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# Sustainable Integration of Tall Buildings and the Urban Habitat for the Megacities of the Future | 未来巨型城市高层建筑与城市人居环境的可持续发展



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Mark has worked on more than 40 tall and supertall building buildings over the last 15 years and is a structural engineer by training. His extensive exposure to tall building design, and his leadership within BuroHappold's multi-disciplinary tall building community, has led to a wider interest in tall buildings as a genre, and he has written and been quoted in several technical papers and media articles on subjects ranging from innovative structural design to the psychology of tall buildings. He is currently a CTBUH City Representative for Dubai and is a member of the Urban Habitat / Urban Design Committee.

Mark Lavery作为一名资深的建筑结构专业设计师，在过去的15年中曾参与过40多座高层及超高层建筑设计工作。他广泛深入到高层建筑设计的各个领域，并多次与多学科团队合作，现任标赫公司超高层建筑设计的主要负责人，经他指导的超高层建筑受到广泛关注，他发表的创新型结构设计和超高层建筑心理学等方面的多篇论文被广泛引用和受到媒体转载。目前他作为迪拜市的代表，CTBUH的城市人居环境和城市设计的CTBUH委员会成员。

## Abstract | 摘要

*Tall buildings increasingly dominate our skylines as an almost inevitable response to urbanisation. They often do not integrate well with the urban habitat in which they are located however, a must for long-term social, environmental and commercial sustainability, marching towards the age of the megacity. Instead, their dominance of the skyline separates them almost physically from the urban fabric around them, taking away from their environment instead of breathing life into it. This paper examines what it takes to successfully integrate a tall building into the urban fabric, outlines the symbiotic benefit such integration generates for the urban habitat, the tower itself, and the city, and looks at the current drivers for integration from the perspective of different building typologies. Through examples, we will look at the keys to successful integrated design, including people-centric design, and will consider a framework for success for social, commercial and economic sustainability.*

**Keywords: Integrated Design, Social Interaction, Sustainability, Urban Habitat**

随着城市化进程的加剧，中小型城市向大中型城市发展，超高层建筑作为城市化的象征逐渐受到关注，我们的日常生活也越来越受到超高层建筑的影响。超高层建筑在设计时往往只会更注重自身设计，而没有综合考虑区域发展，已经对环境的带来的影响。忽略了社会、环境和经济统一长期的可持续发展。本文主要探讨如何将超高层建筑顺利融入现有城市格局中，使建筑与城市规划两者间构建和谐共生互利的关系，从多角度多层次分析受经济利益驱使下的当代建筑。通过列举一些成功案例，有助于分析总结其成功的关键在于一体化设计，包括以人为本的建筑设计理念。前车可鉴，在总结经验教训的基础上，遵从可持续发展的原则框架，使经济、社会和环境三者平衡发展，长期的可持续发展。

**关键词：整合设计、社交联系、可持续性、城市人居栖息地**

## Introduction

With rapid increases in world population, migration between continents and a trend towards urbanisation, pressure is rapidly growing on new and, particularly, established urban centres globally in terms of environmental, social and economic sustainability.

According to the last revision of the World Urbanisation Report (United Nation's Department of Economic and Social Affairs, 2014), the world's urban population is expected to increase by 64% by the year 2050, and the number of megacities, those with in excess of ten million inhabitants, are set to increase in number by 50% by the year 2030, from twenty nine to forty one.

This urbanisation is further pressurising established cities due to lack of land availability, land costs and the limitations of infrastructure at both the macro and micro scale. The current trend to accommodate these population challenges through building dense and high, adds further pressure

## 前言

随着世界人口的快速增长，城市化进程的加快，面对全球环境、社会和经济的可持续发展向新型社会转型，全球性一体化城市的压力也随着增加。

根据联合国经济社会事务部发布的世界城市化进程报告2014最终修订版，预计到2050年世界城市人口将增长到64%，人口过千万的特大型城市的数量也将由29发展到41，预计到2030年增长量达50%。

无论是在宏观还是微观上看，可利用的土地资源越来越少，土地成本的增加以及局限的交通市政基础设施不够完善，导致城市化进程的压力进一步增大。就目前的发展趋势看，虽然建筑的密度在增加，但是仍然缓解不了人口剧增与居住环境之间的压力，再加上不能及时的维护和改进老化的局限的基础设施，更增加了想要进行可持续发展的难度。

为了迎接挑战，可持续设计从一个微观尺度上讲，建筑与建筑之间不再是孤立的。需要整合：环境、社会以及经济三者之间的协调发展，既要容纳高层建筑，还要做

to the existing, and in some cases aging, infrastructure and can place further strain on the sustainability of such densification for the long term if not tackled appropriately.

To meet the challenges, sustainable design at a micro scale, building by building, is not sufficient in isolation. The three pillars of sustainability: environmental, social and commercial, all need to be addressed in an integrated way in our urban centres at all scales: through both the tall buildings that accommodate us, and the urban environment that forms the basis of our communities (Figure 1).

### True Sustainable Development

The definition of sustainability quoted in Our Common Future (Brundtland, 1987) largely captures the essence of sustainable development: "... development that meets the needs of the present without compromising the ability of future generations to meet their own needs." Environmental challenges related to carbon emissions, depletion of natural resources and air quality are well documented and largely well understood, and some measures have been adopted to work toward more environmentally sustainable development, but it could be argued that economic and social sustainability have not received the attention they warrant, serving only inward focussed needs.

It is often considered that tall buildings and densification of the urban habitat are in and of themselves, sustainable responses to population growth, however in reality, they can work against sustainability if they are not well designed and are not integrated with their location. Isolated tall buildings, with maximising return on investment an overriding priority and solely focussing on the individual building or development, are seldom sustainable in any form.

Tall buildings in well planned and integrated developments can be the answer to long-term sustainable development, but in order to do so, they need to address all three pillars. Maintaining the health, happiness, security and prosperity of our growing communities is paramount.

### Challenges of Current Development Approaches

Tall residential buildings, typically sold off-plan, are often a poor example of sustainable development and seldom consider lifecycle energy costs and lack focus on minimising water and energy demand. Limited research in Chicago (Peng Du, 2015), comparing an area of low-rise urban sprawl to a residential high-rise area in the city, concluded that the low-rise sprawl was notably more sustainable from an energy perspective than the significantly more densely populated high-rise

到城市环境保护，为我们的社区发展打好坚实的基础（图1）。

### 真正意义上的可持续发展

引用我们共同的未来(Brundtland, 1987) 对于可持续发展的定义，在很大程度上抓住了可持续发展的本质：“既要满足当代人的需要，又不会对子孙后代满足其需要的能力构成危害的发展。”环境挑战涉及到碳排放，自然资源枯竭，新鲜的空气质量。在很大程度上不难理解，采取相应的措施保证可持续的发展。但是很多时候往往只关注了经济，认为只有经济发展了才能有更大的发展，忽略了社会的可持续发展。

人口增长将会影响可持续发展，仅仅凭借高层建筑来解决城市人口密度，而没有从长远利益上考虑地理位置环境等因素而进行设计，可能会对可持续发展不利。仅仅追求高层建筑带来的最大化投资回报，不关心建筑本身或周边地区发展的话，根本就不可能持续发展。

想要做到长期的可持续发展下去的话，高层建筑需要以精心设计并综合考虑地方发展为前提，并确保三大支柱之间的平衡问题：环境的退化不应侵犯到健康以及社会福利的其他方面。

### 当前发展面临的挑战

在可持续发展中表现最差的要数高层住宅建筑，高层住宅一般都以出售为目的，很少考虑生命周期成本和能耗方面尤其是减少水资源消耗的。对芝加哥这个城市做了些研究(Peng Du, 2015)，发现仅从能源上讲低层建筑的可持续发展性远远要优于人口密度相对较大的高层建筑。住宅的发展，特别是在市场相对不成熟的城市来讲，往往更多的关注于建筑的外观而不是住宅的舒适度。空气质量，公共空间的采光和照度等往往都被忽视掉，开发商以出售目的为主，不采用后期维护等，所以在建筑设计时更注重外观的整体设计，根本不考虑环境和社会因素，更不会从可持续发展的角度去考虑建筑。这种类型的建筑通常可以孤立存在周边无相应的配套设施，建筑仅仅用于住宅像块巨石一样矗立在那里，根本不考虑对周边环境的影响，且人口密度大极有可能影响当地周边的交通，给交通出行造成很大困扰。

商业综合体项目相比之下由于上述住宅类高层建筑，并深刻认识到区域连通性的重要，良好的创造力集合内部连通合理利用空间，注重高质量的环境品质，可以带来更强大的商业利润，增加了整体的活力提高了劳动生产力。经过精心规划设计的综

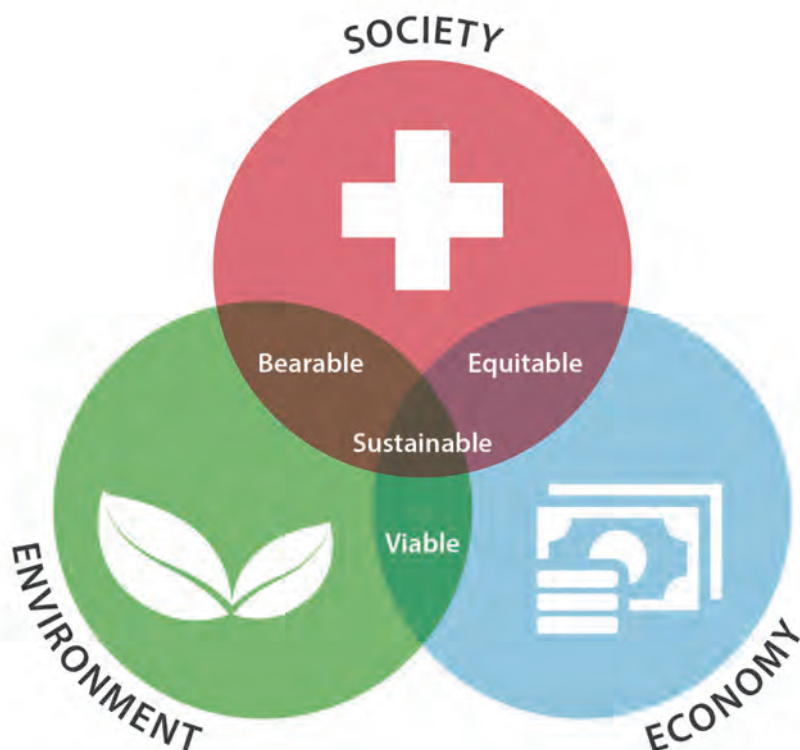


Figure 1. Three Pillars of Sustainability (Source: BuroHappold)  
图1. 可持续发展的三大支柱（来源：标赫工程设计顾问公司）

area. Residential developments, particularly in less mature markets, are also often more focussed on the “look” of a building and its apartments than the “feel.” Air quality, access to natural light and quality and availability of communal social spaces are typically less tangible from a potential customer’s perspective than a building’s appearance, particularly when units are to be sold off-plan, so there can be less of an impetus on the developer to give these environmental and social factors equal consideration, particularly when their driver is principally a commercial one. These type of buildings often also establish themselves as monoliths that do not interact with the neighbourhood – building to plot lines, incorporating podiums, and generally interrupting the flow of the streetscape and closing it in on itself.

Commercial and mixed-use buildings typically fare better, with recognition of the importance of high quality environments and social interaction spaces, and good internal connectivity all boosting productivity, creativity and communication – strong commercial drivers. In well-designed examples, this connectivity and provision of social space continues down to the building entrance and its wider connectivity with the streetscape through openness of the façade treatment and the use of uncluttered and accessible lobby space connected to external public space provided within the plot.

Outside the individual plots, poorly considered planning is a major challenge. Without the right mix of developments and without considered and complimentary amenities, retail and public spaces, the streetscapes can become dead areas at times of day, lacking vibrancy and a sense of community. The infrastructure to support such poorly planned areas can also be inefficient, with large peaks and troughs in infrastructure demand challenging the efficiency and long-term viability from a commercial and environmental viewpoint. A lack of connectivity to transport hubs, notable in some developing countries, also detracts from the benefits of building densely in the first place, with more reliance on the use of cars and its implications on carbon emissions and air quality.

The same research from Chicago previously discussed however, showed that better access to amenities, common in modern high-rise developments, played a strong role in promoting social sustainability from the viewpoint of residents’ perception of a higher quality of life in the tall building development compared to the low-rise area.

While building dense has the potential to be sustainable, it can only be truly achieved through an integrated approach in consideration of the buildings with the urban habitat to target all three pillars of sustainability.

## The Importance of the Urban Habitat and Integration

The role and planning of the urban habitat is key to creating true sustainable urban development. Each of the three sustainability pillars can be hugely positively impacted by a well-designed public realm, integrated with the buildings it connects. The principal factors are:

- Optimised mix of building use
- Provision and connectivity of public space at small, medium and large scale
- Design of buildings to integrate with the streetscape
- Integration of appropriate technology

Optimising the mix of commercial and residential buildings can greatly improve efficiency of infrastructure by flattening out the peaks and troughs of water and energy demand. Sustainable energy generation also becomes more feasible, with renewable energy systems incorporated into tower designs able to feed into a localised infrastructure to optimise their use and direct it where it is needed. An efficient and centralised infrastructure also reduces overall energy cost. The right mix also encourages a more vibrant community with continued use of the public realm for longer periods during the day and evening, improving security and helping attract investment in amenities for all. Balancing typologies and integration of public transport as part of these optimised developments also lead to reduced reliance on private cars and improves air quality, and reduces time and cost associated with personal travel.

Flexibility is also an important consideration. As cities develop and expand, they need to be able to respond in an organic way and some consideration should be given to the resilience of developments to react in this way to change in usage and accommodation of changing infrastructure.

Provision of public space as part of single developments, and medium to large spaces as part of larger developments or masterplans,

合体建筑，很注重建筑整体与周边环境的综合考虑，会灵活运用空间采用开放式简洁明朗的中庭或大堂既与各个区域相互连接，同时还与外部公共空间进行连通，有的甚至直接将主入口与周边的交通设施相贯通。

个别地块遇到不良的规划建设将面临重大的挑战。周边区域发展不健全，综合体建筑却没有做到全局考虑搭配不合理，零售和公共区域在空间上分配不合理，往往有些局部区域形成死区，缺乏活力和社区意识，导致无顾客去光顾该区域的店铺。从长期的商业环境观点看无商业价值不健全的计划和设施不够完善造成低效率的市场竞争力。缺乏连接的公共交通枢纽，一些发展中国家尤其值得注意，发展商业基本市政设置简陋，仅凭汽车作为主要交通工具会对环境空气质量造成影响增加碳排放量进而变成环境污染。

从前面讨论的对芝加哥研究中，无论从居民对高层建筑的生活质量的感知角度，还是与低层建筑的生活质量相比较，不难发现若超高层建筑具有良好的设施的话更具吸引力，发挥的作用更大，促进社会的可持续发展。

考虑到城市人居环境与建筑物所涉及的可持续发展三个主要支柱，想要真正实现可持续发展，建筑的密集程度决定可持续发展的方向。

## 城市人居环境的重要性

城市人居环境的规划设计对于创建可持续发展的城市起着至关重要的作用。可持续发展的三大主要支柱间，既相互制约又互相影响。城市经过精心设计可以做到更好的可持续发展。主要包括：

- 优化建筑使用
- 无论规模大小合理利用空间，达到连通性
- 建筑设计要与周边区域协调设计
- 合理的应用新技术

根据商业综合体建筑与住宅建筑的使用的特殊性，通过负荷峰值和峰谷的变化，将两者相结合可以很好的提高设备设施的利用率，减少水资源的使用和降低建筑对能耗的需求。可再生能源发电的利用是可持续发展的一个有效措施，可以弥补地区基础市政实施的不足。有效的整合利用市政设施可以减少能耗的总成本。合理组织交通出行，鼓励使用公共交通出行，不仅可以保证白天的运输，夜间也可以提供合理的公共交通而且提高安全性，使整个区域更加连同充满活力有助于吸引更多的





Figure 2. Urban Connectivity (The High Line) (Source: Eric Soltan)  
图2：城市连通性（高线公园）（来源：Eric Soltan）

can form interconnected walkable neighbourhoods if legislated and planned properly, further encouraging community, enlivening the streetscape and driving further investment. The creation of such public realm can be symbiotic with the buildings it supports, breathing life into each other, with buildings providing public spaces as part of their developments helping create the network of spaces, and the public realm itself creating community and attracting further investment in turn (Figure 2). Such an example is The High Line in New York, a disused, elevated freight rail line on Manhattan's west side, which was transformed through a mix of public and private money into a linear urban park (Figure 3). The park brought energy and vitality to this forgotten neighbourhood and has since been credited with bringing \$2 billion dollars in private investment to the

投资项目。平衡公共交通设施与私家车的使用，鼓励大家尽量采用公共交通出行，减少使用私家车为改善空气质量做贡献，私家车行驶出行量的减少可以提高公共交通的效率，减轻路面压力，节约时间减少成本。

灵活性也是一个重要的考虑因素。随着城市的发展和扩大，他们需要能够建立一种有效的模式及能灵活应对城市发展的需要和改变又能基本保持原有特色，也许改变使用功能设施和住宅的基础设施。

无论是小区域还是大的综合性社区都需要有个公共空间，作为扩大发展和总体规划的一部分，公共空间可以更好的连通各个区域，带动社区间交流发展，活跃社区文化，良好的社区景观可以更好的推动地区发展，进一步吸引外资。这样的公共空间不仅是社区中的一部分，相互间的联系共



Figure 3. High Quality Public Realm (Source: Eric Soltan)  
图3：高质量的公共空间（来源：Eric Soltan）

同享有公共空间，节约空间成本的同时更好的连通性体现（图2）。美国纽约曼哈顿西区的高线公园就是一个很好的成功案例（图3），曾经的货运高架铁路线由于社区的发展被停用了若干年后，给周边发展了的区域带来了负面影响，经过精心设计再次改造合理利用后，不仅保留了原有的建筑结构，在优化建设成本后融合了公共和私人资金后，将被遗忘的铁路线改造成连接各个区域的空中花园，不仅带来了20亿美元的私人投资，还创造了120000个新的就业机会，产生超过1亿美元的财产税，还为居民提供了更多的休闲场区域环境得以改善的同时，增添了社区活力（Ascher, Uffer, 2015）。

提供绿色和种植的空间，足够的遮阳和使用自然通风也可以帮助减少在温暖的气候在密集的街区的热岛效应（图4）。国王阿卜杜拉金融区（KAFFD）的总体规划，由标赫公司Henning Larsen参与设计，利用这种技术后，利雅得的夏季与周边区域相比，降低环境温度高达8°C（Chen, Godefroy, Kurek, 2014）。

高层建筑提供底部的公共空间并和周围共同分享使用该公共空间部分，建筑物的这种设计及满足建筑用户的自身使用同时还打通了和周围区域的连接，有助于城市环境的统一协调发展节约了更多的空间。这样的考虑与街道建筑的一体化，建筑在设计上采用了更透明的外立面增加了空间的通透感与周边街道连通，开放式兼共享性的公共区域理念，这种做法受到了多伦多市规划部门的推崇，他们鼓励私营建筑业主与区域规划公共空间（P.O.P.S.）在情节设置上共同商讨，通过规划让步的谈判，征集了建筑物的需求后，针对建筑物的详细信息进行仔细研究后将作为规划过程一部分的合理利用。这种对细节的关注和提供空间，使建筑物本身，为他们创造



area along with creating 12,000 new jobs and generating more than \$100 million in property taxes (Ascher, Uffer, 2015).

The provision of green and planted spaces, adequate shading and the use of natural cross ventilation can also help with reducing heat island effects in dense neighbourhoods in warmer climates (Figure 4). The King Abdullah Financial District (KAFD) masterplan, by Henning Larsen and BuroHappold, makes use of such techniques to provide air movement and shade through the urban network with the result of reducing the ambient temperature by up to 8°C during Riyadh's summer months, compared to the adjacent city centre zone (Chen, Godefroy, Kurek, 2014).

As well as providing public space within and around the base of tall buildings, the design of buildings where they meet the street can also benefit both individual building users and the urban environment they contribute to. Such consideration of the integration of buildings with the street, including set-backs and transparency of the façade treatment, is something indirectly encouraged by City of Toronto Planning Department, where creation of privately owned, public spaces (P.O.P.S.) at the base of towers within plot set-backs are encouraged through negotiation of planning concessions, and detailed information of the treatment of the buildings at the base of the towers requires detailed scrutiny as part of the planning process. Such attention to detail and provision of space enlivens the buildings themselves, creating better buildings for their occupants and provides further connectivity through the public realm with improved visual lines and the additional security it provides.

With technology so embedded into modern life, ensuring that cities integrate with technology and are able to keep pace with its rapid evolution by allowing for the necessary flexibility in infrastructure, are also important factors in creating a sustainable, "smart" city.

Such integration is symbiotic in nature, and is not just about ensuring that we feed consumerist needs. Integrating technology into the urban environment can positively impact on social, environmental and economic sustainability of a city by encouraging connectivity of communities, enabling smart management of personal and city-scale energy resources and encouraging commercial enterprise, connecting businesses more directly and relevantly with customers.

Aspects of the "smart" city include:

- Smart buildings: buildings that collect and interpret advanced data related to power, security, occupancy, water, temperature, and humidity. This allows the facility's management to gather comprehensive insights of their properties, steer expenditure and increase efficiencies and system optimization. From a personal perspective, it also allows individuals to monitor and take more control and responsibility for their own environmental footprint.
- Smart transportation: seamless integration of sustainable IT concepts enables better and more reliable transport management thanks to real-time information delivery about people flow and traffic congestion, road hazards, CO2 levels, and the location of available parking and

更好的建筑和居住者通过改进的视觉线和额外的安全性提供了公共领域并进一步的连接。

融入现代生活的技术，确保城市与技术的结合，并能够跟上其快速发展的快速发展，允许必要的灵活性，基础设施，也是创造一个可持续的，“智能”城市的重要因素。

这样的同步型的整合理念使单独建筑和环境区域采取共生的方式，并将高新技术融入城市环境的积极影响社会，通过鼓励连接社区的城市环境和经济的可持续发展，使智能管理个人和城市规模的能源资源、鼓励商业企业，更直接地连接企业与客户“智能”城市层面包括：

- 智能建筑：对建筑物收集来的电力、安保、用户、水、温度和湿度等有关的数据进行整理和解释。这使得物业设施管理部门，在收集整理后的数据基础上掌握建筑物真实情况，从而指导维护、提高效率和系统优化工作效率。从个人的角度来看，它也允许个人监控和采取更多的控制了解到自己对环境的影响，明白其责任和义务。
- 智能交通：智能化可持续的信息技术采用更好的和更可靠的运输管理，根据实时信息传递有关的人流量和交通拥堵、道路危险，二氧化碳浓度，以及可用的停车场和电动新能源汽车的充电站的位置等。这样的智能管理可以提高安全性和方便性，现在和下一代连接的车辆和基础设施。
- 智能基础设施：整合到基础设施设计，支持一个智慧城市和高效的管理，通过帮助最大化效率，降低成本和风险有关的权力，水，照明，煤气供应和其他公共服务，确保提供服务的基础上实时的数据。

融入建筑和城市环境的技术必须被认为是一个城市的必要性并真正的可持续发展，使他们能够适应和发展，以满足他们的未来需求。

## 走向一个全面的可持续发展的未来

建筑提倡可持续发展和向可持续发展城市人居栖息地靠近，对于将来城市的发展到底是不是真正的可持续发展了。就目前发展情况两者在一起讨论，往往取决于地理位置，单独建筑的可持续发展在很大程度上依赖于个别开发商的一时兴起，由于缺乏强有力的立法支持，很难真正的做到可持续发展。



Figure 4. Green and Planted Spaces (Source: Eric Soltan)  
图4. 绿地和种植空间（来源：Eric Soltan）



charging stations for electric vehicles, just to mention a few. Such smart management can enhance safety and onvenience, now and for the next generation of connected vehicles and infrastructure.

- Smart infrastructure: the integration of IT into infrastructure design supports an intelligent city and efficient management of that city, by helping to maximise efficiency and reduce cost and risk related to power, water, lighting, gas provision and other public services, by ensuring that delivery of services are based on real-time data.

Integration of technology into buildings and the urban environment must be considered a necessity for cities to be truly sustainable, and to enable them to adapt and evolve to meet their future needs.

### Toward a Rounded, Integrated Sustainable Future

A sustainable approach to buildings and a sustainable approach to the urban habitat separately cannot provide truly sustainable development for the megacities of the future. Both are currently often addressed in a piecemeal way depending on location, with the sustainability of individual buildings largely dependent on the whim of individual developers, and the typology of the building under development, often due to lack of strong legislation.

As previously discussed, commercial buildings are typically more mature in their approach to sustainability, with energy efficiency and quality of space significant commercial drivers due to energy costs and direct correlation between the quality of space and environment and the productivity of staff. The initial outlay on construction and fit-out in these cases is far outweighed by the savings in lifecycle costs and the impact of improved productivity on the bottom line. As little as a 10% improvement in productivity can as much as double profitability, and a case study carried out on the Genzyme Headquarters building in Cambridge Massachusetts estimated a \$5 million return due to improved productivity (BuroHappold, 2014) (Figure 5).

Improved internal environmental quality, access to natural light, improved acoustics and improved physical and visual internal connectivity all lead to improved well-being leading to productivity and creativity benefits. The same benefits can be transferred to



Figure 5. Genzyme Headquarters (Source: Anton Grassl)  
图5. Genzyme公司总部 (来源: Anton Grassl)

正如前面所讨论的，商业建筑通常是更成熟的方法来可持续发展，能源效率和质量的空间显著的商业驱动程序，由于能源成本和直接相关的空间和环境的质量和生产力的工作人员。在建设的初期投资和装修是在这些情况下，远远超过了储蓄的生命周期成本和对提高生产率底线的影响。只有在生产力提高10%可以双倍盈利，从对Genzyme总部大厦在马萨诸塞州剑桥的个案研究发现，大概500万美元的回报是由于生产率的提高（标赫工程设计顾问公司，2014）（图5）。

借用商业建筑的模式方法同样应用到住宅项目的开发设计上，通过改善内部环境质量，采用自然光，改进的声学和改进

的物理和视觉的内部连接方式，都能很好的改善室内环境从而提高人们的劳动生产力和创造力，环境的改善人们的身心健康，从而降低医疗成本，降低能源成本。但往往买家不了解室内环境的改善带来的好处，有点买家甚至也是以投资为目的也不关心使用者，所以仍停留在肤浅的水平，任由开发商提供最低限度以赚取最大的投资回报的住宅建筑。为了帮助推动可持续发展从商业用途到住宅的使用，我们需要更好地让用户更多的了解室内环境质量的好处以及切身的利益，同时通过相应的立法和激励机制推动我们的改善，通过规划和监管部门一起推动我们的可持续发展标准。

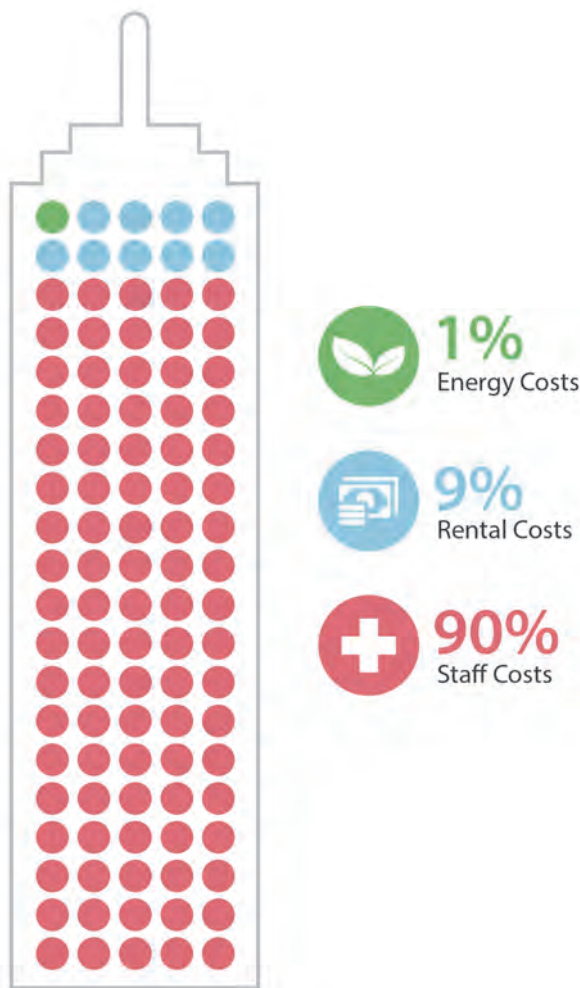


Figure 6. Operating Costs of Tall Buildings (Source: BuroHappold)  
图6. 高层建筑的运营成本（来源：标赫工程设计顾问公司）

residential development, leading to improved health and well-being, and thus reduced healthcare costs, and reduced energy costs, but buyers do not generally insist on such quality other than at a superficial level and developers will generally provide the minimum they can to earn maximum return on their investment. To help drive the sustainability benefits learned from commercial use into residential use, we need to better educate users on the benefits, or create legislation and incentives to drive the improvement for us, with sustainability standards raised through planning and regulation.

Without improved environmental sustainability in building design across the board, and intelligent, integrated design where all parts of the design are focussed to optimise the whole rather than designed in isolation, the benefits of denser living may be lost. Energy efficiency of individual homes and offices within tall buildings, through use of common infrastructure and decreased energy demand, and less exposure to the external environment, may be outweighed by the use of more materials, inefficiency of space, and the energy requirements of common spaces and elevators etc. (Figure 6).

### A Framework for Success

As discussed in this paper, sustainable development consists of the three pillars of social, environmental and economic sustainability and each must be addressed by both individual buildings and their connecting environment in an integrated way.

Sustainability in individual building design is currently inconsistent in approach and efforts should be made to align sustainability efforts independent of building usage, whether through education of tenants / buyers, or through legislation and planning to address key design issues from a people-centric viewpoint:

- environmental quality (air quality, comfort, access to natural light, acoustics);
- creation of social spaces;
- optimised energy efficiency;
- optimised building design to improve efficiencies (built area, materials, infrastructure).

在整个建筑设计过程中，如果缺少改善环境的可持续发展，没有综合考虑，对建筑设计进行整体优化的智能化设计，只是单纯性的考虑建筑设计的话，那超高层建筑所带来的好处都不会存在。在高层建筑的私人家庭和办公室的能源效率，通过共同使用的基础设施和减少能源需求，减少对外部环境的污染，减少建筑材料的超出使用，提高效率低下的公共空间如电梯等建筑面积的使用率减少公摊面积的需求量（图6）。

### 成功框架模式

作为一个概念，可持续发展包括社会、环境和经济三个主要层面，三者间相互交错既互相影响又互相制约，可持续发展问题其实就是关于这三大支柱之间的平衡问题。

个别建筑设计虽然追求的是可持续发展但结果却相互矛盾，应采用合理适当的方法使可持续发展设计理念与实际相结合，无论是通过教育业主/买主，还是通过立法及规划，让更多的人明白可持续发展是以人为本的设计理念：

- 环境质量（空气、舒适度、自然光、声学）
- 创造社会空间
- 优化能源效率
- 优化建筑设计以提高效率（建筑面积、材料、基础设施）

高层建筑结合城市环境经过精心策划改善城市环境，综合考虑可持续发展规划发展城市，协调环境景观设计与高层建筑的相互关系。

- 综合考虑合理利用建筑结构与周边区域环境的连通性，根据已有经验选择入口的同时，鼓励采用物理分析周边环境选择最恰当的人流疏导分布走向，增强区域间的连通性；
- 合理利用公共空间，如采用步行连廊区域作为咖啡厅，休闲区或景观公园等，增加区域的互通性。

城市环境与建筑本身存在共生关系，城市由建筑组成，而也正因为有建筑，城市才会更充满活力，社会才会安全稳定。精心设计社区与建筑（图7）。才能营造更好的社区生活环境进行可持续发展：

- 提供适宜的密度，混合高效的城市基础设施，增加可再生能源的利用率使之



Integrating tall buildings with the urban environment and the design of a well-planned urban environment itself are critical components of sustainable development for our growing cities. When integrating with the streetscape, the base of tall towers should:

- carefully consider façade treatment to encourage physical and visual continuation of the public realm for passers-by and provide great entry experiences for occupants, and limit the use of podiums and other barriers to integration;
- provide public space that enliven the buildings themselves and connect to a network of walkable spaces, such as cafes, use of street furniture, small parks etc.

The urban environment itself has a symbiotic relationship with the buildings, with the buildings feeding into the public realm, while the neighbourhood feeds the success of the buildings through enlivening and providing a sense of community and security (Figure 7). A well designed, sustainable urban habitat will:

- provide an optimum density, and mix of typologies to drive an efficient urban infrastructure, increase viability and efficiency of renewable energy production incorporated into building design, enliven the urban environment and encourage investment in amenities and entertainment provision;
- include flexibility in buildings to respond to the evolving needs of the city and to limit the necessity of future demolition and re-development;
- provide a walkable neighbourhood, encouraging a lively streetscape and community through connected spaces provided by both individual buildings and by spaces created as part of the public realm;
- provide a feeling of security and wellbeing;
- integrate with transport hubs and reduce reliability on use of cars and improve air quality;
- include an integrated, flexible technology component to manage infrastructure and provide improved social connectivity.

As our populations increase and as migration and urbanisation continues to rise significantly, the above steps when taken in combination will help cities, particularly megacities, in meeting the needs of true sustainability and ensure the needs of the

纳入增强建筑设计的可行性，搞活城市鼓励倡导设施和娱乐的投资；

- 灵活利用建筑，限制拆迁或重建再开发；
- 提供适于步行的社区，鼓励活跃的街景和提供、创造公共空间领域建立城市社区与建筑的连通
- 保证安全感和提升优质生活；
- 整合利用交通枢纽，减少汽车的使用率的同时提高运营效率，改善空气质量；

• 集成灵活的利用新的高科技技术来管理基础设施，并不断增加社会的连接性。

当人口的增长和迁移，城市化进程的加速发展，尤其是特大规模的城市，两者相结合将有助于城市满足可持续发展的真正需求并确保当前的需求得到满足的前提下满足未来需求的能力。对于这样一种综合方法的责任将落在许多政党，但它似乎很清楚，而对于开发者和用户的可持续设计的好处，这可能是立法、监管和刺激，策动地方当局和政府层面，需要确保一致的、可持续的方法。然而，可以看到，整合高层建筑和城市人居环境的好处显而易见，



Figure 7. PNC Plaza - Integrating with the Public Realm (Source: Connie Zhou)  
图7. PNC广场-整合公共空间 (来源: Connie Zhou)



Figure 8. Urban Environment - The High Line (Source: Eric Soltan)  
图8. 城市环境-高线空中公园 (来源: Eric Soltan)

present are met without compromising the ability to meet future needs. The responsibility for such an integrated approach will clearly fall on many parties, but it seems clear that, while there are benefits to sustainable design for developers and users alike, it may be that legislation, regulation and incentivisation, instigated at local authority and governmental level, is required to ensure a consistent, sustainable approach. As can be seen however, the benefits of integrating tall buildings and the urban habitat can have significant benefits to all parties, and can drive further investment and revenue, providing the incentives needed (Figure 8).

Solutions to sustainable development do not all look the same, however. The challenges and drivers differ from one location to another, and all must be considered in the process. Local environmental conditions and the type of macro infrastructure in a location play a big part.

What is also clear is that our current approach to sustainability globally is often piecemeal and inconsistent, and is largely falling short in addressing the real issues we face. Targeting density and building tall are often more a response to maximising return from expensive and scarce plots of land, sometimes under the banner of sustainability, but may indeed actually be less sustainable than well designed and connected urban sprawl. Such examples are seen in developing countries where mass tall building construction is evidenced, built around economic drivers which, while key to initial economic growth, need to be tempered through maturing of those markets to make sure that they are sustainable for the long term. The responsibility of architects and engineers to promote and pursue sustainable practices and approaches to design, considering the wider context, should also not be overlooked.

涉及各方在提供所需的激励机制可以推动进一步的投资和收入 (图8)。

可持续发展的解决方案大致是相同的,但是面临的挑战和受经济利益驱使不尽相同。综合考虑所有因素后,无论城市大小,当地的环境条件和配套的基础设施在一定程度上发挥了很大的作用。

目前我们朝着可持续方向发展不一致的步调,零散的分布,全球范围内某些城市在积极的需求可持续发展的方法,但是有些城市却没有,整体来看我们虽然一再强调可持续发展,但在很大程度上整体趋势处于下滑走势,我们需要真正的解决问题而不是停留在喊口号上。面对人口密集大规模的城市扩张和稀缺昂贵的土地资源,超高层建筑想要在此基础上做到可持续发展确实需要精心设计和城市发展的连通性,尤其是这种现状在发展中国家尤为突出,在市场不够成熟而受经济利益的驱使,经济增长是关键的情况下,对于建筑师和工程师来说责任重大,要综合考虑仔细斟酌寻求可持续发展的办法和设计,确保发展中国家能有长期发展可持续发展的可能。

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