SOM的遗产和创新：标志性天际线

SOM Legacy + Innovation: The Iconic Skyline

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Skidmore Owings & Merrill设计和实施了世界上10座最高建筑中的5座，其中包括目前世界上最高的建筑——828m的Burj Khalifa大厦。可以说摩天大厦的演化是在SOM不断的创新和实验性建筑中进行的，这些取得突破性的建筑包括西尔斯大厦、芝加哥的约翰·汉考克中心，以及吉达的国家商业银行。在SOM公司长长的创新设计名单中还包括不同领域的设计和工程项目，其中有对现代办公建筑的空间规划理念、模块化建筑系统、创新性建筑表皮系统和超高层建筑先进的结构工程体系等的研究。最近的一个案例是SOM事务所的结构总监Mark Sarkisian运用在钢结构建筑中的抗震连接节点，这项技术最近获得美国专利办公室颁发的创新专利。

历经75年，SOM虽然仍是一个建筑事务所，但更像是一所研

Skidmore Owings & Merrill designed and engineered five of the ten tallest towers in the world, including the tallest, Burj Khalifa Tower at 828 meters. The evolution of the skyscraper cannot be thought without SOM's long list of innovations and seminal buildings like the Sears Tower and John Hancock Center in Chicago, or the National Commerce Bank in Jeddah. Firm's long list of innovations expands to all fields of design and engineering, like the space planning concepts of the modern office building, the modular building systems, innovations in building enclosures, and advanced structural engineering systems for the super tall tower. One of the recent examples is SOM Structural Director, Mark Sarkisian's pin fuse joint design for seismic connections in steel buildings. It is recently patented as an invention with the US Patent office.

After 75 years in practice, SOM is as much an institution as it is an architectural office. The schooling is embedded in the practice as the expertise and know-how of the firm passes down to younger generations of architects and engineers. The collaborative spirit, as the working ethos, continues to move the

约翰·汉考克大厦

西尔斯大厦

迪拜Burj Khalifa（哈利法）塔

究性教育机构。教育贯穿在项目实践中，技术和策略被传授给年轻的建筑师和工程师。合作的精神作为公司的道德信条更近一步地推动着SOM向着高质量设计和创新性设计的方向前进。SOM作为一个设计集合体，在大规模和复杂项目方面有着卓越的表现，这些项目一般需要极其专业人员的相互合作和不同背景的技术人员的支持。可以说，超高层是一种独特的建筑类型，因为它需要包括城市规划、建筑、室内设计和工程学在内等各方面的相互协作，才能促成高水准的解决方案，从而生成积极、美丽、优雅、标志性、永恒但又高效、安全、可持续的设计。

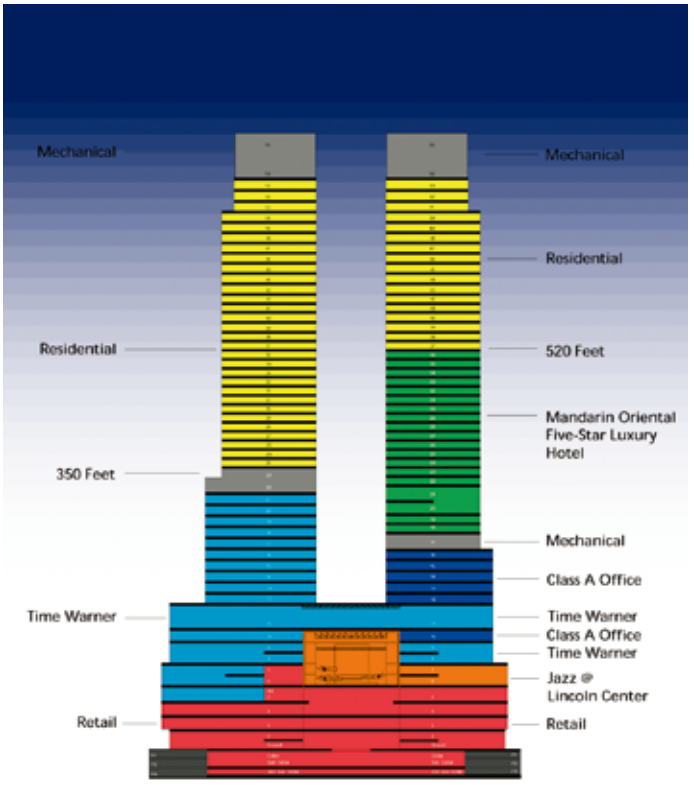
SOM贯彻在超高层建筑中的协作式设计方式，在建筑最初的形成阶段就显而易见，因为它是由很多因素定义出来的，诸如项目性的、城市性的、结构性的和环境方面的。例如迪拜Burj Khalifa塔的外墙缩进是为了减轻风荷载，同时为建筑打造独特的形象。另外这座塔楼平面布局形式就像一个“Y“字形其实是一种有效合理的结构形式，同时也是一种能够灵活放置不同项目元素的形式。芝加哥的约翰·汉考克大厦的外观和外立面上对角线式的支架也是其结构体系的一种反映。同样地，Burj Khalifa塔优雅的、向上逐渐尖细的造型也是其结构构成的一种直接反映，这也是从较大面积的办公空间向较小面积的住宅空间过渡的策略。广州珠江大厦的设计不仅是为了承受风荷载，同时也是为了利用风能——建筑中巧妙设计的

firm forward in fulfilling its commitment to high quality and innovative designs. SOM, as the design collective that it is, excels in large-scale complex projects, as they require an orchestration of high talented and capable team members, with different backgrounds of professional expertise. One can argue that, super tall tower is one typology, where urban design, architecture, interior design and engineering disciplines, all need to collaborate and integrate better than any other, to come up with highly calibrated solutions that are inspiring, beautiful, elegant, iconic, timeless, and yet, efficient, safe and sustainable.

SOM collaborative design approach to super tall buildings can best be seen at the genesis of the building form, as it is informed by many factors, like programmatic, urban, structural and environmental. The setbacks at the Burj Khalifa Tower in Dubai, for instance, are calibrated to manage the wind loads, while giving its distinct profile. Furthermore the tower's principle plan form as a Y shape is an efficient structural profile, as well as a flexible one for housing different program components. The formal expression of John Hancock Tower in Chicago, with the external diagonal bracing is also the reflection of its structure. Furthermore, the elegant tapering form of the tower is a direct reflection of the structural forces, as well as a strategy to reduce the floor area from larger floor plate size of office to smaller floor plate size of residential. The form of Pearl River Tower in Guangzhou, is designed not just to resist but harvest wind. The holes that are carefully placed in the building are shaped to intensify the wind velocities for the wind turbines to generate energy. SOM engineers have done intensive computational modeling in optimizing these voids for the best performance. Meanwhile these voids help reduce the structural wind loads on the tower. In the case of Al Hamra Firdous Tower in Kuwait, the building form is optimized in order to maximize the water views from the office floors while minimizing the intense solar radiation of the harsh desert climate.

Site & Context

Early examples of tall buildings in Chicago and New York, occupied



纽约时代华纳中心

空洞是为了增加风速从而带动涡轮机的转动，进而产生能量。SOM的工程师们对此做了大量的计算机模型，以确保最大限度地利用这些空洞。同时这些空洞还能减少结构上承受的风力。就科威特的Al Hamra大厦而言，它的建筑形式的由来是为了使办公空间能获得最大限度的水景，同时尽量减少沙漠气候严酷的光照。

场地和背景

芝加哥和纽约早期的高层建筑占据标准的城市街区，为城市带来前所未有的密集度。建于1915年的位于曼哈顿的公正大厦（Equitable Building）面积达到112 000m^2，相当于容积率为30。它的建造导致一个无光峡谷的形成，最终刺激了1916年纽约城市分区法的通过，从而规范了建筑的高度和外墙缩进。随后1961年纽约城市分区法案规范了容积率，控制了城市的密度，现行的纽约城市分区法案最大允许的容积率值为21.6，曼哈顿大中央分区例外。尽管如此，摩天大楼仍占据大面积的街区，并继续在城市范围内发展，它们融合不同的场地或是将发展方向向着单一区域转移。例如帝国大厦高443m，而场地尺度为60m × 140m。

不管是作为总体规划的一部分还是作为一个单独的开发项目，场地范围都在超高层项目中扮演重要的角色。它们将如此高的密集度集中到一个单一的场地内，所以对它们与城市的融合要加以细致分析。对这些大规模项目的环境影响进行分析，对于理解它们对城市造成的积极和消极影响起着重要作用。例如理解一个新项目对于已有道路系统的影响，或是对基础服务设施的影响就很重要，如能源、卫生或电信线路等。就城市范围来说，这些项目的成功与否不仅仅是由它们与城市肌理的融合来决定的，还要看它们是不是能够

standard city blocks, bringing unprecedented density to the cities. The Equitable Building (built 1915), at 112,000 SM, at a density equivalent of 30 FAR, in downtown Manhattan created such a lightless canyon, that resulted in the passing of the 1916 New York City Zoning Law, regulating the height and setback for buildings. Subsequently, in 1961, New York City Zoning Resolution regulated the floor area ratio (FAR), controlling the density of the city. The current New York City Zoning Resolution, with all bonuses, caps the maximum FAR to 21.6, with the exception of Grand Central Sub-district in Manhattan. The skyscrapers within the urban fabric of the cities continued to develop, albeit, on larger zoning lots, created through combining multiple lots or transferring development rights to a singular parcel. Empire State Building, for instance, reaches 443 meter in height, and its zoning lot, measures 60 meters by 130 meters.

Either being part of a master plan or as a stand-alone development, the site parameters play a significant role in the design of super tall towers. They concentrate so much density on a singular parcel that their integration to the city needs to be carefully studied. Environmental impact assessments for these large-scale developments are crucial to understand their possible positive or negative impacts on the existing city fabric. For instance, it is critical to understand the possible traffic implications of a new development on the existing road network, or to the service infrastructure of the city like power, sanitary or telecommunications lines. The success of these developments at an urban level, is not only measured by how well they integrate with the existing urban fabric, but also how they become a catalyst for the future of the city.

Up until 1990s, eighty percent of world's tallest hundred buildings were located in North America. Today, only 30 percent is in North America, and almost half of them are in Asia. As the skyscrapers started to be built further away from its birthplace, new directions were pursued that responded to their new contexts. Jin Mao Tower, in Shanghai, (completed in 1999), finds an architectural expression that has references in Chinese culture. Its tiered form has strong references to the traditional pagoda form, which was the closest to the tower typology in Asian culture. This approach is not very dissimilar from the beginnings of the skyscrapers, when designers were looking into the verticality of the Gothic Cathedrals as an architectural expression of this new building

成为城市未来发展的催化剂。

直到二十世纪末，世界上最高的100个建筑中有80%都位于北美，而现在这个数字只有30%，剩下的有一半位于亚洲。随着摩天大楼的建造离开自己的出生地，其新的发展方向也在新的环境里不断诞生。上海的金茂大厦（1999年完工）就是在中国文化下促成的产物。它阶梯状层层攀升的形式极大地反映了中国传统的宝塔形象，与亚洲文化中的塔类建筑型制非常相似。这一形式与摩天大楼初期的形式相差无几，因为那时设计师是参考哥特时期大教堂的垂直性来定义这种新兴建筑形式的。

位于吉达的国家商业银行（1984年完工）可能是世界上最独特的建筑之一了。从外面看，建筑浑然一体，外表是大块的石灰华。三角形巨型主体上唯一的开口是那些显露漂浮花园的多层窗户。“V“字形的办公楼层面向这些花园，避开了阳光的剧烈照射。这座大楼在可持续方面起到了先锋作用，具体表现在对严酷的沙漠气候的整体应对策略。此外，建筑通过整体的形式反映出中东地区的院落结构，同时细节和空间的样式呼应着伊斯兰文化中的几何特性。

除了城市、文化和环境背景，场地条件对大厦的结构设计也有着很重要的影响。在SOM结构设计总监马克·萨克逊的《思考摩天大楼：结构即建筑》（“Considering The Tower: Structure as type.

National Commerce Bank in Jeddah (completed in 1984) is perhaps one of the most unique towers in the world. From outside, the building is completely monolithic, sheathed in large slabs of travertine. The only openings to the triangular monumental shaft of the tower are the multi-story windows that reveal hanging gardens. V shape office floors look into these gardens, shielded from the intense solar radiation. This tower pioneers the sustainable tower paradigm, in how it responds to the harsh desert climate as an integrated design approach. Furthermore, the cultural references to the courtyard buildings of the Middle East can be seen in the building's overall form, and the inspirations of geometric articulation in the Islamic culture in the detailing and the patterning of the spaces.

Besides the urban, cultural and environmental context, the site conditions of the tower have a strong influence in the structural design of the tower. In his book 'Considering The Tower: Structure as Architecture', Mark Sarkisian, SOM Structural Design Director, lists the primary site considerations for tower design as wind, seismic and geotechnical conditions. All these site criteria either code defined or derived from specific site conditions, are modeled analytically to replicate expected behavior. Mark points out that:

'Structures 650 feet (200 meters) or more in height, even those consisting of reinforced concrete (which has greater mass than structural steel) and located in moderate to high seismic areas, are usually controlled by wind effects rather than seismicity. This is by no means relaxes the required ductility, detailing and redundancy for the structure, but it does mean that the structure is flexible with a significantly long fundamental period of approximately 5 seconds or longer, attracting less inertial forces than a shorter structure with a shorter period. Poor soil conditions, near-fault effects, and potential earthquake intensity must be considered and may change the governing behavior.'


金茂大厦


吉达国家商业银行

Architecture”）一书中，他列举了大厦设计时主要的场地条件考虑因素，如风、地震和岩土工程技术等。所有这些场地条件要么是规范定义的，要么是从具体场地条件中衍生的，它们都要被全面地分析模仿以便得出最佳的预期效果。马克指出：

“200m或是更高的结构，即使是钢筋混凝土结构（比钢结构重）和位于地震敏感带的建筑结构通常都是由风的作用控制的，而不是由地震控制。这并没有降低对结构延性、构造和冗余度的要求，但却意味着结构会有超过5s时间的基本周期，相对于短周期的低矮结构，它受到的地震力更小。较差的土地条件、近断层效果和潜在地震都是要考虑的因素，它们可能会改变主导行为。”

项目和表现

在单一建筑内大面积楼层面积的聚集将创造绝佳的机会。就摩天大楼的面积而言，可以说它是一个垂直的城市。从项目角度看，高层建筑由高层建筑委员会和城市居住地（CTBUH）分为两种：单一功能的大楼，30%的楼层面积用作单一功能；综合利用大楼，包含两种或多种功能。

大多数单一功能的高层建筑都是办公楼。高塔作为密集生成机制是CBD的自然组成。例如作为超高层建筑典范的芝加哥西尔斯大厦是一个416 000m^2的办公楼，为16 500人提供日常服务。造成大多数单一功能的建筑都是办公楼的另一个原因是建筑结构和空间规划。楼越高，基底就越宽，于是就有了较大的楼层面积。例如世界贸易中心大厦的每个标准层面积都超过3 500m^2。这个面积的楼层比较适合用于办公，而不适合住宅。进深过大的空间不利于自然采光和通风，因此也就不适合用于住宅功能。

约翰·汉考克大厦是最早的综合利用大厦之一。它将商业、停车、办公、设施、住宅、观景台和餐厅融入到一座体量当中。人们甚至工作和居住都可以不离开大楼。综合利用的概念是为了将大厦所提供的巨大面积打破成微小的项目元素，从而变得更具商业价值。实际上，这些综合性建筑就像多个建筑的堆砌。另一方面，综合性利用的塔楼给建筑师带来独特的设计挑战。它需要创新的解决方式，以实现高效的结构，在垂直结构内满足不同项目元素的需求。例如金茂大厦有一个位于低层的A级办公大楼，提供高效的现代化办公空间，随着它慢慢上升则转变为顶部的一个酒店，这时一个中庭就替代了办公塔楼的核心筒，创造出一个五星级酒店。这是一个缓慢优雅的变化，它从大面积平面转为小面积平面。结构层尺度的转变是非常正常的，同时结构系统也会随着功能的转变而发生变化。一般情况下，大厦内部会有一个转换层，为结构的转化提供空间，同时也可以充当服务性空间。

可能没有其他项目能像纽约的时代华纳中心那样容纳如此多不同的功能。这个位于哥伦比亚圈占据中央公园西南角的260 000m^2的大楼包括一个平台和两个塔楼。项目包涵有高级商业购物区、健

Program & Performance

The concentration of a significant amount of floor area in a singular building offers tremendous opportunities. Skyscrapers, by virtue of their sizes act like vertical cities. From a programmatic perspective, tall towers are classified under two categories by Council on Tall Buildings and Urban Habitat (CTBUH); the single function tall building containing at least 85% of the floor area dedicated to a single use, and the mixed use tall building containing two or more functions.

Most single function tall buildings are office towers. Towers, as density generators, are the natural constituents of central business districts. Sears Tower in Chicago, as one of the pioneering example of the super tall, is an office building of 416,000 SM, serving 16,500 daily residents. Another reason why the majority of the single-function towers are for office use is due to building structures and space planning. The taller a building gets the wider its base needs to be, resulting in larger floor areas. For instance, the lower floor levels of World Trade Center Tower One are over 3,500 SM per typical floor area. This size floor plate is well suited for office program, but it will not be suitable for residential. It generates too deep a floor with not adequate daylight and air required for residential functions.

John Hancock Tower is one of the earliest examples of the mixed-use super tall tower concept. It has retail, parking, offices, amenities, residences, observation deck and restaurants within its singular shaft. One can theoretically work and live without ever having to leave the tower. One of the significant advantages of the mixed-use concept is to break the tremendous area these towers offer into smaller program components that are more marketable. In effect, these buildings act like multiple buildings stacked on top of each other. On the other hand, the mixed-use super tall tower offers unique design challenges. It requires innovative solutions to achieve an efficient building that satisfies the demands of each program within the vertical stack. For instance Jin Mao Tower has a Class A office building within its lower stack that provides efficient modern office space, and as it transitions to the hotel at the top, an atrium replaces the center core of office tower, creating a five star hotel experience. This is an elegant solution of transitioning from a larger floor area requirement of the office to the smaller floor area requirement of the hotel. It is also very common to see a shift in structural bay sizes, and even the structural system as the building program shifts. There is usually a transfer zone in the stack to accommodate these structural transfers, and these zones are used as service spaces.

Perhaps, no other project houses the variety of the programs in one building like the Time Warner Center in New York City does. Located at Columbus Circle anchoring the South West Corner of Central Park, the 260,000 gross square meter development comprises of a podium and two towers. The project houses, high end retail mall, health club, a gourmet super market, Michelin star restaurants, jazz center with one large auditorium and a separate performance space, headquarter offices for Time Warner Center, including broadcasting studios, the headquarters of Related Companies, five star Mandarin Oriental Hotel and branded residences, and high end condominiums. Time Warner Center is the epitome of vertical city.

Skyscrapers are machines, and they need to perform. The parameters of efficiency are paramount in designing and evaluating the skyscrapers. Efficiency applies to a variety of areas, and any discussion on efficiency needs to clarify the parameters that are being evaluated. For instance, in residential towers, to track the efficiency of the sellable apartment area to the gross floor area of the typical floor is a good measure to see if the floor plate is sized appropriately for the intended unit mix. On the other hand the efficiency of an office floor plate is typically measured by dividing useable area to the gross floor area. Useable area in an office building includes some of the core functions like washrooms, elevator lobbies, local MEP spaces that serve the floor, but

身俱乐部、食品超市、米其林星级餐厅、带有大礼堂和一个独立表演空间的爵士中心、涵盖广播工作室的时代华纳中心总部、其他公司总部、五星级文华东方酒店和高级公寓等难以尽数的功能。可以说，时代华纳中心是垂直城市的经典之作。

摩天大楼是机器，它们需要运转。效率参数在设计和考核摩天大楼时至关重要。效率适用于不同的领域，关于效率的讨论必须要清楚被考核的参数。例如在高层住宅里，追踪可销售公寓面积所占标准层楼层面积的比例是一种检测楼层平面是否合理分布的有效方法。另一方面，办公楼的效率一般是由各个功能区所占楼层净面积的比例来衡量的。办公建筑的分区包括几个核心的功能，如盥洗室、电梯大厅、当地为楼层服务的MEP空间，但不包括所有的机械、垂直交通和出口楼梯系统。这个衡量方法是在检测楼层的表现能力，是相对于一个单层办公空间来说的。理论上讲这种单层办公空间具有100％的工作效率，但是一个主人可能想知道可计划区内的使用率（这里是指覆盖地毯的区域在总面积中占到的比例），而这个数据会生成不同的效率比率。可租用空间的利用率会因为具体城市的出租行为和测量传统不同发生重大改变，所以任何关于可租用空间利用率的讨论都要事先声明测量和评价手段。纽约房地产委员会（REBNY）为此定义了可租用空间利用率的衡量方法，以期为测量纽约的建筑提供合理参考，但这并不适用于有着不同出租情况的其他城市。

任何关于摩天大楼效率的讨论都离不开结构工程。超高层塔楼的几何性、纵横比（高宽比）、结构成员的放置，楼层之间的高度都是工程师和建筑师共同关注的话题。例如约翰·汉考克大厦就是一个非常高效的结构系统，每平方英尺只用了29.7磅的钢铁，而帝国大厦每平方英尺用了42.2磅。

标志性摩天楼

摩天大楼从它的规模上来讲是一个标志性结构。它们存在的逻辑起源于房地产的实用性、价值性，但是它们的魅力在于它们的外表，它们是人造环境内高级别的成就。摩天大楼的概念随着超高层塔楼类别的形成而得到了极大的扩充。在这个类别里，建造一个极具标志性的建筑能为城市带来重要的象征意义。纽约帝国大厦建于大萧条时期，是美国历史的一个里程碑，知名的快速建造过程反映出美国的技术能力和效率；无与伦比的壮观规模颠覆了国家经济危机下的死气沉沉，成为当时世界上最高的建筑。现在帝国大厦是纽约天际线中不可缺失的一笔。

SOM的建筑师和工程师都是朝向着天空的开拓者。芝加哥的西尔斯大厦在两个10年内一直保持着世界上最高建筑的称号。迪拜Burj Khalifa塔将这一标准提高了一个水平，它比自己最强硬的竞争者还高出300m，以828m的高度位居世界第一高层之列。这是一个伟大的建筑和工程成就，它将不断激发未来的摩天楼建设。

excludes all mechanical and vertical transportation shafts and the egress stairs. The logic of this way of measuring is to gauge how a floor performs, relative to a floor of a single story office building which theoretically will be hundred percent efficient. However, an owner may want to know the plannable area, which sometimes is referred as the carpeted area to gross floor area ratio. This number will result in a different efficiency ratio, lower than the former one. Depending on leasing practices and measurement conventions on a particular city the leasable area of the building varies significantly and any discussion on efficiency of leasable area needs to clarify how the measurements are done. Real Estate Board of New York (REBNY) defines leasable area measurements to bring a rational basis to measuring buildings in New York. This however, will not apply to other cities, where leasing practices of office buildings are different.

Any discussion on the efficiency of the skyscrapers cannot be fulfilled without discussing the structural engineering. The geometry of the tower, the aspect ratio (height of the tower to its width), the placement of structural members, floor to floor heights are all factors that engineers and architects work closely to design an efficient structure. For instance, the diagonally braced, tapered tube of John Hancock Tower is a very efficient structural system that only uses in average 29.7 lbs of steel per sq.ft compared to 42.2 psf of Empire State Building.

The Iconic Tower

Skyscrapers, by virtue of their scale, are iconic structures. The logic of their existence originates from the pragmatics of the real estate, the value generation by multiplying a valuable land, but their allure is much owed to their physical manifestation, as high level achievements of the man made environment. All that can be said about the skyscrapers get augmented when the scale shifts to the category of super tall towers. In this category, the impetus to build structures of incredibly iconic scale brings a symbolic significance to the cities. Empire State Building in New York, for instance, built in the midst of the Great Depression, marks a milestone in the history of United States, from its famed super fast construction process, as a symbol of American technological proves and efficiency, to its incredible scale hovering over the economic gloom of the country, as the tallest structure in the world. Today, the skyline of New York cannot be imagined without the presence of Empire State Building.

SOM architects and engineers have been the pioneers in the race towards the sky. Sears Tower in Chicago held the record of being the world's tallest building for more than two decades. Burj Khalifa Tower in Dubai, the world's current tallest at 828 meters, raises the bar to a height that is 300 meters taller than its nearest competitor. It is a great architectural and engineering accomplishment that is inspiring for the next generation of towers to come.

作者简介

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Aybars Asci毕业于哥伦比亚大学，获硕士学位。Aybars Asci在SOM工作期间，曾参与了世界各地设计的复杂机构和商业项目的设计，包括美国人口普查局总部、纽约证券交易所、纽约第五大道住宅楼、利雅德Al Rajhi银行总部，科威特Al Hamra塔，迪拜Al Sharq酒店大楼，多哈卡塔尔石油公司总部，伦敦Wood Wharf和墨西哥Anida住宅楼。Aybars Asci在2007~2008年担任SOM伦敦办公室的设计总监，目前在SOM纽约办公室工作。