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A Hypothesis in Future Development of High-Rise Buildings in China

中国高层建筑未来发展的一种假想



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Abstract

The so-called infinite challenge to building height is in fact only a matter of technology, having gradually deviated from people's consideration concerning the sustainable exploitation of available resources. China has its own characteristics: there is much hilly land in China accounting for more than 3/4 of its territory. Why don't we fully use hilly land, for example, building high-rises along slopes of the mountain as we imagined, and restore the flat land once occupied by the urban area to farming or reforest the land? Why isn't it possible for us to build high-rises along slopes of mountains in hilly land since buildings styled this way are expected to be the basic model in the future?

We will obtain a kind of "sloping high-rise" which can bring numerous benefits and multidirectional potential for the development of high-rises: being green, being flexible, and being sustainable...

Keywords: Hill Land, Sloping, Flexible, Sustainable

摘要

所谓的对建筑高度的无限挑战，其实只是一个技术的问题，已经逐渐偏离了人们对可用资源的可持续开发的考虑。中国有自己的特点：在中国有很多丘陵地带，约占其领土总面积超过3/4。我们为什么不充分利用丘陵岗地，例如，沿着山坡建设高楼，把一度被城市占据的平原地带还原给耕地或是森林？沿着山坡建立高楼是完全可行的，这种建筑方式预计将在未来成为建筑的基本模型。

我们将获得一种“倾斜的高层”，这种高层建筑可以带来许多好处，和高层建筑发展的各种潜力：是绿色，是灵活的，并且是可持续的。。。。。

关键词：山地，斜坡，灵活，可持续

Introduction

In the past 20 to 30 years, the implementation of the reform and opening up and the rapid acceleration of economy are accompanied by a large-scale city construction fervor. Extended from the coastal areas with developed economy to hinterlands, high-rise towers over the ground one after another, have changed the original urban images and narrowed the regional differences among cities.

100m, 200m, 300m, 400m, 500m... No one could predict the final height of a city's landmark building.

Before we hardly find time to be self-congratulatory for creating the huge buildings which not only save land resources but also fully represent the efficiency of the age, a raft of contradictions and problems from which numerous western cities have been taught lessons appear in China: the high plot ratio of high-rises brings about the high local density of population which results in a heavy traffic and further leads to the high energy consumption and high

导言

在近20-30年的中国，改革开放的推进和经济的迅速提升伴随而来的是大规模的造城运动，从经济发达的沿海迅速地向着内地延伸，高层建筑纷纷拔地而起，高层建筑改变了原有城市形象也缩小了城市之间的地域个性的差异。

100米，200米，300米，400米，500米.....谁都不能预测城市地标建筑的高度最后会停留在哪个数字。

在我们还来不及为这种既节约了土地又充满时代效率的庞然大物如雨后春笋般涌现而沾沾自喜的时候，一大推在无数的西方城市早已充满了教训的矛盾和问题在中国重现了：高层的高容积率带来了人口的局部高密度，高密度的人口带来了拥挤的交通，拥挤的交通带来高能耗和高排放.....，而这种令人不忍面对的每天都在发生的环境现实却总是夹带着烦躁、焦虑、压抑的精神后果。北京，一个又比一个大的“环”上艰难蠕动的车轮让它的驾驭者的天生的好脾气也成坏脾气，而从小养成的坏脾气却有可能磨蹭出好脾气.....，再看看上海陆家嘴的目前世界仅有的3幢400米以上

emission. Such environmental reality which is unbearable for us and which appears everyday always causes the spiritual consequences like boredom, anxiety, and depression. In Beijing, the wheels crawling on the increasingly growing "rings" turn the drivers' inborn good temper to bad temper or the bad temper cultivated since childhood to good temper. With regard to the 3 neighboring high-rises (Jin Mao Tower, Shanghai World Financial Center, and Shanghai Center which is to be completed soon) which respectively surpass 400m in Lujiazui, Shanghai, they rise steeply on the soft soil foundation, piercing the sky like three sharp swords. But what are their capacities when they run normally? Except for the number of guests and staff of the hotels of the high-rises: the office areas on floors 3-50 of Jin Mao Tower are used by near 10,000 persons; the Shanghai World Financial Center is capable of holding approximately 20,000 persons; and the Shanghai Center which is under construction is also expected to hold over 20,000 persons. This means that more than 50,000 persons go to work simultaneously within a merely same time in such a narrow space. Such scene is equivalent to an everyday opening and closing of a football match in a large football pitch full of audience, and the pressure to the traffic is beyond imagination. That is Shanghai which is a typical modern metropolis densely covered by high-rises. Its overground space is fully covered and so is its underground space. It is bearing the vast crowds of people and rolling vehicle wheels. How high will the next skyscraper rise above the ground, and can this trend be continued? All these have been doomed to be an insoluble endless loop.

People cannot help providing some explanations: It is because we have to preserve China's final arable land of 1.9 billion mu that we now creating more high-rises which make use of spaces at high altitudes. However, what we neglect is the area of roads we need to balance the traffic when we guarantee the arable land.

It is obvious that high-rises play an important role in driving the elevation and development of construction technologies. We have been constantly raising seismic fortification intensity and strength of soft soil foundation. We have manufactured the elevator moving at 17m/s, and we have reduced the dew point temperature of hollow glass. But in a sense, such "intensity, strength, speed, and temperature" we changed may be some mistakes because our new technologies actually have covered the reasons for the successive mistakes.

The so-called infinite challenge to building height is in fact only a matter of technology, having gradually deviated from people's consideration concerning the sustainable exploitation of available resources. Every life, every person, or every architect on the earth is only a passenger in the long process of history. The struggles that human beings experience are only several moments in the history. Plight of the reality and aspiration for an ideal future drive our buildings towards a desired goal via expedience and even compromises.

Analysis

Hereto, we must earnestly analyze the essential issues existing in every single high-rise which is a city cell.

Obviously, high-rises could easily and quickly change a city's image and skyline, which is one of the reasons why governments encourage the large-scale development of them. Developing towards the sky or occupying the sky space—a strategy full of excitement and challenge is indeed the most efficient way in saving the land resources, which is exactly the biggest advantage that high-rises provide and the major

的超高层紧邻的现象: 金茂大厦、环球金融中心和即将建成的上海中心, 它们已注定要默契地合力在上海的软土地基上一起做到了“刺破青天锷未残”壮举, 可是它们在正常运行下的容量有多大呢? 这几栋摩天楼若均不计其酒店部分入住和工作人员数量: 金茂大厦单3-50层办公部分就有近万人使用, 环球金融中心可容纳的办公人数亦近两万人, 而建造中的上海中心可容纳的办公人数将超过两万人。这就意味着在这个狭小的地带每天有超过5万人在很接近的时间内同时上下班, 相当于每天都有一个大型足球场的观众数量开场和散场一次, 那么它对于周围交通的压力已经无法想象。这就是上海, 最典型的高层密布的现代都市, 空中也架空了, 地下也掏空了, 却无奈地承受着浩瀚的人潮和滚滚涌来的车轮……, 还要造多高? 还能造多久? 这一切早已经注定成为一个无解的死循环。

人们不禁要为此辩解: 正式为了守住中国最后的19亿亩耕地红线, 就是必须竖起更多的高层而向天空要地, 但是人们忽略的问题是保障这个19亿亩耕地同时还需要多大的面积的道路面积来平衡交通问题?

无可厚非, 高层建筑给建造技术的提升与发展发挥了一个巨大的拉动作用, 我们挑战了抗震的烈度, 我们挑战了软土地基的强度, 我们制造了每秒17米电梯的速度, 我们降低了中空玻璃的露点温度……, 但是从某种意义上而言, 被我们所改变这一个又一个的“度”也许在某种意义上就是一个又一个的错误, 因为我们新的技术实际掩盖了一个又一个注定的错误的原因。

对高度所谓无限制的挑战, 事实上仅仅是一个纯技术意义上的问题, 已经逐渐背离了人类可持续的开发一切可利用资源的战略。这个星球上的每一种生命、每个人、每个建筑师都是历史长河中的一个过客, 无数次人类所经历的漫长的苦苦挣扎的百转千回都仅仅是这时间长河中一个或几个瞬间, 现实的困境和对理想未来的奢望使得建筑不断以权宜地折中地甚至是可妥协地方式向着美好的目标推进。

解析

对此, 我们必须认真地解析一番作为城市细胞的每一个公共建筑高层单体性的所存在的基本问题:

显然, 高层建筑能够轻而易举地迅速地改变城市的形象和天际线, 这也是政府鼓励其大规模发展的重要原因之一; 向空中发展或者直接说向空中要地——这种具有刺激性的和挑战的策略, 的确是节省土地的最有效的方式, 这正是高层建筑所具备的最大的优势, 也是我们难以将其割舍并努力发展与改良它的主要原因(图1)。但是它的一堆共生的顽症也跟随而来:

1. 首先是垂直交通的问题, 在24米以上建筑物内, 除了消防楼梯之外, 人流在垂直方向的运送主要依靠电梯系统, 但问题在于无论你在哪一个层面哪一个标高上, 总是始发和回归于同样一个汇集点——底楼电梯的等候空间和相关的交通区域, 一旦进入高峰时段, 这里就成了令所有人郁闷的人流瓶颈。即便如此, 任何开发者和设计者也绝不可能无视经济性而无限地增设电梯。而设备和能源的管线同样存在着与人流类似的问题, 局部负荷超大, 输送成本随着高度的攀升而攀升。在输送线路上的任何故障和突发情况一旦降临, 整个建筑物立刻陷入困境或停滞状态。如此一来, 为了保证设备稳定与管线的畅通, 整个大楼的运营与维护成本又成为了使用者和管理者难以忍受的重负。
2. 其次是建筑物高昂的造价, 若不计设备的投入, 单一系列削减水平力的抗震要求使得原本就庞大的结构成本

reason why we do not give them up but endeavor to develop and improve them. However, this has been accompanied by an assortment of persistent ailments (See Figure 1), including:

1. Problem on vertical transportation. Within a building above 24m, except the fire stairs, all people are vertically transported by elevators, but the problem is that no matter which floor or elevation you are in, you always start and end at a same gathering point– the point for waiting for the elevators and the necessary transportation area. During rush hours, the point is an annoying bottleneck issue for the stream of people. Even so, no developer and designer would add the number of elevators without taking consideration of the economic efficiency. Problems similar to those of the stream of people are also found in the pipelines of equipment and energy. Under heavy local loads, the transportation cost rises with the increasing height of the building. Once any malfunction or any emergency occurs on the transportation lines, the whole building will be immediately left high and dry, or in a stalemate. Sequentially, in order to guarantee the stability of equipment and smoothness of the pipelines, the cost of operation and maintenance of the whole building becomes a forbiddingly heavy burden for users and managers.
2. High cost of the building. Without factoring in the equipment input, only the anti-seismic requirements which reduce the horizontal forces will make the originally huge structure cost more exorbitant. In case of some adverse factors, for example, special soft soil foundation, the expenses on the structure alone will largely increase the pressure of leasing and marketing market.
3. Consumption of large amount of energies not only goes against the future development mainstream regarding energy conservation and sustainable development, but gives rise to the disadvantageous heat island effect and additional carbon emission.
4. Difficulties in disaster prevention and reduction have multiplied. In both the “9.11” terrorist attack in New York and the “11.15” fire in Shanghai, the high-rises suffered disastrous losses. However, while buildings grow taller, the conflict between the humanization of buildings and the increasing height of buildings now becomes more conspicuous and has evolved into a prominent social problem: the depressive space brings about more fear and boredom while the long-term living away from the ground has alienated us from the nature.

Even so, architects and engineers have never stopped researching and exploring high-rises. We make innovations in structure, and endeavor to make the shape and structure of high-rises closely connected. We apply new technological means to improve the equipment of high-rises and try to reduce the negative effects on high-rises, but what we could actually achieve is very limited. Contrarily, we help elevate the increasingly high urban capacity in a certain sense, and the urban problems will finally become a kind of insoluble vicious cycle.

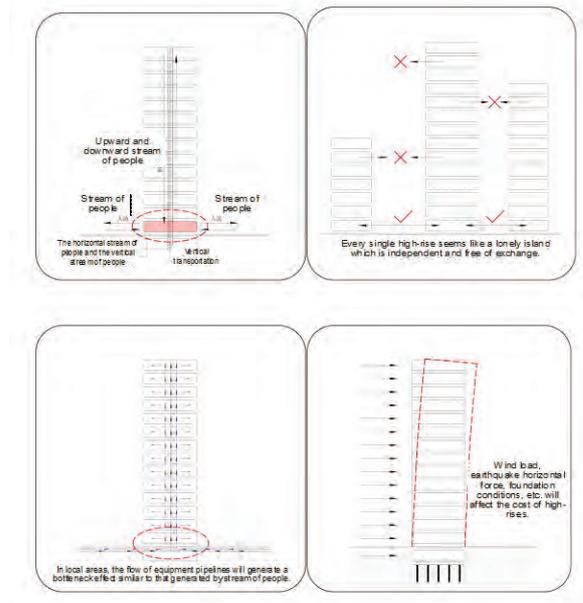


Figure 1. The challenges of high-rise buildings
图1.高层建筑面临的挑战

- 变得更加触目惊心，如果再遇上一些特殊软土地基等不利因素，仅仅结构花费就将直接地大大增加租赁与销售的市场压力。
3. 大量的能源损耗不仅仅有违于节能与可持续发展的未来主流，而且给城市增加了极为不利的热岛效应和额外的碳排放量。
 4. 大大地增加了防灾减灾的难度，从纽约的“911”恐怖袭击至上海的“11·15”大火都使得这些高层建筑付出了的惨重的代价。然而，在这一系列的技术性问题之外，而围绕着建筑的人性化与高度不断提升之间所引申出的矛盾也随着建筑的高度一样攀升，已经逐渐演变成为了一个显著的社会性问题：压抑的空间带来了更多地恐惧和烦躁，而长期远离地面愈加疏于自然。

尽管如此，建筑师，工程师们从来就没有停止过对高层的研究和探索的步伐，我们在结构上创新，努力使得高层的体型上与结构咬合的越加紧密；我们不断地运用新的科技手段改良高层的设备，力图减少高层建筑的负面效应，但是事实上我们所有能够做到的工作都是十分有限的，反而从某种意义上而言却是我们助长了越来越高的城市容量，而城市的问题终将形成了一种无解的怪圈。

求索

那么未来高层建筑的出路在何方？

显然应该从两个层面去判断和逻辑推导：

1. 一个城市规划的未来；
2. 一个未来高层建筑单体的理想化模式。那么未来高层建筑出路，理论上是一定是两者合二为一的产物。

Exploration

Where are the solutions for future high-rises?

It is obvious that judgment and logical derivation should be conducted from two aspects including,

1. future of urban planning;
2. an idealized pattern of future single high-rises. Theoretically, the future development direction of high-rises is bound to be the product of the two aspects.

A High-Rise Pattern in Dream

Before thinking about the future urban planning in a macroscopic way, we may free our mind and imagine the most ideal pattern for single high-rises: high-rise in our dream. High-Rise in our dream is capable of being flexible and convenient in vertical transportation and providing free exits and entrances at different elevations of several stories for people to enter and exit from the building instead of gathering at the base story or a certain story. She is capable of acquiring the connection points between equipment and pipelines for energy supply, water supply and water drainage and the external municipal pipelines from stories of different elevations, so as to largely reduce or avoid the bottleneck effect that these equipment and pipelines form at local areas of the high-rise. She is capable of, to the greatest extent, reducing the impact from horizontal force and seismic force. She must be green and able to reduce the energy consumption. She does not exist in the crowded steel forest any more. She is able to provide each story with an uncovered outdoor space, so that we could get close to the nature. . .

It will be wonderful if the future high-rises could present such dreamlands. However, how to tease the dreamlike thoughts and derive or realize breakthroughs in the idealized high-rises? We must seek for a sally port of the aforesaid key points and then gradually extend our explorations.

All key words like city, high-rise, and ecology focus on problems about human beings. So we should start from human-related problems, because those are the core of all contradictions, and other problems can be one by one solved with our current technological means or based on future sci-tech progresses. Let's picture the humanistic high-rise dreamland we just painted: we could be able to provide all users of each story with an external space close to the nature and the blue sky. What we could imagine is a high-rise in which each story is longer (shorter) than its neighboring story, which is indeed a good solution, but the area of outdoor terraces obtained from such traditional pattern is very limited compare with the whole high-rise (shown in figure as follows). The lower the story is, the larger the floor area needed and so will the area of the land occupied. The excessively small proportion of lower stories or the outdoor parts, or the excessively large depth will prevent the stories away from natural light. On the contrary, the area of nucleus of vertical transportation increases with the rise in height, which largely reduces the economic efficiency of the high-rise. Comprehensively speaking, it is hard to realize this kind of high-rise pattern in common urban environment. So we could imagine that if we derive a demarcation line parallel to the slope of terraces and get rid of all redundant uneconomical areas, we will obtain a "sloping high-rise" which is formed by parallelizing a string of standard stories to the slope. How to constitute such kind of building? The easiest way is to construct it on the slope of a mountain (See Figure 2).

一个梦想中的高层建筑模式

在我们宏观地思考未来城市规划以前，我们可以尽情地先设想一种高层建筑单体最为理想化的模式：我们梦想中的高层，她可以在垂直的交通上变得灵活与便捷，甚至可以从多个楼面的不同的标高上自由进出建筑物而并不是仅仅拥挤到底层或某一层；我们梦想中的高层，她可以从多个不同标高楼层获得多个的能源供给、水供给与排放等的设备管线与外界市政管线的对接点，最大程度地减少或避免这些设备管线在高层的局部区域可能会形成的瓶颈效应；我们梦想中的高层，她可以最大程度地减少所受水平力或地震力的影响，并且仅仅是以较低的投入代价取得；我们梦想中的高层，她必须是绿色的，能够最大限度地减低能源消耗；我们梦想中的高层，她不再生存于拥挤的钢铁森林之中；我们梦想中的高层，她可以让我们可以在每一层都可以获得没有一个上部覆盖体的室外空间去充分地贴近自然.....

未来的高层建筑若能呈现如此的诸多的梦境，当然是再美妙不过了。但是，如何梳理如此繁多而缥缈梦境的头绪并推导出或实现我们未来高层建筑理想化的突破呢？我们必须寻找到一个以上的关键点突破口，然后由点及面的展开与深入问题。

城市，高层建筑，生态.....，这些关键词的重心都在与人。因为人性化的问题才是一切矛盾的核心，其余的均可以现有的技术手段或未来的科技进步得到逐步地解决。我们先设想一下我们以上所描画出的人本主义高层的梦境：我们可以让每一层的使用者都能最大限度地得到一个切近自然的头顶蓝天的外部空间。是的，这样的模式大家想到的只可能是层层退台式样的高层建筑，这的确是一个很好的解决问题的方案，但是这样传统的层层退台方式所获得户外露台面积与整个高层建筑物体量相比却是非常有限（如下图所示），而且越是处于下部位置的楼层所需要的建筑面积越大，所占用的土地也就越大，且下部楼层或户外部分的比例过小或因进深过大而更加远离自然采光，反之，垂直交通核所占楼层的面积比例会随着高度变得越大，也就大大降低了这类高层经济性。综合而看，这种高层模式显然难以在我们普通的城市环境中实现。那么我们可以设想一下，如果我们能够推导出的一根平行于退台斜度分界线，把不经济的面积作为多余的部分切除掉，那么我们实际获得了一连串的标准层在高度的方向上沿着斜面上平行错位构成“斜体高层”，这样的建筑如何才能构成呢？最简单得方法——在山体的坡面上（见图2）！

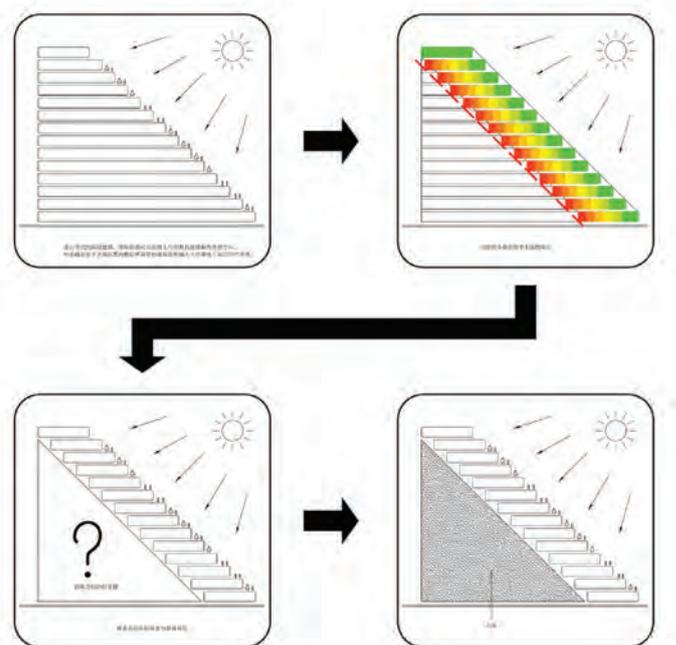


Figure 2. The diagram of hypothesis evolution
图2. 假想的演变过程图示

We finally derive the concept of “mountain”. Mountain belongs to the nature. Since the mankind wants to get close to the nature, natural mountains are the best choice for the carrier of high-rises.

The utilization of mountain slopes can bring numerous benefits and multidirectional potential for the development of high-rises (see Figure 3). First, in terms of construction concept, it provides every standard story with an open terrace, and the advantage in getting close to and integrating with the nature is obvious. It enables the high-rise to contact the outside world via different elevations, and the stream of people entering or evacuated from the building will not give rise to a bottle stopper effect on any story, so such sloping high-rise provides great convenience for the fire safety in terms of evacuation. It is able to provide free and smooth connections among several high-rises from different elevations, and enable the vertical transportation systems of the stories to be mutually supplemented, so that the resources could be reasonably allocated in a wider range, the economic efficiency of each single high-rise is increased, and the humanistic exchanges among high-rises could be enlarged. Second, in terms of structural system, the entire high-rise is closely connected with the mountain, so that the loads of the building are largely borne by the mountain and the direct impact on the building from horizontal force or earthquake force could be lowered to the greatest extent. It plays a significant role in both the safety and the economic efficiency. Third, in terms of the equipment of the main construction, the multidirectional connection between the internal pipelines and the external piping network makes the utilization and installation of construction equipment more flexible and diversified and makes it possible to realize a certain economical pattern effect in a wider range. Meanwhile, it reduces the possibility of equipment malfunctions in main construction and increases some more emergency response means.

What needs to be particularly explained is that such sloping high-rise pattern is different from the traditional sloping high-rises. The traditional sloping high-rises are vertical high-rises which are freely constructed according to the different elevations of base foundations and are the same as buildings on flat ground, ignoring the multi-elevation connection (closely connected to the slope) between the high-rise and the terrain, and among high-rises so that they cannot realize the aforesaid state of “high-rise in dream”.

Some Thoughts on China’s Future Cities

Buildings are fast “expanding into the sky” as a result of high density planning in cities as well as the mentality of reliance on central cities. In fact, from the 1940s, the development structure of cities in the West had been gradually adjusted. They tried on the approach of “organic decentralization” by decentralizing a central into several units, and organizing the units into centers for associated activities. Or they sped up growth of new cities around a central city by developing towns around the central city into independent sub centers as components of an urban belt with a view to diverting people who would have swarmed into the central city. Either in theory or practice, they aimed to reduce the pressure on central cities through a decentralized way of development. It is obvious that under the background, the prospect and space of development of high-rise, one of the major tools which contributed to (are contributing to) high-density development of cities, is greatly affected.

China is even more typical today. As the most populous country in the world, China is still at the stage of fast economic growth. More

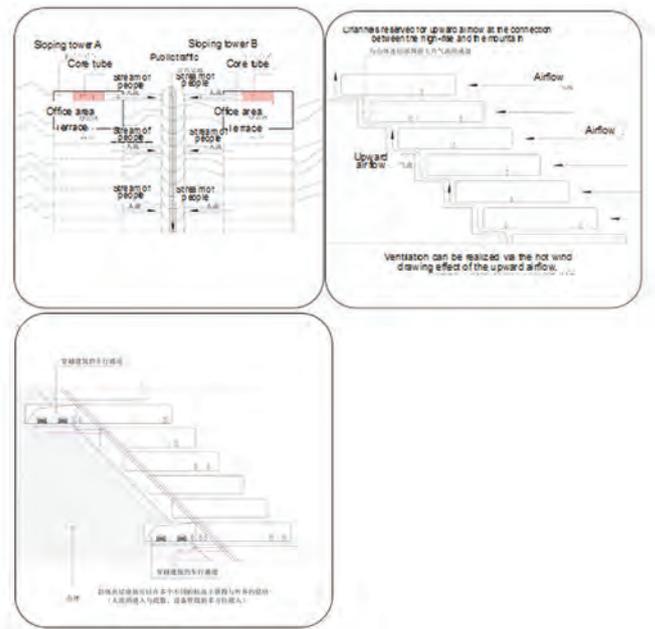


Figure 3. Solutions of the hypothesis
图3. 假想的解决方案

我们终于引导出“山体”这个概念! 山体是地球表面最自然的东西, 既然人类要贴近自然, 那么自然的山体完全可以成为高层建筑的载体。

山体的坡面利用可以为高层建筑的发展带来诸多的益处和多方位的潜力 (见图3): 首先在建筑概念上, 它使得每一个一个高层的标准层能最大限度地获得敞开的露台, 这种与自然的融合切近的优点是显而易见的; 它使得高层建筑可以从多个不同的标高获得与外界的联系, 如此一来, 无论是进入还是疏散出主体建筑的人流都不会在某一层上形成堵塞效应, 因此这种斜体高层的消防安全疏散将获得极大的便利; 它可以使得多个并联的高层之间、在多个标高上获得自由和顺畅的联系, 而且可以使得各个高层之间的垂直交通体系可以相互补充, 资源在更大的范围内合理分配, 提高每个单体的经济性和效率, 更可以扩大高层楼宇之间的人文交流。其次在结构体系上, 整个高层建筑与山体的紧密咬合, 使得建筑物的荷载有相当大的一部分直接由山体承受, 并且在可以最大程度减少水平力或地震力对建筑物的直接影响, 其安全性和经济性的意义巨大。再其次, 对于主体建筑的设备而言, 内部管线与外部的管网的多方位对接更使得建筑设备的利用与安装更具备了灵活性和多样性, 可以在更大的范围内达到某种经济性的规模效应, 同时也减小了主体建筑设备在运行中自身的故障发生的可能性, 并增加了更多的应急手段。

这里特别需要解释的是, 这种的斜体高层的模式, 不同于传统意义上的山地高层建筑, 传统意义山地高层建筑多为依据底层基准标高不同而自由建造的与平地建筑无异的垂直高层, 而且忽略了高层与地形之间、高层之间的多标高的联系——与坡面紧密咬合! 而无法达到我们上述所提及的“梦想高层”的状态。

一个中国未来城市的幻想

正是由于城市高度密集的规划和对中心城市的依赖, 才带来了“向空中伸展”的高层建筑迅速的发展。事实上自上世纪的40年代起, 西方社会已经逐步开始了对城市发展的结构布局的调整, 并对大城市或尝试“有机疏散”(即: 将拥挤城市疏散至若干的单元, 并将这些单元组织成相关联活动的集中点)、或加速新城发展(即: 将中心城市周围的城镇建设成若干个独立的中心, 成为城市圈带组成部分, 截流涌向中心城市的人潮), 无论是何种理论或实践的

and more people are migrating into cities. There are 236 cities in China which have a population of more than 500,000 respectively, accounting for 1/4 of cities which have a population of more than 500,000 respectively throughout the world. According to a report from the population division of the UN DESA (United Nations Department of Economic and Social Affairs), it is expected as of 2025 another 107 cities will join the rank; as of now, there are 142 cities in China which have a population of more than 1 million respectively (there were 29 as of 1978); there are 6 cities in China which have a population of more than 10 million respectively (there are 25 in the world); and there are 10 cities in China which have a population of 5-10 million respectively (based on data provided as of December, 2013). Central cities are increasingly blamed for the various urban diseases and potential future risks in the urban area which are taken into account when the government makes the overall plan for urban development in China.

China has its own characteristics. There is much hilly land in China accounting for more than 3/4 of its territory. It is flat in central and eastern China which is relatively developed. China has 1.9 billion mu of arable land. It has to feed more than 1 billion people. Obviously, this is a heavy task beyond the capacity of the conventional farming in China. Large-scale mechanized farming can only be fully used in flat land. In the flat land of China, there is scarcely large-scale forest around cities conducive to improvement of air and environment of the urban area. We need more land to feed the people. Even worse, because large area of land is requisitioned for the urbanization process in China, it is increasingly hard to leave the remaining 19-mu arable land (a red line set by the central government) intact. In mountainous areas in China, farming is done on terraced fields which are low in production capacity. Large-scale deforestation in mountains is blamed for major geological disasters such as debris flow, mudslide, etc (See Figure 4).

Here is a question. Why don't we fully use hilly land, for example, building high-rises along slopes of the mountain as we imagined, and restore the flat land once occupied by the urban area to farming or reforest the land?

Indeed, this is a great change which is to last for several generations. We are even horrified when we think about the change because firstly potential investment in terms of supporting facilities as well as the infrastructure for the city to be built in the mountain as we imagine is indeed more than that on the flat area; and because secondly we are used to the existing pattern of urban development as well as the allocation of resources. However, if we fully use sloping land and hilly land for the urbanization process, and if we reclaim or reforest land in the flat area once occupied by urban area, we can say we are step by step realizing a sustainable strategy of development which is to last for several generations. Of course, merely from an economic point of view, in a short term, it is impossible for us to give up the urban space we have established. But think about it. How long is the service life of the high-rises the humans created? 50 years? 100 years? What if the service life is 1,000 years? Compared with history of evolution of the mankind, 1,000 years are less significant. The "great change" is where the so-called "sustainable development" we talk about lies in. Through the "change which is to last for several generations" and the replacement strategy, we can reach an equilibrium point between sustainable development and use of resources.

方式，都是为了减小中心城市压力而分散化的发展。显然这样的背景下，那些曾经或正在帮助城市实现高密度发展的主要武器——高层建筑的前景与空间必将受到了极大的抑制。

今天中国情况与现状更是具有了代表性，作为人口数量第一的中国还继续处于经济快速上升期，城市与人口越来越集中，超过50万人口的城市达到236个，占全世界50万以上人口城市总量的1/4，联合国经济与社会事务部人口司有报告预测：到2025年，中国又将有107个城市加入这一行列；而目前超过百万人口的城市中国已经达到了142个（1978年时只有29个），其中，1000万人口以上的中国城市有6个，世界上也只有25个，500万-1000万人口的中国城市有10个（数据截止2013年12月）。一切城市问题和未来的隐患越来越凸显，目前中国政府所推广的城镇建设的正是在很大的程度上基于这类因素的考虑。

然而，中国客观国情又具有太多的特殊性，中国是一个多山的国度，全国山地面积占国土面积的3/4以上，平原和人口均集中要东部和中东部，而经济也正是这个区域相对发达。现在仅有的19亿亩的耕地要养活十几亿的人口，显然传统农业已经无法承受这样的能力，而大规模机械化作业也只能在平原上发挥出最大的效率。在平原地区中国几乎不存的环绕城市并能够改善城市空气环境的大面积的郊外森林，因为我们太需要更多的土地来养活人口，大量的城市扩容征地已经使得这最后的19亿亩土地红线的坚守已经越发困难了。而在中国的广袤的山区农业却只能依靠劳动效率极其低下的梯田，而大面积的山林砍伐更是造成了大量的泥石流山体滑坡、等地质灾害（见图4）。

我们是否可以提出一个问题，为什么我们不能充分利用山地，比如：想象中沿着山坡建满高层建筑，同时将之前占据的平地归还给农田和森林呢？

这的确是一种需要几代人的沧海桑田的巨大转变，甚至会让感到某种恐惧：首先，山地城市配套和市政投入成本肯定高于平原。其次，我们已经习惯现有的城市模式和资源的配置。但是中国那大面积的坡地和丘陵如果于被城市化地利用起来，并置换出大量的平原城市的土地，这将是一个通过几代人逐步才能实现的真正意义上可持续发展的战略。诚然，我们单单从经济角度而言，在目前短时期内无法割舍我们早已建成的城市空间，但仔细想来，人类的创造的这些高层建筑的使用寿命是什么呢？50年？100年？就算是1000年又当如何？与人类社会的未来长河相比，是何等的微不足道？这也正是人类提出的“可持续发展”的意义所在，也正是这样长期的过度与置换，以达到可持续发展与现有财富利用的平衡点。

在此，我们必须探究和解释另一个逻辑概念，为何在山地不采用传统意义上的分散的多单体的建筑却要嫁接其这类斜体高层呢？因为，我们的山地与平原同样需要我们节省用地，这种新坡

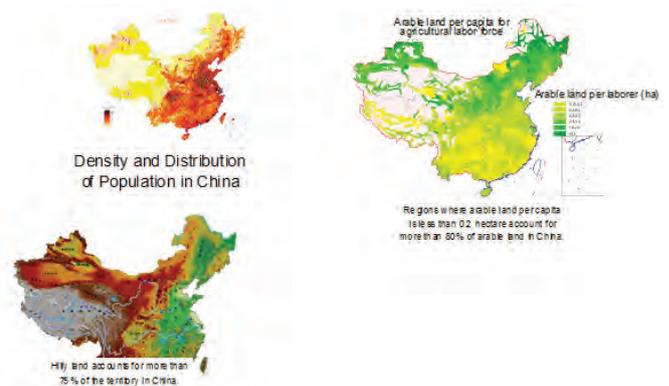


Figure 4. Resources and potential for the hypothesis in China
图4. 中国适用假想的资源和潜力

Here, we have to make a further explanation for the question “why do we build such sloping high-rises rather than scattered complex or independent buildings on slopes of the mountain?” Since we have to be economical on use of land both in hilly land and flat land, high-rises we build along the slopes are capable of retaining all advantages of high-rises, such as economic use of land, efficiency, central management and control of equipment, etc. And on the other hand, we can fully use the vertical space between high-rises for growing vegetation or reforestation, etc., and more importantly, improving microclimate between the high-rises as well as the visual landscape. In addition, high-rises built along the slopes have the positive effects such as protecting the slope, preventing loss of soil and water as well as secondary geological disasters from happening, etc (See Figure 5).

How can we fully realize functions potentially provided by high-rises built along slopes of the mountain and promote development of the mode? Firstly, when we plan for overall urban development, we have to scientifically locate the city based on comprehensive study of natural conditions, such as geological conditions, hydrological conditions, climate, etc. Secondly, we have to make a series of guiding policies to gradually decentralize the available populous cities. Thirdly, we have to fully use the modern technology. Today, the automobile express system is increasingly losing its edge to the information highway. We can easily acquire information from deep inside the mountain all over the world. We can easily shop in hilly land. We can easily attend the conference over trade of financial futures via a long-distance audiovisual system in the mountains....All these activities would be only possible if conducted in a high-density city. Development of modern technologies may alleviate the urban diseases. It helps reduce man's reliance on central cities. It provides a solid base as well as a means for diversification and flexibility of overall planning for green cities in the future. More importantly, it forebodes a bright market prospect for development of high-rises to be built on slopes as we imagine. We can use the advantageous factors of the existing land policies. China is equipped with another special advantage operable: the owner of any building in China has the land use right of the land on which his or her building is situated rather than the right of ownership thereof.

Based on inference from our independent study on urban development, we arrive at the same conclusion: it is possible for us to build high-rises along slopes of mountains in hilly land since buildings styled this way are expected to be the basic model in the future.

As is required by humanistic spirit, we need to have a building space which improves our living and working conditions; we need to be brave enough to abandon the concrete forest we have been always grumbling about but are reluctant to part with; we should not use green and sustainable development as a buzzword or a label to be pasted at will but as the strategy for real time practice; we have to remind the designers that they would be in a dilemma if they only mind the excessive details or simply intend to challenge the technology at the cost of long-term planning. Using high-rises as one of the means to get more space and more height from the nature, we, the mankind never ends challenges against the nature. Over the years, designers have come up with a series of experience that enables high-rises to be efficient in the use of space. At the same time, they are continually improving the experiences. Today, we are again at a crossroad: protecting the environment or seeking economic development, achieving short term effects or sustainable development. The conclusion we get from countless painful lessons, experiments, and attempts is once more affirmed: Only by integrating with the natural elements can high-rises maintain the vitality!

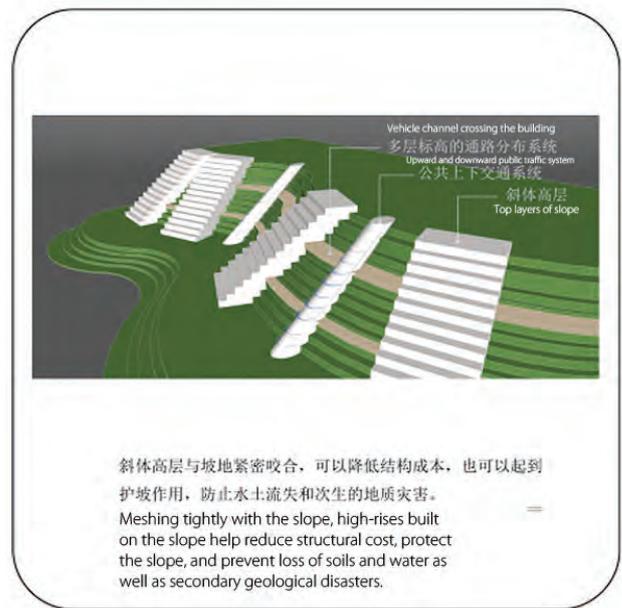


Figure 5. The advantages of the hypothesis
图5. 假想的优势

地高层不仅仅保留所有高层的优点:节约土地、使用效率高、设备集中管理与控制等,高层之间的接缝地带就可以最大范围地节省出归于山林草坡等的垂直绿地,并可以直接改善高层的小气候环境和视觉景观。除此之外,新型坡地高层还有一些更积极的作用,比如护坡,防止水土流失和次生的地质灾害的产生(见图5)。

如何实现这种新型坡地斜体高层功效的最大化并推动这种模式的发展?首先是在对未来城市规划过程中,必须综合地质、水文、气候等自然条件科学地选址;其次制定一系列的主导性的政策,逐步疏散高密度城市人口;充分利用现代科技的力量,在今天信息高速公路正在取代车轮的高速公路,我们早已经可以轻松地从遥远偏僻的山地获得全世界各地的资讯、可以在山地进行自由地购物、可以在山地进行金融期货的交易也可以进行远程视频会议.....——这些曾经只可能在高密度的城市中才能完成活动。这一切现代科技发展为城市的分解,减少人类对中心城市的依赖,为未来的绿色城市规划的多样性和灵活性提供了最有力地支撑和手段,更可以为提高我们的未来的坡地斜体高层市场前景带来无限的光明;利用当前土地政策有利因素:中国具备有另一个特殊的可操作性优势:中国目前建筑的土地产权不属于建筑的业主,这将大大有利于政策的引导。

我们从单体和城市发展的维度的推导,殊途同归地得到了一个共同的结论——未来的高层建筑可以向山地发展,并以这种斜体高层作为未来的高层发展的一种基本模式!

人本主义的精神需要一个能改善我们生存与工作的状况建筑空间,需要我们有一种告别我们现有不断被抱怨却又恋恋不舍的钢铁森林的勇气;建筑设计中的绿色和可持续发展不再是口号和可以随意粘贴的标签,它需要的是真实的建筑载体来实践,它需要设计者理解:忽略长远的规划却仅仅为挑战技术而过度的设计终将走入困境。高层建筑作为人类向空间要地、向高度和向各种自然力挑战的产物从来也没有停止过自身改变,多年以来设计师总结出了一系列的经验使得高层建筑能够在保持自身的空间效率的同时又得以不断的完善。今天我们再次走到了要环境还是要发展、要立竿见影的短期效应还是可持续发展的多岔路口,而实际的结论已经从我们无数次惨痛教训中、从无数次新的探索和尝试中逐步得到了肯定——融入自然才能赋予高层建筑继续发展的新的生命力!

Epilogue

I, the author, am an architect. I always try to get away from the worsening environment in urban areas. Fortunately, every one of us acts quicker in thought than deed. I try to grasp some clues from my train of thoughts. Although incomplete and immature, the clues are some of my visions about the trend of development of high-rises in the future. They may not be well thought-out and some of them may even conflict with each other. It is my hope, however, that they will be constantly improved with input from others and finally prove their value in application.

尾声

因为笔者作为一个建筑师，无时无刻不在想挣脱当下一系列不断被激化的城市空间矛盾所笼罩下的环境状况，所幸的是任何人都可以让思想永远比行动更快更自由，可以在无数的转瞬即逝的思绪中努力地去抓住一个个零散的片段，这些既不完整也不成熟的片段仅仅是对未来高层一个假想，粗浅中又夹杂着诸多方面的问题和复杂的矛盾。希望它能够在多方位的意见中不断地完善，并在完善中获得其实际的价值。