社会上: 教育, 社区, 文化, 健康
- 经济上: 营运, 商业, 价值

具体方式:

松岛国际城的设计方式远远超过了目前国际通用的传统方式和大家所公认的工业标准。它使用的全方位集成思维尝试一种全新的、完整的、从传统的三条底线（人力、财富和资源）演绎而来的视角，站在一个由对大自然深入了解而赢得的新的、高度去向传统的、导致我们今天种种危机的顽固陋习和错误观念、进行长期的持久的挑战。

全方位集成思维的前提

千百年来，三千多万物种在地球上生存和繁衍。随着地貌和气候的变化而不断地进化，一切只是为了更“适应”环境。而人们在现代意义上的“设计”行为，无疑是人类进化过程中的一个错误环节。其结果必然是因果倒置、本末不分。运用仿生学，作为可持续发展的“设计”手段，从长远的意义上来说可以让我们学会去“适应”。成功进化的原理无非是该物种对某时某地环境长期“不断适应”的过程，同样的原理在设计上就是运用可

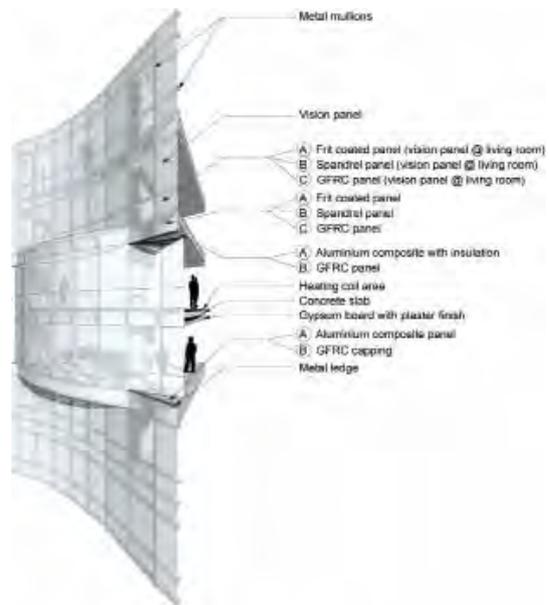


Figure 2. Central Park I Detail . (Source: HOK)
图2. 中央公园一期工程/细节 (图源: HOK)



Figure 1. Central Park I / The Weave. (Source: HOK)
图1. 中央公园一期工程/网织 (图源: HOK)

持续性发展作为长期战略方针，再加上其它必不可少的条件和手段。松岛国际城的每一项设计决策，在提交给开发商 - 盖尔国际 - 之前，都必须经过通过以上十四项基本标准。

中央公园一期工程/网织

中央公园一期（不超过163M）位于松岛国际城中央公园北端，为该城北入口地标。由地上三层商业裙楼和三栋五十层住宅塔楼组成。塔楼充分利用朝南阳光，由大面积玻璃铝合金组成编织型帷幕外墙，造就富有特色的内部空间和开阔视野。该项目含有以下可持续性发展设计特征。

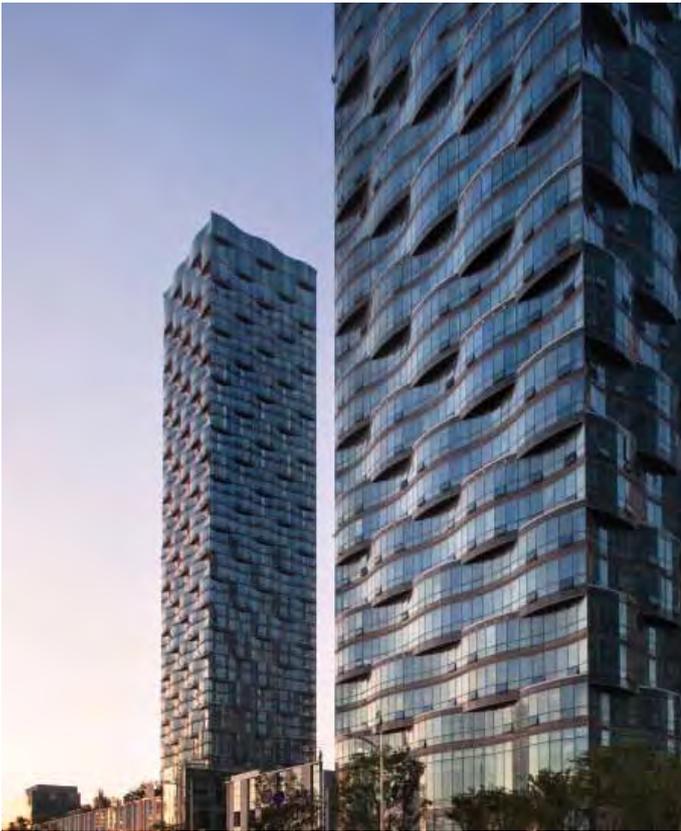


Figure 3. Central Park I. (Source: HOK)
图3. 中央公园一期工程 (图源: HOK)

Central Park I /The Weave

Central Park I (163 M max. height) is located on the northern edge of New Songdo City's Central Park, forming a gateway to the neighborhoods in the city's northern district. The design is marked by three 50-storey residential towers rising above an urban street-edge of three story commercial and retail space. The residential towers take advantage of southern exposure, with the woven, lattice-like façades of glass and aluminum providing unique interior spaces and views for each unit. The project incorporates a number of key sustainable design features.

The high-performance façade design allows for two LEED EA points for improvement beyond ASHRAE 90.1, while also securing an Innovation in Design Credit for Exemplary Performance in Day lighting, providing over 95% of designed spaces access to natural light.

The design of the block utilizes landscaped courts, minimizes footprints of the retail and towers, and creates landscaped roof gardens on each of the low-rise buildings, accessible from the residential towers as amenity spaces. The result is credits for heat island reduction, landscape that is maintained through grey water harvesting (two credits), and two credits for open space design, including a second Innovation in Design Credit for Exemplary performance in Maximizing Open Space.

Additional sustainable design features include:

- Planned Development Density
- Access to alternative transportation, on-site changing rooms, bike storage, etc.
- Water use reduction
- Planned construction waste management with more than 75% diverted from disposal



Figure 4. Central Park II / Cellular Structure. (Source: HOK)
图4. 中央公园二期工程/细胞 (图源: HOK)

高性能外墙设计, 使能源消耗远低于ASHRAE90.1所定底线, 并获得2个LEED AE积分。由于百分之九十五以上的空间都可以接受到自然光线, 该项目亦获得LEED创新设计积分。

裙楼设计上利用花园内庭以减少建筑占地面积, 并以花草植被覆盖裙楼屋顶(绿色屋顶)以供居民休闲使用。由此也获得LEED缩减热岛辐射面积的积分, 外加废水再利用共得两点积分。另外, 开放式公共空间和独特的创新设计亦各获得一个LEED积分点。

其它可持续性发展设计特色:

- 规划性高密度开发
- 自行车库及更衣设施
- 节约用水措施
- 减少建筑下脚料75%
- 利用再生建筑材料
- 利用本地建筑材料
- 可控照明及节能



Figure 5. Central Park II Rendering. (Source: HOK)
图5. 中央公园二期表现图 (图源: HOK)



Figure 6. Central Park I & II. (Source: HOK)
图6. 中央公园一期和二期工程 (图源: HOK)

- Recycled content specified in both core and shell and interior design
- Regional materials specified in both core and shell and interior design
- Lighting system controllability and energy reduction

Central Park II / Cellular Structure

Central Park II (180 M max. height) is located on the northern edge of New Songdo City's Central Park, adjacent to HOK's first project in New Songdo City. The design is comprised of one 50 and two 45 story residential towers, rising above an urban street edge of two and three story commercial and retail buildings. The innovative design challenges the consistent, vertically extruded form of towers typical to Korean residential construction by creating a south-facing, shifting glass volume in front of a north-facing cast stone and aluminum volume. Unique residences are located in the shifting glass form, whose glazing panels are reinforced and shaded by a diagrid of aluminum fins.

The Project incorporates a number of key sustainable design features including a high-performance façade allowing for an estimated 10% improvement over ASHRAE 90.1, allowing for a LEED Energy performance credit, while maximizing glazing area for an Innovation in Design Credit for Exemplary Performance in Daylighting, providing over 95% of designed spaces access to natural light.

Similar to the adjacent woven design, Central Park II creates a series of landscaped roof terraces at the commercial, low rise buildings, accessible as amenity spaces from the residential towers. In addition, landscaped areas have been added at the top of the lower, glass volumes of each residential tower. The result is credits for heat island reduction, landscape that is maintained through grey water harvesting

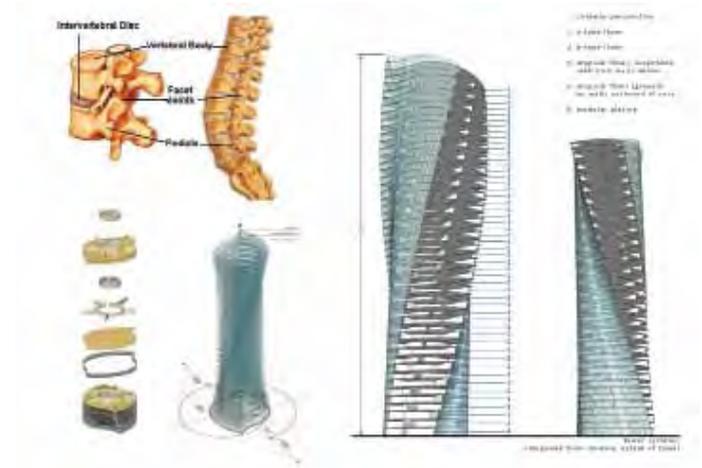


Figure 7. Central Park III / The Spine. (Source: HOK)
图7. 中央公园三期工程/脊柱 (图源: HOK)

中央公园二期工程/细胞

二期工程 (180M标高) 同样处于公园北沿, 比邻一号工程东南。二期工程由两栋45层及50层住宅塔楼为主, 底部由二至三层商业裙楼连接。与众不同之处, 在于朝南部分由富于动感的错位玻璃帷幕为主体, 附着在相对传统的铸石和铝合金贴面的北部楼体上。朝南单元因而拥有非常特别的视觉动感, 而附加的斜向铝合金附翼更进一步强调了这种动感。

根据可持续发展设计的原则, 我们改进了玻璃帷幕的设计, 使其在节能方面超出ASHRAE90.1基本要求百分之十, 获得LEED一个积分点, 同时也得到自然采光创新设计的积分 - 百分之九十五的使用空间都能享受到自然光线。



Figure 8. Central Park III Model Photograph. (Source: HOK)
图8. 中央公园三期模型摄影 (图源: HOK)

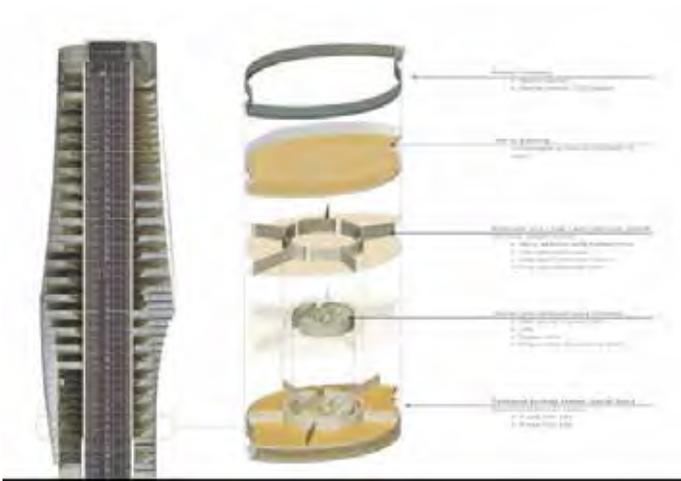


Figure 9. Central Park III Building Components. (Source: HOK)
图9. 中央公园三期局部(图源: HOK)

and additional sustainable design attributes of open space design maximizing open space.

Central Park III / The Spine

Central Park III (180 M max. height) is located on the northeastern corner of New Songdo City's Central Park, adjacent to both Central Park II and the Convention Center Hotel. The design is comprised of one 50 and one 45 story residential towers, rising above an urban street edge of three story commercial and retail buildings. The twisting form of the towers are generated by a unique integrated architecture and structural solution of the interior planning that builds a honeycomb grid of concrete, creating 20-meter plus clear spans for the units with no columns to restrict the resident's space planning.

One of the non-LEED related innovative features of this project is the structure, which uses an equal or slightly less quantity of concrete than a traditional, square building, with quantities significantly less than other contemporary non-orthogonal designs worldwide. In addition, the unique core design eliminates steel link beams altogether, removing the embodied energy of tons of material from the project. In addition, the façade design seeks to further improve the energy performance of the design, while maintaining the unique fully glazed and day lit design features inherent in each block.



Figure 10. Convention Center Hotel / The Cactus. (Source: HOK)
图10. 展览中心大酒店/仙人掌(图源: HOK)



Figure 11. Convention Center Hotel Model Photograph. (Source: HOK)
图11. 展览中心大酒店模型摄影(图源: HOK)

细胞工程也沿用了邻居网织工程的类似方法,绿化裙楼屋顶、并把它沿伸到塔楼玻璃部分的平顶,这样我们就保证了LEED缩减热岛辐射面积的积分。同样,细胞工程也得到了非饮用水再利用及开放式公共空间和独特的创新设计的LEED积分点。

中央公园三期工程/脊柱

中央公园三期工程(180M标高)坐落在公园的东北角,西邻二期工程,南窥展览中心大酒店。类似前两期工程,一栋45层和一栋50层的住宅楼,从三层的商业裙楼上升起。透过螺旋式的外表,我们不容易看到此项目在建筑和结构的结合上所作的创新,就是运用蜂巢错落的结构原理,实现超过二十米跨度浇混凝土楼板而无需立柱,给个单元提供了最大程度的内部分割和设计自由。

虽然此项创新并不能得到LEED积分,但却在材料的节约上,延伸至减少使用材料所省下的总体能源消耗上,该创新的影响不可忽视。此创新不但免去了传统浇混凝土楼板必需的梁柱,也使混凝土使用量等于或低于同面积传统正方形平面设计,类比目前世界上非传统直角平面的楼板,此项目大幅度地节省了混凝土用量。

由于建筑设计方案本身导致的特殊外型,也使一般方型塔楼固有的风阻系数大大降低,从而减少了高层建筑对自然风向的人为干扰。同样,我们遵循规划的原则,最大限度的扩大公共使用空间,绿化裙楼屋顶开放给住户使用。

展览中心大酒店

仁川喜来登旅馆,荣获韩国第一座得到LEED认证酒店的名誉,于2009年8月建成。高二十五层共九十米,坐落中央公园东面,二十三层客层及屋顶双层设备机房和屏围。319套高级客房中,百分之八为超尺度复式套间。客房顶层是豪华总统套间和高级行政官酒廊。平均客房面积为380平方英尺(35.3 M²),每房均有全套四件盥洗设备。底座五层含两个宴会舞厅、若干多功能厅、一个温泉浴场、健身中心、室内游泳厅、两家饭店及一个酒吧。

Convention Center Hotel / The Cactus

The unique form of the towers, an integrated architectural solution, also reduces wind pressures across the façades and creates less disruptions to the natural wind patterns than a square building. The block site design surrounding the towers follows suit with the previous site planning concepts maximizing open space and covering all of the low-rise commercial buildings with landscaped roof gardens.

With the distinction of being the first LEED certified hotel in Korea, the Sheraton Incheon Hotel (90 M height), is located on the east side of Central Park and was completed in August 2009. The 25-story hotel tower has a total of 23 occupied floors and a two story rooftop mechanical area and roof screen. The hotel offers 319 premium guest rooms, eight percent of which are generously-sized suites. The top floors feature a luxurious presidential suite and executive lounge. Typical hotel rooms average 380 square feet and they each include a four fixture bathroom. Hotel amenities are located on the five lower levels, including two ballrooms, function rooms, a spa, gym facilities, a covered swimming pool, two restaurants and a lounge bar.

The hotel is part of a group of building that includes the Convention Center, the Northeast Asia Trade Tower and a future retail mall. The three buildings are connected through a series of plazas and open landscaped areas, as well as a single below-grade parking structure spanning the entire block.

The energy loads of the building are reduced up to 25% through the use of self-shading bay windows and external fins oriented away from the southeast and southwest solar exposures. The scale and texture of the façade shading systems provide for an iconic identity for the hotel while reducing the heat loads on the high performance façades.

Summary

Each of the designs outlined above incorporate the blending of art and science while providing sustainable solutions and iconic architecture. By looking at design opportunities through the lenses of Fully Integrated Thinking (FIT), Biomimicry and the USGBC LEED rating system major sustainable attributes have been achieved. Each of the four project' innovations and achievements have been inspired by Nature. The residential towers have LEED Silver ratings while the Hotel is LEED Certified rating and each of the projects reinforce the principles of the New Songdo City Masterplan.

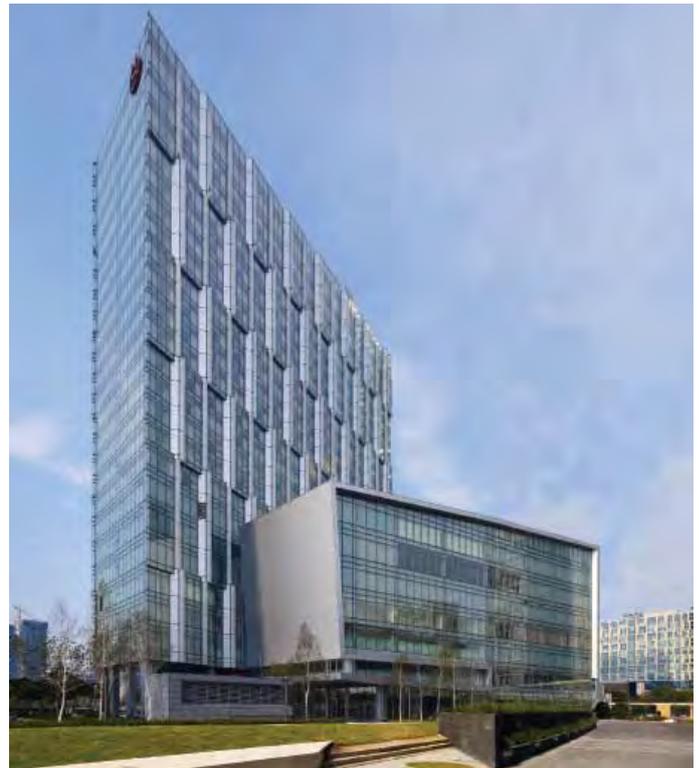


Figure 12. Convention Center Hotel. (Source: HOK)
图12. 展览中心大酒店(图源: HOK)

由于在本楼的东南和西南外表都精心设计和安置了遮阳叶片，使该楼的设计能源需求量降低为标准的百分之七十五。遮阳叶片的设计为玻璃外墙增添了纹理以致更具尺度感，根据当地阳光定位，减少了辐射导热和眩光干扰，同时形成建筑外表地标特征。

结语

虽然上述建筑的设计有阶段性，但都有可持续性发展设计和地标性建筑的特征，是科学和艺术完美结合的产物。运用全方位集成思维、建筑仿生学达到了美国绿色建筑委员会所制定的LEED各类标准。四个项目中的创新设计都源于大自然的启迪。最终，展览中心大酒店获得美国绿色建筑委员会LEED基本认证，而其它住宅群则获得美国绿色建筑委员会LEED银级认证。这也是新松岛国际城总体开发计划中的一项基本要求和原则。