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Guangzhou Finance Centre: An Elegant Simplicity of Form

广州国际金融中心：简约雅致的建筑形态

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Chris Wilkinson is a principal and founder of Wilkinson Eyre Architects. After working in a number of top UK practices, he set up Chris Wilkinson Architects in 1983, formed a partnership with Jim Eyre in 1987 and in 1999 established Wilkinson Eyre, which has developed into a leading award winning international architectural practice. He was director in charge of the CTBUH Award-winning Guangzhou International Finance Centre and has also led many of the practice's other UK and international projects in a diverse range of sectors.

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Abstract

The design for the Guangzhou International Finance Centre makes the case for a high rise aesthetic that aims for an elegant simplicity, but expresses the function, structure and construction in a clear way. The tower has 103 floors and reaches a height of 437.5m with a curved triangular plan. The external walls curve out from the ground to a maximum girth at approximately one third of the height, then taper to the top. The lower 69 floors are flexible office space and the upper 34 stories are Four Seasons Hotel with the reception on the 70th floor opening up to a central atrium. It is the tallest building incorporating a diagrid structure, which acts as an exoskeletal frame providing the rigidity to withstand horizontal wind forces and provides a visual contrast with the smooth curved form of the all glass cladding.

Keywords: Guangzhou International Finance Center, Elegant simplicity, Curved Trochoidal Triangular Shape, Tallest Diagrid Structure

摘要

广州国际金融中心的设计是一个雅致简约外观与简约功能、结构及施工相结合的案例。塔楼共103层，高437.5米，平面呈圆弧三角形。 在剖面上，外立面曲线从底层至约三分之一楼高处形成最大外围，然后向上尺寸逐步缩减。下面的69层设计为灵活的办公空间，上面的34层为四季酒店，其中包括在70层拥有挑高中庭的宏伟大堂。 这是运用菱形斜交网格结构最高的建筑，骨架式结构的刚度可抵御水平风力。同时与平滑曲面的玻璃幕墙造型相比形成强烈的视觉对比。

关键词：广州国际金融中心、雅致简约、圆弧三角造型、最高的斜网格架构

Guangzhou International Finance Center Case Study

This is the right time for high rise development and especially in China. Tall buildings have always been an expression of power and confidence, so it is inevitable that the expanding cities of mainland China should look towards high rise and super high rise development.

Towers provide extremely high density development, which takes the pressure off land shortages in central city areas, and they grace the skyline, offering a new and exciting identity. However, this only works with innovative and exciting Architecture. When a tower rises above the cityscape, it has a responsibility to make a positive contribution and a grouping of towers should make a visually acceptable composition.

The architecture of super high rise towers, however, is challenging. In some ways, it is an expression of the latest technology, but it also has symbolic overtones which relate to cultural aspirations. Examples such as the Jin Mao Tower in Shanghai and the Petronas Towers in Kuala Lumpur have used symbolic gestures to help them relate to their local context, but there is an argument suggesting that the super high rise towers should relate

广州国际金融中心案例分析

这是开发高层建筑的时代，尤其在中国。高层建筑往往代表着权利和信心，中国大陆城市化无疑会追求高层及超高层项目的开发。

建筑的极高密度开发可以解决城市中心区的用地压力，美化城市天际线，形成崭新迷人的城市地标。然而，这仅仅是关乎建筑风格的创新与兴奋。当一座大厦横空出世，它应考虑与周边环境的协调，建筑布局应确保视觉上的可接受性。

然而，超高层建筑仍具有挑战性。在某种程度上，它代表了最新科技，但同时又具有与文化愿景相关的象征意义。以上海的金茂大厦和吉隆坡的双子星塔为例，它们通过象征性符号与当地文化相联系，但有争议表示超高层建筑应更多地与国际环境相符。它们的建筑形态应以技术为基础，正如汽车或飞机考虑功能性审美而无需装饰；符合空气动力学的外形在处理水平风力所要求的型号和结构重量方面更有效。

该理论已获得证实：芝加哥和纽约早期建筑使用新型钢结构，同时使用高度装饰性的传统重砖石外墙。后期建筑因采用更轻质节能的现代幕墙系统而大为改观，开创了新型美学与国际文化相结合的建筑风格。

外墙系统也随着技术不断发展变化，为建

Figure 1. GIFC on the Guangzhou skyline
图1. 广州国际金融中心天际线

more to an international context. Their form would be technologically based like a car or an aeroplane which have a functional aesthetic without the need for embellishment; an aerodynamic shape being more efficient in terms of the size and weight of structure required to deal with horizontal wind forces.

This theory is born out by history, which reveals that whilst the early Chicago and New York towers used new framing construction for the structure, they retained highly decorated traditional heavy masonry cladding. The architecture of the later towers changed considerably with the introduction of modern curtain walling systems that offered more lightness and efficiency, and a new aesthetic relating to an international culture was created.

Cladding systems are also constantly evolving with technology and offering new possibilities for the design of towers. The decision on the amount of complexity or simplicity is down to architectural preference.

The design for the Guangzhou International Finance Centre (see Figure 1) makes the case for an aesthetic that aims for an elegant simplicity, but expresses the function, structure and components of construction in a clear and direct way.

The project was won in an international competition held by the City Planners in 2004 for a mixed use development of approximately 450,000 m^2, to include a tower of 235,000 m^2 on the Zhujiang New Town site in Guangzhou. This was part of a strategic masterplan to consolidate a new civic and financial center around a grand central park developed for the 2010 Asian Games.

Wilkinson Eyre Architects was appointed by the Yuexiu Property Group as architects for the development, along with Arup HK as engineers and the South China University Design Institute. The project started on site in December 2005.

On a site area of 31,000 m^2, the development includes a retail mall, conference center and serviced apartments in a podium together with a tower containing offices and hotel (see Figure 2).

The tower, which has 103 floors, reaches a height of 437.5 meters making it the fourth tallest building in China and the ninth tallest building in the world at this time (see Figure 3). The upper 33 storeys are occupied by the Four Seasons Hotel, which has 374 rooms and a full height central atrium, rising from the grand reception on the 70th floor to a height of 115m, which is tall enough to accommodate the dome of St. Paul's Cathedral in London. The lower 69 floors accommodate a net 167,612m^2 of multi let office space arranged around a central core.

Figure 2. Site Plan
图2. 总平面图

筑设计提供新的可能性。或复杂或简约也仅取决于建筑风格的偏好。

广州国际金融中心（见图1）的设计是一个雅致简约外观与简约功能、结构及施工相结合的案例。

2004年，该项目赢得城市规划部门组织的国际竞标，作为45万平方米的综合开发项目，其中包括在广州珠江新城地块建设23.5万平方米的塔楼。这是战略性总体规划的一部分，以2010年广州亚运会的配套大型中央公园为中心，集中建设一处新的城市金融中心。

越秀投资有限公司邀请英国威尔金森·艾尔建筑事务所（Wilkinson Eyre Architects）与奥雅纳（Arup）及中南大学设计院组成的团队共同完成广州国际金融中心的设计方案。该项目于2005年12月启动。

项目占地3.1万平方米，由主楼和裙楼组成，裙楼包括商业中心、会议中心、酒店式公寓；主楼包括办公和酒店功能（见图2）。

广州国际金融中心共103层，高437.5米，是当时中国第四大高楼

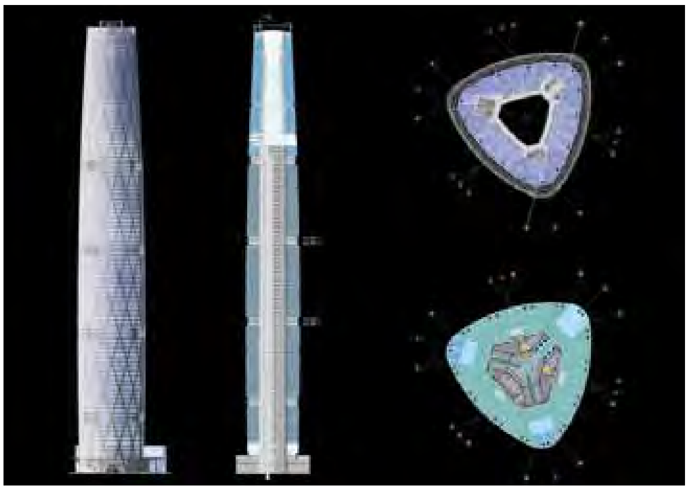

Figure 3. Section, Elevation and Plans
图3. 平面图、立面图及剖面图

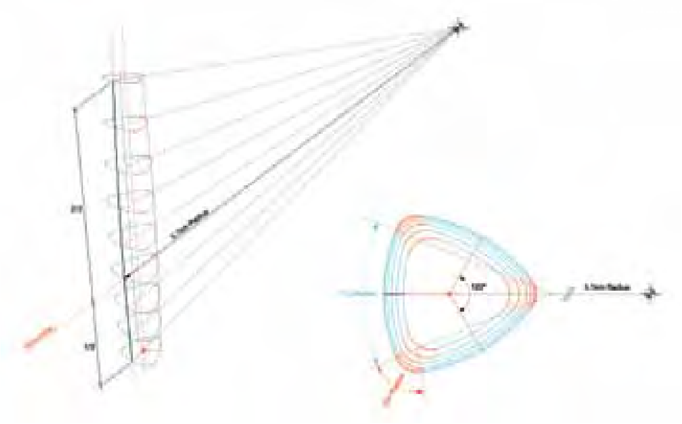

Figure 4. Geometry
图4. 建筑造型

The plan, which is a curved trochoidal triangular shape, was developed to deal efficiently with external wind forces, as well as providing a flexible arrangement for incremental letting. In section, the external walls curve out from the ground floor to a maximum girth at approximately one third of the height, then taper gently to the top where they merge with the sky.

The resultant form looks deceptively simple (see Figure 4) but is based on a complex toroidal geometry, with each of the three facades set out on a radius of 5.1 kilometers vertically and with a radius of 71 meters in plan and 10 meters on the corners. These design refinements were determined by the use of rapid prototyping physical models as well as computer modeling with the aim to achieve an elegant simplicity of form, which gives it a strong identity. The building's shape is emphasized by the smooth glass cladding, which is made up from 1.5 meter wide repetitive, floor high glass panels, which are narrower on the tighter radius corners. A considerable time was put into achieving standardization in order to keep the costs down. With a surface area of 80,000m^2 it would be prohibitively expensive to incorporate too many special size panels, and through an analytical design process, 90% repetition was achieved with four standard panel sizes (see Figure 5)

The cladding was designed as a ventilated double skin with interstitial louvres for energy efficiency, but this was omitted during construction for cost reasons. A unitary system of high performance glass was selected in its place and care was taken to ensure that sufficient transparency was achieved to allow the structural diagrid to be clearly seen through it.

Another distinguishing feature, on the otherwise plain curtain walling system, is the double floor horizontal bands of the refuge and intermediate plant floors, which have a different glazing module with a hit and miss arrangement to allow for ventilation. At the very top, the glazing continues beyond the uppermost floor to give the appearance of fading into the sky (see Figure 6). There is no spire or projecting mast because of the helicopter landing pad, which was requested by the Fire Officer as part of the evacuation strategy. Being a surprising addition to a super high rise tower, the helicopter landing pad has been designed as a sculptural element that hangs out over the top glazing.

The diamond shaped diagrid structure provides a strong visual contrast to the smooth curved form of the glazing (see Figure 7). Structurally, it acts as an exoskeletal frame which provides the rigidity to withstand the horizontal wind forces, in place of the more normal heavy outrigger column structures. Guangzhou IFC is the tallest building

Figure 5. Cladding
图5. 外立面

和世界第九大高楼（见图3）。33层以上为四季酒店，包括374间客房和一个位于70层的宏伟大堂至115米高度的挑高中庭，其高度足以容纳伦敦圣保罗大教堂的圆顶。下面的69层容纳净面积167,612m^2的围绕核心筒布局的多租户办公区。

主体建筑平面为圆弧三角形，有效抵御强风侵袭，同时提供办公空间的灵活布局。在剖面上，外立面曲线从底层至约三分之一楼高处形成最大外围，然后向上尺寸逐步缩减，形成直入云霄的纺锤外形。

整个建筑外立面简洁典雅（见图4），以复杂的曲面造型为基础，三个外立面各垂直半径5.1KM、平面半径71m、转角半径10m。为了得到精美典雅的建筑效果，设计深化采用快速成型实体模型及计算机建模，打造新的城市名片。光滑玻璃幕墙更加突出了建筑造型，玻璃幕墙重复使用1.5米宽、落地玻璃板（半径较小的转角处宽度变小）。为了降低成本，投入了大量时间形成规格化。对于表面积为8万平米的建筑，如果使用太多特殊尺寸玻璃将造成成本过高，通过设计分析，90%重复使用四种标配尺寸的玻璃板（见图5）。

为了节能考虑，幕墙原本设计为通风双层透光百叶栅格，但由于施工成本高而放弃使用。考虑采用高性能的单元式玻璃幕墙确保可见斜网格结构的足够通透性。

另一个设计特色：另外的平面幕墙系统是一系列双层水平避难层和中间设备层， 采用不同的玻璃模块提供随意的通风设计。在塔顶，玻璃幕墙超越顶部继续向上，让塔顶渐渐消失于天空中（见图6）。由于消防疏散要求设置了直升机停机坪，而没有突出

Figure 6. Roof and Atrium
图6. 屋顶与中庭

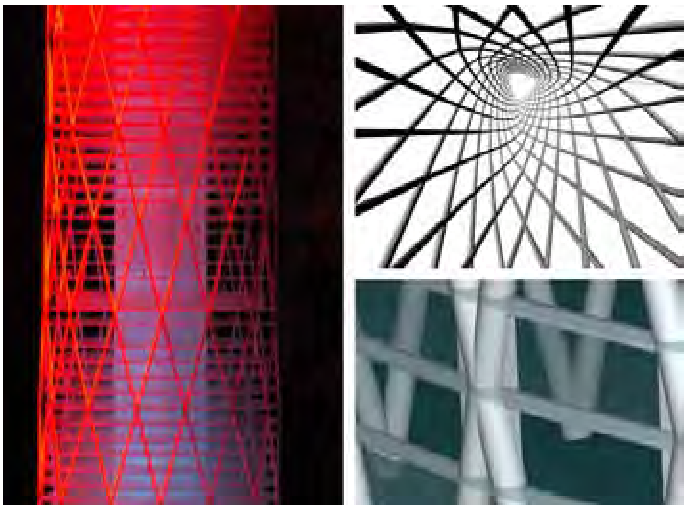

Figure 7. Diagrid
图7. 斜交网格结构

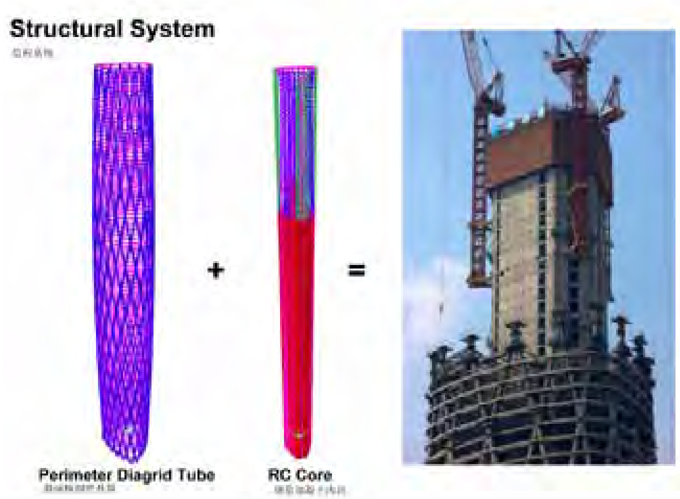

Figure 8. Structural System
图8. 结构系统

where this form of structure has been used and the major benefits it offers are rigidity and flexibility. There has been no need for dampers to reduce horizontal movement and the flexibility has facilitated the large central atrium without any additional major bracing structure.

The diagrid, combined with central core, provides both gravity and lateral resistance (see Figure 8). It is also a good arrangement for seismic design. The diagrid system behaves as an external tube which is fully braced, so that most of the forces are transferred by axial force which makes it more efficient than a moment type frame. The geometry was also developed for efficiency and visual appearance, which has resulted in a 'giant order' of diamonds, 54m tall, spanning between twelve office floors and sixteen hotel floors.

For efficiency and ease of construction, the frame is a composite structure of concrete filled steel tubes. The joints extend between two floors and node out on the horizontal floor structure. Tube sizes are 2m diameter at the lower levels, and reduce to 1.1 meter diameter at the upper levels. They look huge close up but appear quite modest within the overall scale of the building.

The central core, which serves the offices, was constructed in reinforced concrete with a climbform system. Its shape was determined by the lift configuration and the briefing requirement to provide flexible access for multiple letting of the office space.

Altogether there are 71 lifts in the building, of which 52 serve the office floor, 15 serve the hotel and four for the carpark (see Figure 9). A central triangular core arrangement contains nine double decker high speed lifts which serve the key refuge floors from which local lifts connect to the intermediate floors. This system provides fast and convenient access from the ground floor reception to the individual office floors. Two stairs provide means of escape and these are lobbied at each refuge floor. Toilets for each office floor are designed to make use of the vacant spaces between local lift shafts where they tail off and adequate space has been provided for vertical services risers.

Through careful planning of the core, an average net to gross ratio of 70% has been achieved for the office floors and 68.9% over all (see Figure 10). Flexibility is important and the plan shape works well as a single office let on each floor or alternatively it divides easily into three distinct areas, each with its own access to the central core. There is potential for an open plan layout or for subdivision into cellular spaces served by a corridor around the circumference of the core.

Evacuation is also an important factor in the design and computer

塔尖。作为超高层建筑的令人惊叹的附属结构，直升机停机坪构成了悬出于塔顶玻璃幕墙的具有雕塑感的设计元素。

与平滑曲面的玻璃幕墙造型相比，菱形斜交网格结构（见图7）形成强烈的视觉对比。骨架式结构的刚度可抵御水平风力，取代常规伸臂桁架的重质结构。广州国际金融中心是采用该结构的最高建筑，该结构的主要优势是提供刚度和灵活性。无需使用阻尼器减小水平位移，结构的灵活性无需更多主要支撑结构即可满足大中庭的设计要求。

斜交网格结构结合中央核心筒可抵抗重力和侧向受力（见图8），抗震能力强。钢筋混凝土的斜交网格外筒结构使大部分受力通过轴向载荷转移，该结构比抗弯框架更高效。考虑到节能和视觉效果，设计了巨大钻石形结构，高54米，横跨12层办公和16层酒店区。

为了方便施工，采用钢管混凝土复合结构。连接点延伸至两层之间，节点伸到水平楼板结构上。底端钢管直径2米，上部钢管直径减小至1.1米。呈现出巨大的收拢形态，同时在建筑的整体体量上又显得相当适度。

中央核心筒用作办公区，采用带爬模平台系统的钢筋混凝土结构。根据电梯配置以及灵活进出多租户办公区的要求确定了核心筒形状。

整个建筑供设置71部电梯，其中52部用于办公层、15部用于酒店、4部用于停车场（见图9）。中央三角形核心筒布局包括9部

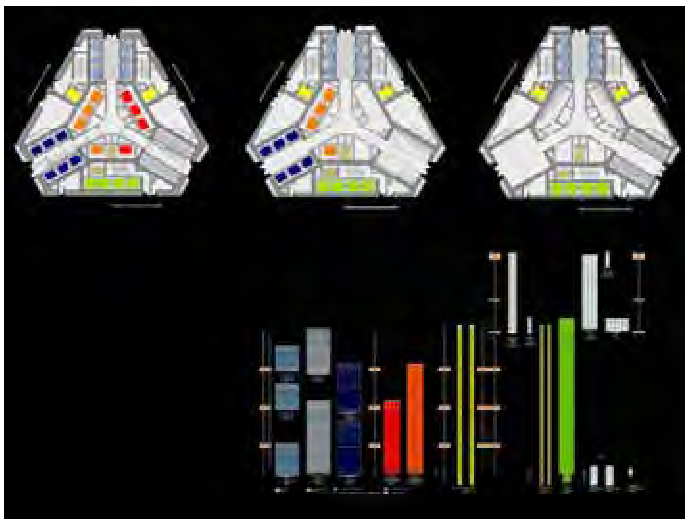

Figure 9. Lifts & Cores
图9. 电梯及核心筒

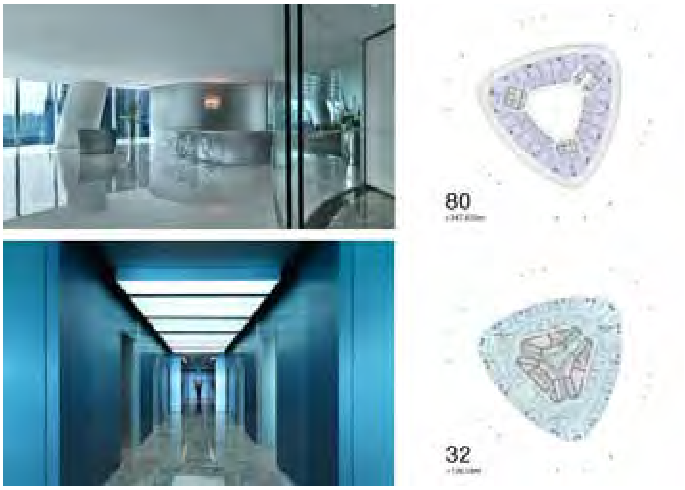

Figure 10. Floor Layouts
图10. 各层布局图

modeling was used to achieve an efficient strategy with a maximum evacuation time of 1 hour 35 minutes. Two escape stairs connect each refuge floor. There is also the potential for the upper floors to escape upwards to the rooftop helicopter landing pad.

The Guangzhou IFC aims to be a low carbon and sustainable building. The main HVAC is provided with a Variable Air Volume System, served from the intermediate double height plantrooms which draw air from the perimeter. Waste heat from a heat recovery chiller is used to preheat the domestic water for the hotel. Partial free cooling is used for the typical office floors during transient periods and computational cooling load and energy analysis has been conducted to optimize the chiller plant.

The main building construction was carried out between 2006 and 2010, with fitting out continuing through 2011 for the offices and hotel (see Figure 11). Although some difficulties were experienced at first in the setting out of the diagrid structure, once these were overcome, the construction proceeded in sequence according to plan with the core, floor and diagrid structure together with the curtain walling

The completed building looks almost exactly like the early computer renderings, produced at the competition stage, so there have been no surprises (see Figure 12). It stands out on the Guangzhou skyline as a super tall tower with an elegantly curved shape clad with a smooth glazed skin, which is visually enriched by the appearance of the diagrid structure behind. Architecturally, it is distinguished by its purity of form and the clear expression of its function and materials of construction.

Figure 11. Construction
图11. 施工

Figure 12. Day and Night
图12. 日景与夜景

双层高速电梯，服务于主要避难层，该处部分电梯可换乘至中间楼层。该系统提供从底层大厅至各楼层的便捷交通。提供两个逃生通道，各避难层设置大厅。利用局部电梯井之间的闲置空间（电梯井在此处变小，可供服务立管提供足够空间）提供各办公层的卫生间。

通过对核心筒的精心规划，办公层实现70%的平均净/毛面积比，总体为68.9%（见图10）。各层平面可提供独立的办公租赁区；或灵活划分为3个不同区域，并分别与中央核心筒相连。可开放布局或通过核心筒外围走廊划分单元空间。

消防疏散是设计的重要内容，通过计算机建模获得有效疏散策略，使疏散时间不超过1小时35分钟。两个逃生与各避难层相连。同时预留向上逃生至楼顶直升机停机坪的通道。

广州国际金融中心的目标是提供低碳可持续性的建筑设计。使用变风量暖通系统，通过中间挑高机电室从周边送风。热回收冷却装置产生的余热用于酒店生活热水。标准办公层采用局部瞬态自然冷却，通过计算机冷载荷及冷源分析优化制冷设备。

2006年至2010年完成建筑主体施工，办公及酒店装修持续到2011年（见图11）。尽管斜交网格结构施工初期曾遇到一些困难，而一旦这些问题得到解决，施工还是按照核心筒、楼层、斜交网格结构以及幕墙的顺序逐步进行。

建筑完工后的外形毫无意外的与当初竞标阶段的计算机效果图几乎完全一致（见图12）。它成了广州城市天际线中引入注目的超高层建筑，光滑玻璃外表皮的曲面形态，营造出高雅气质；内在的斜交网格结构使外观效果更加丰富。从建筑上来说，简洁明快的建筑形态、功能表达以及建筑材料成就了其独特的建筑风格。