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多学科背景下的高层建筑与可持续城市发展最新成果汇总

Editors (编者): Antony Wood, Shiling Zheng (郑时龄) & Timothy Johnson

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Rethinking the Skyscraper

重新思考摩天大楼

Rethinking the Skyscraper in the Ecological Age: Design Principles for a New High-Rise Vernacular

反思迈向生态的摩天大厦: 实现新高层建筑地域性的设计原则

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安东尼•伍德 博士，自2006年起担任CTBUH执行理事，负责学会的日常运作。他同时也是芝加哥伊利诺理工大学建筑学院研究副教授和上海同济大学的客座教授，其专业领域是高层建筑设计，尤精于可持续设计。到芝加哥工作前，他曾在香港、曼谷、雅加达、吉隆坡及伦敦等地任建筑师，他的博士论文从多个学科的角度探讨了摩天大楼之间的空中桥廊连接问题。

Abstract

This paper investigates tall buildings from an aesthetic and social, as well as commercial and environmental, viewpoint; as contributing elements in the fabric of a city. Against a backdrop of the large-scale homogenization of cities architecturally around the world, the paper suggests ten design principles which, if adopted in skyscraper design, could result in tall buildings which are more appropriate to the place in which they are located – physically, environmentally, culturally, socially and economically. In doing this, it promotes the need for a new vernacular for the skyscraper in each region of the world, and suggests this would have significant ecological, as well as social, benefits.

Keywords: Tall Buildings; Ecological; Social; Aesthetic; Design Principles; Vernacular

摘要

本文从美学、社会学、商业和环境视角研究高层建筑这一城市肌理的构成要素。在世界各地城市建筑大规模同质化的背景下，本文提出十大设计原则。如果在摩天大厦的设计采用这些原则，可使其不论是在物质环境层面，还是在文化社会和经济层面更契合所在环境。由此推动世界各地的摩天大厦设计对一种新的地域性的追求，并继而带来显著的生态及社会效益。

关键词: 高层建筑; 生态; 社会; 美学; 设计原则; 本土性

Are we there yet?

Though we have seen major advances in the technologies, efficiencies and performance of tall buildings over the past couple of decades (Parker & Wood, 2013), arguably the urban expression of the typical skyscraper has not changed much from the predominant glass-and-steel aesthetic championed by Modernism in the 1950s. The architectural details have become much more refined since then, and certainly both materials and systems perform much better than a half century ago, but the rectilinear, air-conditioned, glass-skinned box is still the main template for the majority of tall buildings being developed around the world. Many of these boxes vary with how they meet both ground and sky, but they are part of a globalized expression.

There is, of course, a smaller group of ever-more adventurous sculptural forms[1] that have come to the forefront alongside the more commercially-inclined boxes over the past decade or two (defined by the focus of the CTBUH 2006 Conference as "Tapered, Tilted, Twisted", with a tongue-in-cheek "Tortured" added posthumously – see Wood, 2007). But, in both the "box" and the "sculptural" approach, the relationship between the

我们做到了吗?

虽然我们已经看到，在过去的几十年中高层建筑的技术、效率和性能取得了重大进展 (Parker & Wood，2013)，但是代表城市面貌的典型高层建筑并没有在20世纪50年代现代主义所倡导的以玻璃和钢为主导的美学定义之后发生太大改变。自20世纪50年代之后，虽然建筑细部变得更加精致，材料和系统性能相比半个世纪前也获得了很大提升，但其直线型的，带空调的及玻璃立面的建筑仍成为全球大多数高层建筑建设的主要模板。虽然很多方盒子在底部以及顶部会有些变化，但仍然摆脱不了国际式的桎梏。

当然，在过去十年到二十年间，伴随着满足商业性需求的方盒子建筑的发展，还是出现了一少部分更加先锋的雕塑般形态的建筑[1] (在主题为"锥形的，倾斜的，扭曲的"CTBUH 2006年会议后，这样的形式被戏剧化地定义为"受虐的"形态——详见见伍德，2007) 。但是，无论是在"方盒子"还是"雕塑式"的手法下，建筑物与场地的关系要么是实现单一的商业功能，要么是单一的视觉功能。因此，这些建筑大多与其所栖居的环境特征毫无关联——不论是在物质形态方面，文化方面，环境方面，抑或是社会方面。

Figure 1. Cities of the world are becoming culturally and aesthetically homogenized, with skylines that become synonymous with the place, but are not necessarily related to the culture or climate. Skylines from top: Warsaw, Miami, Melbourne. (images copyright Filip Bramorski, UpstateNYer, Cazz)

图1: 随着天际线成为当地的代名词 (与文化或气候不一定有关联)，全球的城市在文化与审美上变得越来越同质化。自上而下的天际线图: 华沙、迈阿密墨尔本。(版权所有: Filip Bramorski, UpstateNYer, Cazz)

building and its location is predominantly either a commercial one or a visual one. Thus these buildings are largely divorced from the specifics of the place they inhabit – physically, culturally, environmentally and, often, socially too. For hundreds, and in some cases thousands, of years the vernacular architecture in many of today's tall building cities had to be intrinsically tied into its location – for its materials, its ventilation, its ability to function within a given climate and culture – but this was largely rejected in the Modernist belief in a "universal architecture", which transcended mere "context" and worked on a higher philosophical plane.

The consequence of this was, and still is, the aesthetic homogenization (and, arguably, cultural homogenization) of cities around the world – a force that has gathered pace exponentially over the past two decades, with the easier flow of capital, labor, goods – and architectural models – that now ensues. Now a "progressive" city is largely defined by its set of skyscraper icons (see Figure 1), but the association is largely "synonymous" rather than "indigenous" – the same set of icons would

在数百年中 (某些例子甚至有几千年的历史)，在当代很多拥有高层建筑的城市中，地域性高层建筑与其所在的地方是在本质上契合的——其在材料、通风、功能性上能都充分考虑了当地的气候和文化——而这些被现代主义所信奉的"国际式建筑"否定了。这样的地域性不仅仅是在考虑与"文脉"对应，而是上升到一个更高的哲学层面。

这带来的后果是世界各地城市审美的同质化 (或者说文化的同质化)，而且这种影响还在继续——这种趋势在过去二十年里由于资本、劳动力、商品流通的加速而呈指数化地增长，而现在轮到了建筑产品。现在，一个城市的"先进"与否在很大程度上取决于是否有一组标志性的高层建筑 (见图1)，但这却让城市变得"同质化"，而不具有"本土性"——这些建筑如果放在世界其它城市中效果也是相同的。这些模式被快速地传播和复制。

当然，谈论这类建筑类型的"本土性"是十分困难的，因为毕竟它只不过只有一百三十多年的历史，最早从北美发展，而如今几乎已经遍布全球。无论是本土性和地域性都暗示与当地文化的长久

1: The question of what has inspired this recent diversification of approaches to building form, and whether they can be justified in energy/carbon terms, is a valid one that needs to become a more essential part of the industry's dialogue. The sustainability discussion in recent years has been focused almost exclusively on operating energy which, while vitally important, has resulted in the neglect of a sufficient discussion of embodied energy in building construction. Even the very definition of "net-zero energy" seems to omit the materials and construction process entirely. Numerous exemplar tall buildings have recently made great strides in the reduction of operating energy. However, the energy expended to create building forms in the first place is by no means constant across buildings, with iconic-sculptural forms clearly requiring more material gymnastics (and hence more carbon) to deliver the same quantity of floor area as a more regular form. But there is another side also to this equation: that of a building's greater contribution to society beyond delivering maximum floor area with the minimum energy/carbon expenditure. What do iconic-sculptural forms bring to our cities in terms of beauty or impact on urbanity and the human senses? Do we want to live in a world full of ultra-energy-and cost-efficient but rather dull boxes? What about the impact on social sustainability and urban diversity and a whole range of other, less-quantifiable aspects of "sustainability"? Like with all things, there will be an optimal balance point in this equation, but the debate thus far, for obvious reasons, has been focused on quantifiable metrics rather than subjective questions.

1:是什么激发了近来建筑形式的多样化? 以及它们是否具有合理的能耗和碳排放? 这些都是需要成为行业对话关注的合理议题，重要组成部分。近年来讨论对可持续性的讨论几乎完全集中在其运行能耗方面，虽然这是非常重要的，但是对此的过度关注导致了对建筑建筑构造物化能的忽视。即使是"零耗能"的定义其本身也似乎完全忽略了材料和施工工艺部分消耗的能量。近来，许多作为典范的高层建筑其运作耗能的减少方面取得了长足的进步。然而，消耗额外的能量消耗来创建建筑形式首先就绝不是可持续的建筑物，标志性的，具有雕塑形态的建筑形式显然需要使用更多材料 (因此具有更大的碳排放量)，相比于普通形式的建筑，为了提供的面积。然后，另外一个方面也会影响最终耗能计算: 即建筑物以最小能量/碳排放提供最大面积而对社会的贡献。标志性雕塑形式的建筑带给我们城市美景带来了何种积极的影响，或如何影响对城市风格和人感知? 我们是否希望生活在一个充满能量并极具成本效益的世界，而是无聊乏味的放盒子里? 对社会的可持续发展和城市的多样性和"可持续性"等方面有何影响，而在"可持续性"不可测量的方面又有什么作用? 像世界上其他的事物一样，会存在解决这些问题的最佳平衡点，但争论至今仍然一直专注于可量化的指标而不是主观的问题，造成这种现象的原因是显而易见的。

largely become just as synonymous with other cities around the world if they were placed there. The models are thus readily transportable.

Of course it is difficult to talk about "indigenousness" in a building type which has only 130 years of history, and which has now spread from its North American roots to encompass almost the entire world. Both the words *indigenous* and *vernacular* imply a long-standing connection with a culture, so how can a relative typological newcomer be even considered in such terms? The answer, of course, is that we need to consider the future, and how the tall buildings being built today will reflect their culture and setting in 100 or 200 years from now (after all, many of them will still be around for that time by default; the industry has yet to constructively dismantle/demolish a building over 200 meters in height, let alone the 1,000-meter heights we are starting to see today). Thus the buildings we are realizing today will become the vernacular of a place tomorrow – a huge responsibility.

There is an argument, of course, that these commercial or sculptural forms are indeed a pure reflection of the finance-oriented and image-obsessed global culture of today, but I believe passionately that we need to find an alternative to this homogenization of cities and culture; the homogenization of expression; the homogenization of the urban experience. It is the differences between places that make them interesting, not the things that are identical, and there is most definitely a path to be charted between commercial return, iconicity and an indigenous approach to the skyscraper that varies physically, aesthetically and programmatically throughout the world. It is only when a building maximizes the potential of its connection with local climate and culture that it can be truly classed as "sustainable" in all facets of that word, including the ecological aspects. Tall buildings are a vital part of the future for creating more sustainable patterns of life – largely through their concentration of people, space, land use, infrastructure and resources – but in many ways they are only several small steps along the huge path they need to traverse to become truly sustainable, and to become positive contributors to the cities they inhabit. There are still far too many question marks hanging over the typology – on ecological, social and cultural grounds (Wood, 2008).

This paper thus outlines 10 design principles which the author believes would result in tall buildings much more related to their locations; a local-specific approach to skyscrapers, as opposed to the adoption of a global template. It uses built examples to illustrate the points made and, in some cases, some of the work developed by the author as an architectural professor at various institutes, working together with students. The 10 design principles are not intended to be approached in isolation. Perhaps the very best buildings would embrace all 10 principles, though some might not be possible in certain locales. Ultimately the intention is to inspire a *regionalist*[2] approach to tall building design, where skyscrapers in Shanghai function every bit as well as those in Seattle or Sydney in commercial and energy terms, but that feel part of a local vernacular, a local response.

It should be stated at the outset that the path to this is not, in the author's view, through using historical vernacular forms in a *literal* sense (e.g., pagoda as tall building – see Wood, 2005). But neither is it in an *abstract* way either (e.g., local philosophy inspires form or

关联，所以在一般情况下建造一座新的建筑该如果考虑这些因素呢在？当然，答案是——我们必须充分考虑未来的影响，今天正在修建的高层建筑将怎样影响一百或二百年内的文化和环境（毕竟，其中很多建筑仍然会在该时间段内持续存在，这个行业还没有拆除过高度200米以上的建筑，更不用说拆除即将出现的1000米的高建筑了）。因此，我们今天所建造的建筑将成为未来当地的本土性要素——为此，责任是巨大的。

当然也有一种说法认为，这些商业性或雕塑般的形式的确是当今经济导向和图像痴迷的全球文化的一种真实写照。但我坚信，我们需要找到新的方式来改变这种城市和文化的同质化、表达方式的同质化、城市体验的同质化。是不同地方之间的差异性（而不是相同性）使得建筑变得有趣，一定存在某种方式能够在摩天大楼的商业回报、标志性和本土性之间找寻到一个平衡点，在世界的不同地方体现出不一样的物质形态、审美导向和组织方式。只有当一个建筑物最大化地融入当地的气候和文化中，它才能真正地在各个层面上达到"可持续性"，包括生态要素。高层建筑是未来创造更可持续生活模式的重要组成部分——主要是通过人、空间、土地利用、基础设施和资源的集中——但在许多层面，它们还仅仅是在实现真正可持续的道路上前进了几小步，距离成为其所在城市的积极贡献者的目标还有很大的差距。这一建筑类型在生态、社会和文化方面仍然存在很多问题（伍德，2008）。

本文由此概述了十个设计原则。作者认为这些原则的应用能使高层建筑与其所在的地理环境产生更紧密的联系；这是一种关注地域特征的高层建筑设计手法，而不是套用全球性通用的模式。本文为阐述这些观点介绍了一些建成的建筑实例，以及作者在不同学校担任建筑设计教授时与学生一起完成的设计成果。这十个设计原则应当是相互结合应用的，而非单一地分别使用。也许最好的高层建筑设计满足所有的十项原则，虽然有些原则可能无法在特定的环境中实现。最终目的是要鼓励使用关注地域性[2]的方法来进行高层建筑设计，这样上海、西雅图或者悉尼的高层建筑在商业功能和能耗表现方面即使是相同的，但它们也都对各自的地域性特征予以一个恰当的回应。

在作者看来，应该最初就说明的是，实现上述目标并不是原样照搬那些历史悠久的本土形式（如宝塔状高层建筑——伍德，2005）。但也不是以抽象的方式（例如将当地哲学理念转化为建筑形式或者布局形状）—— 尽管这两种方法都有效地摆脱了标准的国际式建筑形式。我们所要追求的是以直接和实际的方法来回应一系列的当地条件，而这正是几千年来乡土建筑演进的基础。

设计原则一
高层建筑应与地方性的物质特征相联系

几乎所有的城市都有物质遗产，一个"引人注目的基础设施"——如街道、场所、城市轴线、建筑物、古迹，及其他载体。摩天大楼——虽然在尺度上可能会矮化这些现有元素，但仍旧应该通过延伸的流线到达并穿越基地的方式尊重这些"城市宝藏"，可以让附近的重要古迹来影响建筑物的形式或表达，通过用建筑形体的塑造方式尊重重要的景观廊道。一个很好的例子是伦敦肉类市场大街122号大厦（见图2），建筑采用倾斜的形式，以避免对基地东侧圣保罗大教堂和现有市级圣安德鲁安德谢夫教堂的视线遮挡。在某些情况下，现存的城市遗产可能会影响到高层建筑的形态，例如摩天大楼变成一个历史遗迹的背景或是相框。

2: The term Regionalism, in the context of this paper, is best described by Robert Powell: *"Regionalism is not simply the nostalgic privileging of the vernacular form, but a synthesis of the vernacular with modernism. It is a way of thinking about architecture which is culturally regenerative – not a style, but a search for a cultural continuity… It implies the embracing of modernism whilst simultaneously maintaining links with traditional forms and practices"* (Powell, 1993)

2:"地域主义"这个术语，在本文的语境中，罗伯特•鲍威尔给出了下列最好的阐释："地域主义不是简单给予乡土形式特权，而是一种乡土性与现代性的综合。是一种对建筑文化再生的思考方式，——不是一种风格，而是寻求一种文化的延续的方式……这意味着既包容现代主义，而同时保持了对传统形式和实践的联系"（鲍威尔，1993）

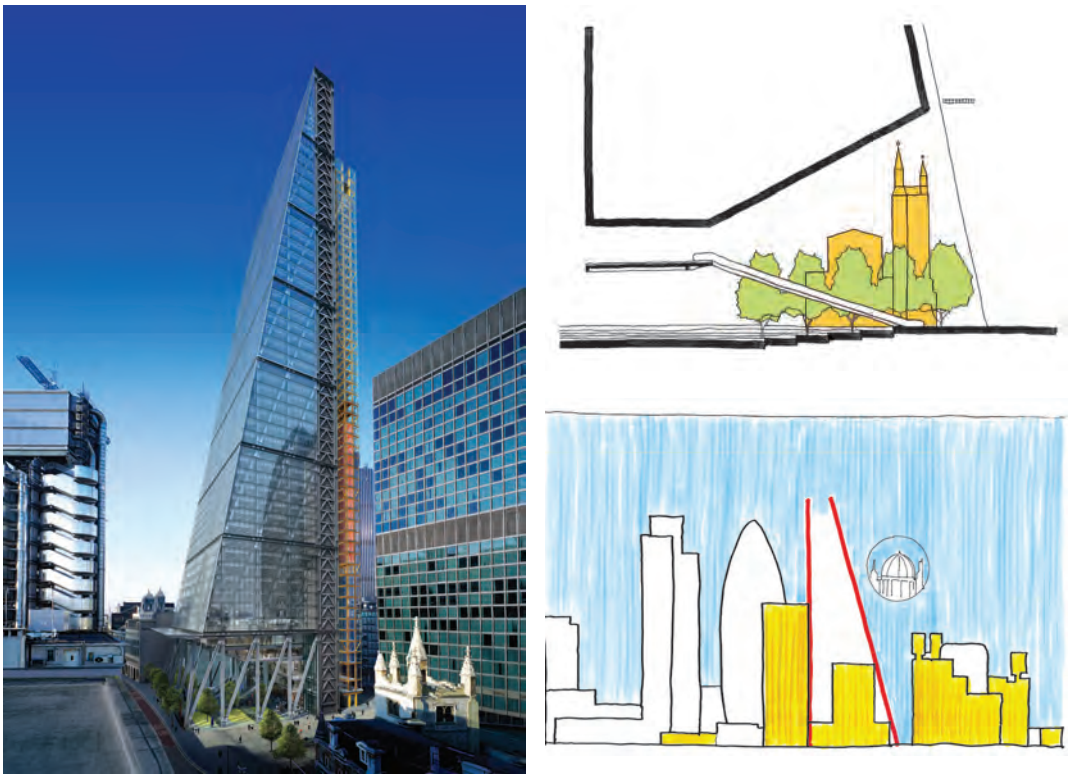

Figure 2. Tall Buildings should respect the existing built legacy, and relate to it where possible. The sloping form of the 122 Leadenhall Building London (2014) came about as a response to not blocking views to/from both St Paul's Cathedral and the St Andrew Undershaft church to the east of the site. Copyright: Rogers Stirk Harbour + Partners

图2: 高层建筑应尊重现有的建成遗产，已及与当地存在可能的关联性。伦敦122兰特荷大厦设计成倾斜的建筑形式，为的是不阻碍通向和来自圣保罗大教堂的视线和以及从圣安德鲁教堂到基地东边的视线。版权所有: Rogers Stirk Harbour + Partners

geometry of plan) – though both of these approaches are a positive step away from a standard globalized architecture. The way forward is in the direct and very practical response to a set of local conditions, which is the very basis on which vernacular architecture has evolved for thousands of years.

Design Principle 1

Tall Buildings should relate to the physical characteristics of place

Virtually all cities have an existing physical legacy, an "evident built infrastructure" – streets, spaces, urban axes, buildings, monuments, other objects. The tall building – though potentially dwarfing many of these existing elements in scale – should respect and physically embrace this existing "urban grain" by extending circulation routes into and through the site, allowing important nearby monuments to impact the form or expression of the building , massing the form to respect important viewing corridors, etc. An example of this is the sloping form of the 122 Leadenhall Building London (see Figure 2), which came about so as to not block the views to both St. Paul's Cathedral and the existing Grade 1-listed St. Andrew Undershaft church to the east of the site. In some cases, built legacy in the low-rise realm might influence the form of the high-rise, for example with the skyscraper forming a backdrop or frame to an important monument.

Design Principle 2

Tall Buildings should relate to the environmental characteristics of place

This is considered perhaps the most important aspect of creating "sustainable" tall buildings, and the aspect which the Modernist

设计原则二

高层建筑应与当地环境特性相联系

这被认为是创造"可持续"的高层建筑最重要的方面，以及现代主义的"国际式"建筑被取代的最重要原因[3]。对于任何真正具有环境适应性的建筑，它不仅需要尊重当地气候的各个因素，并且应当最大限度地利用气候条件各方面的潜力。因此，要将太阳、光线、风、空气和雨水因素都纳入考虑范围，使其对建筑物的负面影响尽可能地小，或者所有这些元素不对建筑的正面性能产生反作用 (见图3)。

风和空气浮力应该用于自然通风，使所有的高层建筑不论其功能，都在一年的某些时段 (理想情况下是全年[4]) 内达到自然通风的效果。

太阳早已被运用于太阳能电池板中，但是更大的回报 来源于技术的结合，如将太阳能光热系统整合到一个高层建筑的外立面中 (特别是在像中东沙漠地带一样日光强烈的环境中)，或使用太阳能获取相变材料等。

风获取是高层建筑中一个有趣的现象。十多年前，世界上许多高层建筑均认为这是技术与高层建筑产生能量的最大潜力所在[5]，但迄今为止，我们只看到三座高层建筑实现了风力涡轮机的有效应用 (它们是2008年的巴林世界贸易中心，2010年的伦敦斯特塔拉大厦，以及2012年的广州珠江大厦)，而其中至少有两幢建筑物因反复出现问题而被媒体报道。因此，对于风能捕获和高层建筑是否是一个很好的组合的问题仍没有定论，而克服问题和改进规模经济的途径是必须的。在一些高层建筑顶部设置大型的"风电场"值得进一步研究。

在下雨的情况下，被许多如LEED一样的可持续发展评级系统奖励的雨水采集和回收，在大多数高层建筑中雨水收集的区域通常仅

"universal" architecture most displaced.[3] For any building to truly be environmental, it needs to not only respect all aspects of local climate, but should maximize the potential for using each aspect of climate within the building. Thus not only should sun, light, wind, air, and rain be considered so as to have as minimal negative effect on the building as possible; most if not all of these elements can be embraced into the building to positive effect (see Figure 3).

Wind and air buoyancy should be used for natural ventilation so that ALL tall buildings, irrespective of building function, should be naturally ventilated for at least part of the year (and ideally all of the year[4]).

Sun has long been embraced in the use of solar panels, but there are perhaps greater returns from incorporating technologies such as solar-thermal systems into the skin of a skyscraper (especially in intense solar environments like the deserts of the Middle East), or using solar energy capture for phase-change materials, etc.

Wind harvesting is an interesting phenomenon in tall buildings. Much of the tall building world thought this was the technology with the greatest potential for generating energy in skyscrapers a decade or so ago,[5] and yet to date we see only three tall buildings with significant wind turbines realized (2008 Bahrain World Trade Center, 2010 Strata Building, London, and 2012 Pearl River Tower, Guangzhou), and at least two of these with considerable problems reported. Thus, though the jury is still out on whether wind energy capture and tall buildings are a good mix, there must be ways of overcoming the problems and improving the economies of scale. Large-scale "wind farms" on the tops of some tall buildings are surely worthy of further investigation.

In the case of rain, many sustainability rating systems such as LEED now award points for rainwater capture and recycling but, in the case of most tall buildings, the area of capture is usually only a part of the tower roof or podium roof. In the context of skyscraper forms, however, the roof is a negligible area in comparison to the façade, especially when one considers that rain at height does not fall vertically but is typically driven in a horizontal plane by wind. Thus perhaps the true potential of rainwater capture is in the façade and not the roof, and this could become a strong influence on the form and aesthetics of some tall buildings.

Figure 3: Climatic elements are not only something to be mitigated in tall building design, but can become embraced for positive effect in both the form and operation of tall buildings; natural energy capture, natural ventilation, rainwater capture etc. The strategies and systems to enable this can influence the design and expression of the building. Pearl River Tower, Guangzhou (2013) demonstrates several of these ideas. Copyright: SOM

图3: 高层建筑不应仅仅在设计方面考虑气候要素，也要通过建筑形式与运营对气候产生积极影响，例如自然能量的收集、自然通风、雨水收集等。实现这些的策略与系统可以影响建筑设计和表达。广州珠江城大厦 (2013) 就实现了若干这样的想法。版权所有: SOM建筑事务所

限于塔楼屋顶或裙楼屋顶的一部分。而高层建筑的形式中，屋顶与建筑立面相比作用可以忽略不计，特别是当人们考虑到高空的降雨并不垂直而通常是由风力驱动而水平移动时。因此，也许雨水采集的真正潜力区域是在建筑立面部分，而不是屋顶区域，这可能对高层建筑的形式和审美的产生深远的影响。

设计原则三
高层建筑应与地方文化特色相联系

3: See Oldfield, Trabucco & Wood, 2009, for an interesting discussion on how policies and architectural trends have directly influenced the energy characteristics of tall buildings over the past 130 years.
3:见Oldfield，Trabucco & Wood，2009年，关于在近130年里，政策和建筑发展趋势如何直接影响了高层建筑的节能特性的有趣讨论。

4: It is only in the move away from "hybrid" ventilation systems (i.e. natural ventilation when conditions allow and mechanical ventilation when they don't) towards full natural ventilation that the mechanical systems – with their space, embodied energy and operating energy implications – can be removed entirely. Of course this means that occupants will need to tolerate greater variations in internal environment fluctuation than the narrow band of temperature and humidity conditions to which they have become accustomed through air conditioning, but this will need to happen with increasing climate change anyway (i.e. when energy consumption becomes a matter of survival rather than choice). Mankind will likely need to accept periods of "less than perfect" internal environmental conditions in both residential and office buildings, and adjust clothing – and possibly even working patterns – to suit. For more on natural ventilation in tall buildings, including a dozen or more modern skyscraper case studies that employ such techniques, see Wood & Salib, 2012.
4: 只有在摆脱"混合型"通风系统而转向空间中全自然通风的机械系统 (自然通风，即条件允许时可采用自然式通风，当条件不允许时采用机械通风方式) ——，如此一来，其物化能和运营耗能的影响可被完全消除。当然，这意味着使用者将需要忍受更大的室内温度变化和湿度条件，而这些变化使用者已经习惯于通过空调来调节，但是需要随气候变化发生 (即当耗能事关生存，无法选择时) 的问题。人类将有可能需要接受"不完美"内部空间的住宅和办公楼的环境条件，并调整衣着，甚至可能是工作模式，以适应室内气候变化。如欲了解更多十几个是采用这种自然通风技术的现代高层建筑信息，参见Wood & Salib，2012年。

5: This was largely because the science of wind energy capture was sound: power out of a wind turbine is the cube of the wind speed in. Thus doubling the speed increases power by a factor of 8, and wind speed increases with elevation above the plane of the earth generally, especially in cities when clearing the potential wind blocking by surrounding low rise buildings. However the other issues caused by wind turbines on tall buildings, amongst them vibration, noise, maintenance etc., has thrown a question mark over their use. Ultimately the energy out from such small-scale turbines takes years to justify the embodied energy in making the turbines in the first place, and many believe that the large turbines and reliable wind conditions of off-shore wind farms are a more productive way forward. The counter to this, of course, is that much of the energy is then lost in conveyance between point of origin and point of need (i.e. the city) and that it is not a case of either/or, but both – we need energy generation both "localized" in the city and through larger-scale installations outside the urban realm.
5: 主要的原因是能量捕获科学是合理的: 风电机组产生的能量与是风速的立方关系。因此，在地平面上风速增加一倍，功率增加至原来的8倍。而且一般来说，风速随着高度的增加而变大，尤其但城市清除周围低矮建筑物时同时清除了其潜对风的阻塞作用。但是高层建筑的风洞也会引起其它方面的问题，比如振动、噪声、维护方面，这对建筑的正常使用产生了影响。最终的总耗能量的计算，这种小规模的涡轮机所捕获的风能需要数年时间来平衡制造涡轮机本身的耗能，很多人认为，在可靠的风力条件下使用大型涡轮机和海上风电场是更高效的利用方式。在此部分能耗的计算中，当然，大部分能量丧失在其产生和消耗点 (即城市) 之间的传输阶段，但是这两种情况并不一定必然出现，我们需要能量产生的，无论是在城市还是通过城市领域之外更大规模的设备。

Figure 4: Tall Buildings can reflect the local culture in a literal way – as demonstrated here with the 1984 Dayabumi Complex in Kuala Lumpur with its façade a modern interpretation of the Islamic *jali* screen – or in a more direct way, by incorporating specific activities and ways of life into the program of the building. Copyright: Antony Wood

图4: 高层建筑可以直接反应当地的文化——1984年建成的吉隆坡Dayabumi综合体的外墙是对伊斯兰jali屏风的现代转译——或者以更直接地方式，将具体的活动和生活方式并入到建筑的功能。版权所有: Antony Wood

Design Principle 3

Tall Buildings should relate to the cultural characteristics of place

Whereas the physical and environmental aspects of place are more easy to define, the cultural aspects of place are less tangible. Culture is more connected with the patterns of life in a city, and how this manifests itself in the customs, activities and expressions of the people. Culture can thus be embraced in a *literal* way in the building, as demonstrated by the 1984 Dayabumi Complex in Kuala Lumpur (see Figure 4), with its Islamic outer façade skin an interpretation of the vernacular Jali screen (though this also has the significant added benefit of shielding the curtain wall behind from direct solar gain). Or it can happen by embracing an aspect of the culture directly into the building program. In 2010, for example, a student scheme we developed in Mumbai (Wood, 2010) was placed on the site of an existing *dhobi ghat;* the huge outdoor washing areas in Mumbai that account for 80% of the city's laundry. Rather than sweep this cottage industry aside in the knowledge that everyone would have a washing machine in the brave new world of Mumbai's future, the social housing tower that occupied the site brought this horizontal activity into the vertical world. Each permeable residential apartment was orientated around a terrace containing large washing vats, so that the residents could continue to take in the city's laundry. Further, the façade became the interface for drying the clothes – thus creating solar shade at far less embodied energy expense that the fixed shading systems of many modern towers. And the resulting aesthetic was very much an

具体场所的物质和环境特征都因有形而更容易进行定义，但文化是无形的。文化与一个城市的生活模式联系更为紧密，体现在传统风俗、活动和人们的情感中。文化可以以一种比较夸张的方式直接转译到建筑中，例如1984年吉隆坡Dayabumi综合体 (见图4)，以其伊斯兰风格的外立面作为对本国贾利屏的阐释 (虽然这也同时带来了一个显著的额外福利: 为其后面的玻璃幕墙遮蔽直射阳光) 。另外，也可以通过将文化的影响直接注入建筑物。以2010年我们在孟买的一个学生设计为例，这个项目位于一个现存的 (伍德，2010) dhobi ghat——孟买的室外洗衣场，这里解决了整个城市80%洗衣服务。我们并没有武断地假定未来的孟买每个人都将有一台洗衣机，而将这些家庭手工业清除掉。相反的，而是在基地上建造了一个新的社会住宅塔楼，将水平活动聚集到垂直的空间中。每一套公寓都围绕一个放置着大型洗涤桶的露台展开，这样居民能继续为这个城市提供洗涤服务。此外，立面成为烘干衣物的界面—— 并顺带为建筑提供遮阳，如此一来节省了很多现代塔楼安装固定遮阳系统所花的费用。同时，由此产生的美感是本土文化的一种诠释，毫不夸张地说，建筑拥有了一个衣服立面 (任何熟悉的亚洲公寓楼的人都知道，这就是大多数时候建筑物的面貌!) 。

设计原则四

建筑的不同高度在形式、肌理和功能上的差别

高层建筑不应该是一个有效平面的重复垂直堆砌，而要随高度的变化采用与其适应的形式、功能和表现形式。无论是在物质层面还是环境层面，这种差异在形式上应当被城市所激发。一座高层建筑和一栋小型建筑之间的主要区别是，后者只与它的直接相邻的基地有直接的视觉关系，而高层建筑可能与城市中许多较远的地方形成视觉联系，在不同的视野中呈现其形式。这种与其他直接可视区域 (和其他建筑物) 形成的对话，可以帮助建筑得到变化的形式使建筑进一步融入其周边环境中。此外，业内现在认识到气候将随高度的变化而发生显著变化，所以当今一些正在建造的高层建筑的惊人高度实际上意味着，我们正在设计一个跨多个气候带的高大建筑物 (见图5)。例如，据报道，在迪拜哈利法塔建筑物顶部外部空气温度比底部温度低大概6-8摄氏度，所以这中间的差异可能体现在形式、外观、系统、甚至功能分区方面。

高层建筑应该是多个社区的堆叠，这些社区取决于其所处"水平面"的可能性以及在气候和物理上与城市的关系，而不是将地面层重复机械地堆砌。这可以体现在建筑的形体及功能上，并且整个建筑的外立面和材质上，也要根据不同高度层所具有的不同视觉效应做出不同的处理。水电和其他系统也将有所不同 (至少是进气口应该安置在塔的顶部，利用这几度天然的温差) 。尺度的概念应被引入到整个高层建筑的设计中，高层应该被认为是 (并据此设计) 数个建筑上下堆叠形成的一个整体结构、系统和美学框架，而不是由一个平面拉伸形成的单一形式。

设计原则五

最大限度地发挥所有系统和材料层的作用

高层建筑的传统业态需要进行革新从而提高这一建筑类型在未来可持续性城市中的实用性。这种业态上的挑战存在于两个层面上: (i) 传统高楼大厦中容纳的功能类型 (ii) 单个高层建筑中功能的数量和类型。高层建筑还有着各种各样的发展潜力: 比如除了现在标准的办公、居住、酒店功能之外还能容纳其他的功能，通过交叉使用/复合使用为建筑带来更持久的使用时间，一些功能产生的余热能够被其他功能空间利用，如共享停车场/汽车，共享配套功能和服务等。此外，可以对所有的材料和系统进行复合使用，创造性地考虑生活各个方面的需求，作为对可持续发展的回

expression of local culture with, quite literally, a façade of cloth (anyone familiar with Asian residential towers knows that many of them often look that way already!).

Design Principle 4

Variation with Height in Form, Texture and Program

Tall buildings should not be monolithic vertical extrusions of an efficient floor plan, but should vary in form, program and expression with height. This variance in form should be inspired by the city, both physically and environmentally. The main difference between a tall building and a small building is that the latter will only have a direct visual relationship with its immediate site content, whereas a tall building potentially has a visual relationship with many places far and wide in the city, at differing horizons within its form. This visual dialogue with these distinct places (and other buildings) can help inform a variance in form to further connect the building to its locale. Further, the industry is now realizing that climate varies significantly with height, and thus some of the great heights being achieved with tall buildings today effectively means that we are designing single tall buildings that cut across multiple climate zones (see Figure 5). The external air temperature at the Burj Khalifa in Dubai, for example, is reported to be approximately 6–8 degrees Centigrade cooler at the top of the building than at the bottom, so this could be reflected in the form, façade, systems and even program of the building.

A tall building should thus be considered as a number of stacked communities according to the opportunities of each specific "horizon," both climatically and physically in its relation to the city, rather than extruded as a single monolithic form from the ground floor. This could manifest itself in the manipulation of building mass as well as program, and there should also be variance in skin and texture throughout the building, depending on the responsibilities of each different horizon within the form. The MEP and other systems would also vary (at the very least air intake should occur at the top of the tower, to take advantage of several degrees of free cooling). The concept of scale should thus be introduced throughout the building – a tall building could be thought of (and designed accordingly) as a number of small buildings placed on top of each other within an over-arching framework of structure, systems, aesthetics, etc., rather than one extruded, monolithic form inspired by a single plan.

Design Principle 5

Maximize Layers of Program and Usage on all Systems and Materials

Traditional programs for tall buildings need to be challenged to increase the usefulness of the typology in sustainable cities of the future. This challenging of program should occur on two levels: (i) the type of functions that are traditionally accommodated within tall buildings, and (ii) the number of functions that are accommodated in a single tall building. Tall buildings have the versatility to accommodate uses other than the standard office, residential and hotel functions that currently predominate, and cross-programming/mixed-use gives opportunities for more duality, for aspects such as waste heat generated through one function being used in another, for car parking / car sharing, for sharing supporting functions and servicing, etc. In addition, the layers of usage that can be overlaid on all materials and systems should be creatively considered in all aspects of life, as a

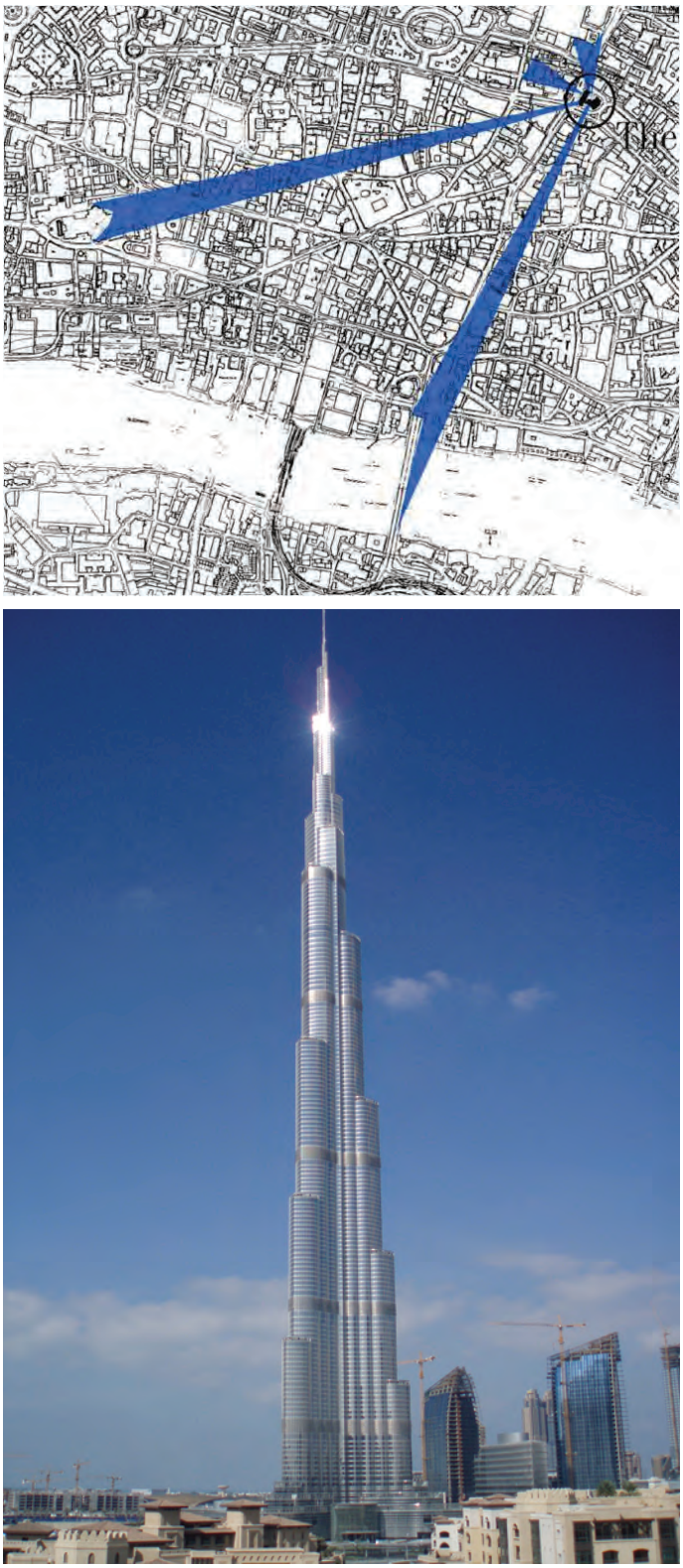

Figure 5: Both climate and the visual relationships in a city vary massively with height (top). The great heights being achieved with some tall buildings today effectively mean a single building is being designed across numerous climate zones. For example the Burj Khalifa (bottom) is approximately 6–8 degrees Centigrade cooler at the top of the building than the bottom. This should be used to influence the form, skin and program of the building. Tall Buildings should be designed in height "horizons," taking advantage of the unique opportunities of each horizon. Photo Copyright: Peter Weismantle

图5: 城市的气候和视觉关系随建筑高度的不同变化很大 (上图) 。今天的一些高层建筑具有很高的高度，这实际上意味着这座建筑单体跨越了很多个气候带。例如哈利法塔 (下图) 的顶部与底部之间的就足足相差了大概6-8摄氏度。这一点应该用来对建筑的形式、表皮和功能产生影响。高层建筑应该依照高度的"水平层面"来设计，利用每个水平层面带来的独特机会。版权所有: Peter Weismantle

Figure 6: Every expenditure of carbon through the embodied energy in materials and systems needs to be justified by overlaying more usage on those systems. In the 2011 NBK Osaki Building in Tokyo, the "Bioskin" solar shading shields internal spaces from solar gain and, through the system containing recycled rainwater, simultaneously reduces the external urban heat island effect through evaporation. Copyright: Nikken Sekkei

图6: 材料和系统的自含能量中每项碳排放都需要建立在同时实现更多系统使用的基础上。在2011年建成的东京NBK川崎大厦中，遮阳板不仅能减少室内的太阳热辐射，这一系统还能实现雨水收集，并同时减少室外因蒸发产生的城市热岛效应。版权所有: Nikken Sekkei

response to sustainability, including tall buildings. Every expenditure of carbon through embodied energy should be accompanied with the question: "How many layers of usage can we get from this element?"

The BioSkin system on the 2011 NBF Osaki Building in Tokyo (see Figure 6) operates a sun-shading system that not only shields the interior spaces from solar gain, but contains recycled rainwater that evaporates through the ceramic skin when heated by the sun, simultaneously lowering the urban heat island effect.[6] Similarly, double-skin façades have been used in some buildings as return air ducts for ventilation for a number of years now, as have stair voids for internal ventilating atria stacks. But can we get more radical than this? Can we see vegetation taking the place of solar shades within double-skin façades, forming "façade farms" that simultaneously soak up solar gain, create agricultural produce, and improve the psychological environment for building occupants? Could we see the use of façade shading systems as rock climbing walls, or liquid dampers/water storage tanks as swimming pools?

Design Principle 6

Tall Buildings Should Provide Significant, Communal, Open Recreational Space

More open, communal, recreational spaces (internal or external, hard or landscaped, large and/or small) need to be introduced into tall buildings. This means breaking away from the contemporary insistence on maximum financial return on every square meter of floor space. Such spaces have been proven to improve the quality of the internal environment, which has a direct impact on saleable/

应，包括高层建筑。建筑的物化能中每一笔碳的消耗都应该伴随着对这个问题的思考: "这种部件能有多少种功能?"

2011年东京NBF大崎大厦中所使用的一个双层表皮系统 (见图6)，不仅为内部空间提供了遮阳减少辐射的热量，同时作为雨水收集器，天晴后水分从陶瓷立面中蒸发，从而降低城市热岛效应[6]。同样，将双层外墙作为建筑物的回风管道进行通风以及用楼梯井作为内部的通风井已经有数年的应用历史了，但是，我们能否更进一步? 我们是否可以在双层幕墙中用植被取代太阳遮阳板的位置，形成"立面农场"的同时吸收太阳能增益，产生农产品，改善建筑使用者的心理感受? 我们是否可以将外墙遮阳系统做成攀岩墙，或将液体阻尼器/储水罐作为游泳池使用?

设计原则六

高层建筑应提供优质、公共、开放的休闲空间

更加开放的公共娱乐空间 (不论是在内部或外部，硬质或软质景观，尺度大或是小) 需要被引入到高层建筑中。这意味着打破当下对于建筑每平方米楼面面积经济回报最大值的追求。事实证明这样的空间能够改善内部环境，这对可出售和出租回报率有直接影响，还能够提高使用者的满意度和员工的生产力。此外，引入这些空间将让高层建筑更适合一些通常被其边缘化的社会经济群体，比如家庭、年轻人、老人，增加社区归属感。在城市尺度上的社会可持续性是我们未来城市的一个重大挑战。1997年的法兰克福商业银行，尽管到现在已近二十年的历史，仍然是可能是高层建筑天空花园使用的最重要的典例[7] (见图7); 每个使用者可直达十个四层高的建筑螺旋上升的天空花园之一 (这也是它的自然通风策略的一部分)。该商业建筑也可以作为一个理想的居住建筑模型，进深很浅能够实现空气对流的居住单元围绕着"空中花园"

6: The NBK Osaka "BioSkin" system was winner of the CTBUH 2014 Innovation in Tall Buildings Awards. See CTBUH, 2014

6: 大阪NBK "BioSkin"制度是CTBUH2014年创新高层建筑奖的得主。见CTBUH，2014年

Figure 7: The 1997 Commerzbank in Frankfurt is still one of the best examples of significant, communal skygardens in a tall building anywhere in the world. This office building is also potentially an excellent model for an idealized residential building, with thin, cross-ventilated floors of apartments all grouped around one of ten "gardens in the sky," where a sense of residential community can develop. Copyright: Nigel Young – Foster + Partners

图7: 1997年建成的法兰克福商业银行仍然是全球高层建筑具有重要的公共空中花园的最佳实例之一。这座办公建筑也有可能成为理想住宅的优秀模型，因为建筑内有10个"空中花园"，每个花园都环绕上下可交叉通风的公寓单元，居住社区的感觉由此而生。版权所有: Nigel Young – Foster + Partners

Figure 8: It is nonsensical that we are building towers with all-glass façades, especially in intense solar environments such as the Middle Eastern deserts, then expending more energy installing solar shading to cover up the glass. Tall buildings should concentrate glazing where it is best placed, and introduce more opacity back into the façade, which would also give a greater opportunity for more varied expression, as seen in the 2009 O14 Building in Dubai. Copyright: Reiser and Umemoto

图8: 全玻璃外墙的高层建筑是荒唐的，尤其是在中东沙漠这样有强太阳辐射的环境下，因为安装遮阳板在玻璃外墙上会耗费更多的能源。高层建筑应将玻璃用在最应该使用的地方，而让更多不透明材料的使用回归建筑外墙。这同时也有助于创造更多的表达方式，比如2009年建成的迪拜O14大厦。 版权所有: Reiser and Umemoto

rental return, satisfaction of occupants, productivity of workers, and so on. In addition, the inclusion of these spaces will make tall buildings more suitable for socio-economic groups often marginalized from tall buildings through the lack of such vital spaces where a sense of community can develop—families, the young, the old, etc. Social sustainability on an urban scale is a major challenge for our future cities. The 1997 Commerzbank, Frankfurt, despite being almost two decades old, is still perhaps the most significant tall building for skygardens in existence[7] (see Figure 7); every occupant has direct physical access to one of the 10 four-story skygardens spiraling up the building (which are also part of its natural ventilation strategy). This commercial building could also serve as an excellent model for an idealized residential building, with narrow, cross-ventilated floors of residential apartments grouped around a "garden in the sky" where a sense of community can develop. This is difficult to achieve when the elevator and corridor are the only infrastructure for chance meetings.

，创造出一种社区归属感。而这在将电梯和走廊作为居民唯一交流空间的建筑中是无法实现的。

设计原则七
减少使用透明的幕墙立面

高层建筑立面的设计应采用更多不透明的形式，而不全是透明的玻璃盒子，采用玻璃立面就需要大量的外部遮阳装置来阻挡过多的光线、辐射和炫光。虽然玻璃可以平衡内部采光并满足景观视线的要求，全玻璃建筑体是没有意义的，尤其是在炽热高温的环境中。此外，更大不透明外观能够承受更大的热容量，使立面避免外部温度和气候的变化的影响。更大的立面不透明度也提供了更广泛的外墙变化和表达的可能，迪拜O14项目就是一个佐证 (见图8)。

设计原则八
将自然植物作为材料体系的重要部分

在气候条件允许的情况下，自然植物应成为高层建筑材料体系的

7: The Shanghai Tower, currently nearing completion in Shanghai, will likely challenge this, with its continual perimeter zone of skygardens stretching 600+ meters into the sky.

7: 目前已接近尾声的上海中心大厦的建立将对此带来挑战，其天空花园的周边区域不断延伸，直插入600多米云霄。

Design Principle 7

Introduce More Façade Envelope Opacity

Tall buildings should be designed with more envelope opacity, not as all-glass transparent boxes requiring significant external shading devices to control the excessive light, heat and glare created by making it all-glass in the first place. Although the impacts on both internal daylighting and views out need to be balanced, all-glass towers do not make sense, especially in intensely hot solar environments. In addition, greater façade opacity gives an opportunity for greater thermal mass to allow the envelope to be more insulated from external temperature and climate variations. Greater façade opacity also gives the opportunity for wider façade variance and expression, as evidenced by projects such as O14 in Dubai (see Figure 8).

Design Principle 8

Embrace Organic Vegetation as an Essential Part of the Material Palette

In those climates that allow, vegetation should become an essential part of the material palette for tall buildings, both internally and externally. The benefits of vegetation on both the building and urban scale are now well proven (see Wood, Bahrami and Safarik, 2014) and include: increased shading and thermal insulation of the building envelope, improved air quality (both internally and externally), reduction of urban heat island effect, carbon sequestering, oxygen generation, sound absorption, possible agricultural produce, providing natural habitat for insects and small animals, as well as the psychological benefits for both building and urban dwellers. Great things are now being achieved with greenery in tall buildings, particularly in Singapore but also in other cities globally, as evidenced by the 2014 One Central Park building in Sydney (see Figure 9). In the context of this paper, the adoption of *local* vegetation (which is already hardy to the environment) would also contribute to the localized aesthetic of the building too, since even if every tall building the world over were cloaked in greenery, they would all reflect their local indigenous plant species, in the same way that the fields and forests of every region around the world are different. The embrace of vegetation into our buildings would also create an aesthetic more in keeping with the main challenges of the age (climate change and environmental challenges) than the 70-year old glass curtain wall aesthetic that still predominates.

Design Principle 9

Introduce Physical, Circulatory and Programmatic Connections Between Tall Buildings: Skybridges

It seems completely nonsensical that cities are making a push for ever-denser, ever-taller urban form, but allowing only the ground plane to be the sole physical means of connection between towers. *Skybridges* and *Skyplanes* (wider skybridge connections that contain functional space beyond just circulation) have the potential to enrich both tall buildings and cities, allow the sharing of resources between towers (spatial as well as service infrastructure), improve evacuation options, and reduce energy consumption through allowing horizontal as well as vertical movement between towers. There has hardly been a science-fiction city of the future created in the past 100 years that hasn't embraced the idea of the multi-level city, because it seems implausible to people creating those future cities that we would reach

重要部分，不论是在内部或是外部方面。植被能够给建筑和城市的尺度上带来益处 (见Wood, Bahrami 和Safarik，2014 年)，其中包括: 增加阴影和建筑围护结构的热容性，改善空气质量 (包括内部和外部)，减少城市热岛效应，碳的吸收、氧代，吸音，生产农产品，为昆虫和小动物提供栖息地，以及提升建筑和城市居民的心理愉悦感受。特别是在新加坡实现了高层建筑与绿化的结合，而且在全球其他城市也相继应用，如2014年正在建设的悉尼中央公园一号 (见图9)。在本文的论述中，采用当地的植物 (已经对当地环境具备良好的适应性) 也将有助于建筑体现出本土美学，因为即使世界各地每一个高层建筑都被笼罩在一片绿色中，它们也会反映出当地植物的物种特色，就像世界各地不同地区的田野和森林是不同的一样。相较具有七十年历史并仍然占主导地位的玻璃幕墙美学，植被与建筑的结合也将创造一种更加符合时代的美学 (以应对气候变化和环境挑战)。

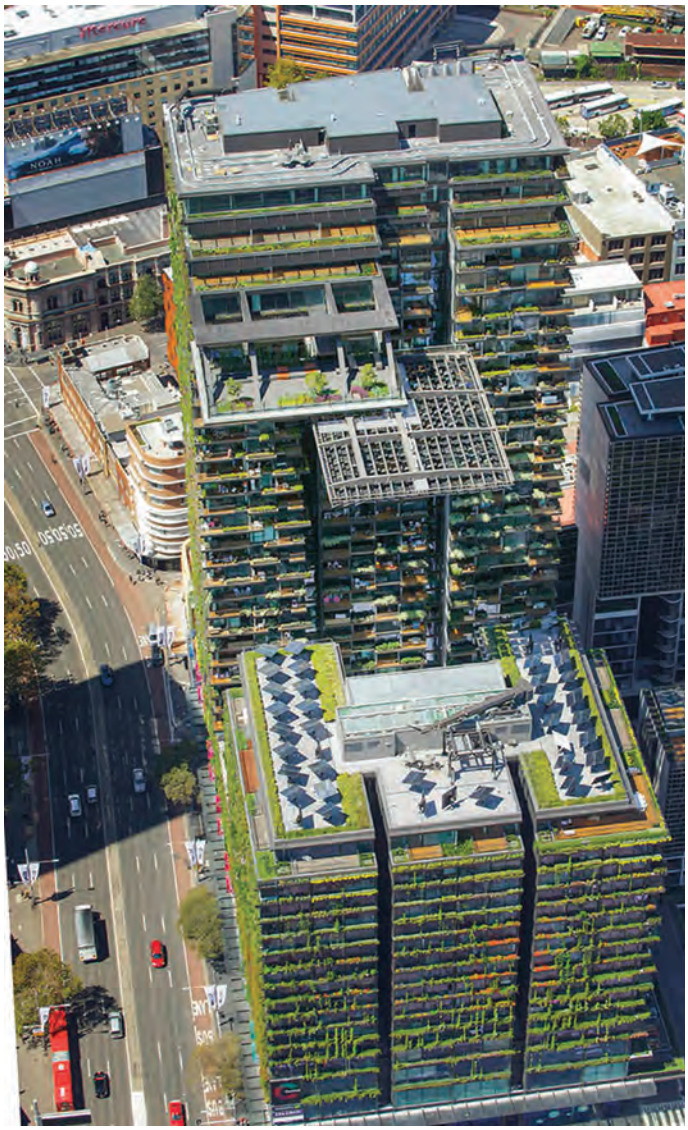

Figure 9: The benefits of introducing more greenery into our cities are well documented, plus green walls made up of local plant species would help create both a localized vernacular for tall buildings, and an aesthetic more akin to the environmental challenges of the age. The 2014 One Central Park in Sydney shows what is now becoming possible with greenery in the skin of high-rise buildings. Copyright: John Gollings

图9: 将自然植物引入我们城市所带来的益处已被广泛证实，而且使用当地绿色物种做成绿色墙体也有助于实现高层建筑当地的本土性，同时也适应当代环境挑战下的美学变化。2014年建成的悉尼中央公园1号大厦证明了在高层建筑表皮植入绿色植物正在一步步成为现实。版权所有: John Gollings

to hundreds of stories and yet require every inhabitant to descend to the ground plane to move sideways, breathe fresh air, or get lunch. In Hong Kong and many other cities in China, we often see numerous identical residential towers side by side in long rows – five, six, seven towers – often separated by just a few meters, but with vacant fire refuge floors all lined up at the same level. What leap of imagination would it take to physically connect these vacant refuge floors with skybridges, simultaneously giving more fire evacuation routes but, perhaps more importantly, creating the potential for communal zones in the sky[8]? Fortunately, many building designers and owners are now recognizing this,[9] with projects such as Singapore's 2009 Pinnacle @ Duxton housing scheme connecting seven residential towers with not only skybridges, but *skyparks* at two horizons in height, containing gardens, jogging tracks and significant urban habitat at height (see Figure 10).

Design Principle 10

We Need to Bring ALL Aspects of the City Up into the Sky

If cities embrace the principle that the dense vertical city is more sustainable than the dispersed horizontal city, then we need to recognize that the ground level is an essential support layer to the people who live in cities now. It is the ground level where the essential elements of life in the city are largely contained; circulation, recreation, education, shopping, health and, most crucially, where a sense of community forms. Thus if we are looking to concentrate perhaps 10 or 100 times more people on the same quantity of land through building tall – a proposition not out of scale with urbanization patterns that are happening in countries such as China,[10] India, Indonesia and others – then we need to replicate these facilities that exist at the ground plane up in the sky, including the parks and the sidewalks, the schools and doctor's surgeries, the shops and sports facilities, and many other public and civic functions. The ground plane thus needs to be considered as an essential, duplicable layer of the city that needs to be replicated—at least in part—at strategic horizons within and between buildings in the sky; not in place of the ground plane but in support of it. This does not mean the re-creation of the ground plane in a literal way, blocking out light and view to/from the spaces below and encouraging a physical stratification of society akin to the *"Blade Runner"* dystopian visions. Nor does it mean replicating the failed Le-Corbusian second-floor concrete "streets in the air" which, at the very least, sucked life away from the street because there was insufficient population density to support them where they were implemented.[11] The skybridges and skyplanes would largely create public realm at strategic horizons by connecting and unlocking the spaces that exist *inside* the towers at those heights, thus re-creating the horizontal,

设计原则九

引进高层建筑之间的的物质、流线和功能联系: 天桥系统

城市正在推进的日益稠密不断长高的城市形态中，只允许地平面作为建筑之间连接的唯一物质手段似乎完全没有意义。天桥和空中平台 (更加宽阔的空中走廊能够包含功能空间而不仅仅作为交通空间) 有丰富高层建筑和城市两方面的作用，让建筑之间实现资源 (空间以及服务基础设施) 的共享，增加疏散途径，在垂直交通以外再在建筑之间增加水平交通从而降低能耗。在过去的一百年中，科幻小说里构想的未来城市几乎没有一个不采用多层城市的理念，因为对于幻想这些未来城市的人们来说，如果建筑达到数百高却还要求每个居民下降到地面层以实现水平移动，呼吸新鲜空气，或获得午餐是难以置信的。在中国香港和许多其他城市，我们经常会看到很多相同的住宅大楼并排长排—— 五幢六幢或七幢 —— 往往仅有数米的距离，但位于相同的高度都有空置避火层。很容易想象，为什么不采用天桥的方式连接这些空置避难层，创造更多的消防疏散通道，更重要的是能够有潜力在高空中创造公共区域[8]? 可喜的是，许多建筑设计师和业主现在也认识了到这一点[9]，如新加坡2009年Pinnacle @ Duxton 高层公寓项目，在两个高度上不仅仅是用天桥，而是空中公园来连接七幢住宅大楼，在高空中创造了花园、慢跑道和卓越的城市栖息地 (见图10)。

设计原则十

我们需要让城市的所有元素都升上天空

如果城市采用这个原则，即密集的垂直城市比分散水平的城市更具有可持续性，那么需要认识到，地面对于城市的居住者来说是一个重要的支撑平台。生活在这个城市的基本要素在很大程度上包含在地面空间内，如交通、娱乐、教育、购物、医疗，以及最关键的社会归属感。因此，如果我们想要通过高层建筑而在相同土地面积内容纳也许十或一百倍的人——这个命题放到印度、中国[10]、印尼等国家的都市化进程中并不夸张 ——那么我们就需要在空中复制这些地面的设施，包括公园和人行道，学校和诊所，商店和体育设施，以及许多其他公共和市政设施。地平面应该被看作城市的一个必不可少的可复制面，至少其部分需要被累加复制，在空中的合适高度上形成建筑之间的水平联系; 这并不是代替地面层，而是作为其补充。这不意味着在字面上照搬地平面，阻断进入下方地面的光线和视线，并造成类似"刀锋战士"中反乌托邦式的社会分层。也不意味着对柯布西耶失败的二层混凝土"空中街道"的再造，这个理念会使得生活与街道剥离开来，因为其街道所位于的层面没有足够的人口密度来支撑[11]。天桥和空中平台，在特定的高度上通过连接和解放这一高度上建筑的内部空间而创造了新的公共空间，从而再造了和地面层一样的水平展开的公共活力。听起来是否有些牵强? 也许吧，但人们只需要看看新加坡、香港这样的城市，虽然比这里所说的规模要小，但已经真正实现了。

8: The proposition of the skybridge is outlined in more detail in Wood, 2003. The potential of skybridges for evacuation, as well as the great potential of Hong Kong for connections at height, is explored in Wood, 2011.

8: 人行天桥的建议在Wood，2003年的文章中可以找到详细的说明。天桥疏散的潜力，以及香的高空连接的巨大可能性将被进一步介绍，详见Wood，2011年。

9: It is interesting that, in the competition to replace the World Trade Center New York towers in the mid 2000s, of the final seven competition proposals, five of these proposals included links between towers in some form. See Wood & Oldfield, 2007.

9: 有意思的是，2000年中期，在取代纽约世界贸易中心的竞赛中，总决赛的第七项方案建议使用某种形式进行高层建筑之间的联系。见Wood & Oldfield，2007年。

10: The urbanization of China, and how this is impacting tall buildings, is explored extensively in the Introduction to the CTBUH 2012 Shanghai Conference proceedings: *Asia Ascending: Age of the Sustainable Skyscraper City,* see Wood, Johnson and Li, 2012.

10: 中国的城市化，以及对高层建筑的影响，在CTBUH 2012年上海会议论文集——崛起的亚洲: 可持续性大楼城市时代——中进行了深入讨论，Wood, Johnson和Li，2012年。

11: Consider Hong Kong as the antithesis of this. In the Central district of Hong Kong (as well as numerous other areas in the city) three entire levels of walkway are required to handle the sheer number of circulating people; street level, below-street level through the connection of MTR subway stations and entrances, and above street level through the world's largest network of skybridges, snaking between and through largely private buildings. One can walk for, quite literally, miles without touching the ground in Hong Kong. See the Robinson & Wood, 2014 paper in this proceedings.

11: 以香港作为对照。香港中心区 (以及城市许多其他区域)，三个层面上的通道需要处理大量的交通人流; 街道层面通过低于街道的地铁站和出入口的连接; 在街道层面上方，通过世界上最大的天桥在私人楼宇之间进行连接，形成蜿蜒的网络。可以毫不夸张地说，行人可以行走数公里的距离而不接触香港的地面。见Robinson & Wood，2014年论文集。

Figure 10: It is nonsensical that we are going ever more vertical in our cities, without introducing the horizontal. Skybridges and Skyplanes give the opportunity for not only linking functions, circulation, services and fire evacuation routes across tall buildings, they can create significant urban habitat in the sky, as evidenced by Singapore's 2009 Pinnacle @ Duxton housing project. Copyright: ARC Studios

图10: 如果我们的城市仅仅在追求垂直建设而没有加入水平要素，那么这也是荒唐的。空中连桥和空中平台带来的并不仅是在连接功能、流线、服务和防火疏散通道上的益处，它们还可以创造重要的空中城市人居环境，例如2009年建成的新加坡Pinnacle项目便成功实现这一点。版权所有: ARC Studios

public dynamic that exists at the ground level. Far-fetched? Perhaps, but one only needs look to cities such as Singapore and Hong Kong to see it already happening, albeit on a smaller scale than suggested here.

So What's Needed to Deliver All This?

The principles outlined above are obviously tinged with a utopian ideal, and contain considerable challenges to make happen – technically, operationally and financially. For sure, they cannot happen by the developer or architect working in isolation. To make this happen, we need a completely different way of thinking about our cities – a new regulatory, political, financial and social framework for urban development. Currently, in most cities of the world, the responsibility for urban infrastructure – sidewalks, roads, parks, power, lighting, waste, sewage etc – lies with the local government, but their involvement in the actual building stops at the front door to those buildings. The building itself becomes the responsibility of the developer alone, especially financially, with the local government playing only an oversight role. Yet much of what is suggested through the design principles above involves the creation of urban, public infrastructure *inside* the buildings, and thus we need to rethink how our buildings are financed and realized. Each building needs to become a public-private partnership, with the spatial and public infrastructure in the building being financed by the local government, the same as it would be in the low-rise horizontal realm. And to deliver this, an overall three-dimensional, long-term, stratified-in-height plan needs to be created, to replace the limited two-dimensional

为了实现这些目标我们需要做什么?

上述原则显然带有一种乌托邦式的理想，并带给技术、运营及金融领域相当大的挑战。当然，开发人员或建筑师并不能独立应对这些挑战。要做到这一点，我们需要采用完全不同的方式重新思考我们的城市，为城市发展构建一个监管的，政治的，经济的和社会的新制度框架。目前，在世界上大部分城市，建设城市基础设施的责任都归于政府——如人行道，道路，公园，动力，照明，废物，污水管道等设施的建设，而政府的管辖范围就止步于建筑门外。特别是在经济方面，建筑本身成为单独开发者的责任，而当地政府只扮演一个监督的角色。然而，上述设计原则中建议在建筑内部创造城市和公共性设施，需要重新思考建筑物的财务支持和实施流程。每栋建筑都需要建立一种政府—私人合作模式，建筑中的空间和公共设施由政府资助，如同在中低层建筑开发中那样。为了实现这一点，需要有一个三维的、长期的、高度上分层的总体规划，以取代目前占主导地位的只进行二维平面的分区和控制建筑最大高度这种方式。

因此，任何高层建筑将被视为在一个整体的、三维的城市框架中一个重要元素，而不是二维城市平面上一个孤立的标志物。这也将有助于减少许多通过高层建筑实现个人欲望的情况，因为高层建筑必须要融入到一个整体框架中，并自然地与周围建筑建立联系。

这使我们回到本文的主要议题，也就是这一类型在未来的主要挑战之一是: 创造在物质、环境和文化层面上与当地融合的高层建筑。要实现这一点，我们需要高层建筑最大限度地与其所在的城市、气候和人产生联系。我们城市的未来，甚至我们能否在这个星球上继续生存，都依赖于此。

zoning-plan-plus-maximum-building-heights-specified visions that predominate now.

Each tall building would thus become considered as a vital element in an overall, three-dimensional urban framework, rather than as a stand-alone icon superimposed on a two-dimensional urban plan. This would also help to break down the individual ego informing many tall buildings, once they need to fit into an overall framework and be, quite literally, connected to neighboring buildings.

Which brings us back to the main topic of this paper, and one of the main challenges for the typology into the future: to create tall buildings that are relevant to the specifics of place—physically, environmentally and culturally. To do this, we need tall buildings that maximize their connection to the city, climate and people. The future of our cities, and perhaps our continued survival on this planet, relies on it.

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