Title:	**Sustainable Buildings - or Sustainable Cities?**
Author:	Mark Schwettmann, Skidmore, Owings & Merrill
Subjects:	Sustainability/Green/Energy Urban Design
Keywords:	Community Density Sustainability Urban Design
Publication Date:	2015
Original Publication:	International Journal of High-Rise Buildings Volume 4 Number 2
Paper Type:	1. Book chapter/Part chapter 2. **Journal paper** 3. Conference proceeding 4. Unpublished conference paper 5. Magazine article 6. Unpublished

International Journal of High-Rise Buildings
June 2015, Vol 4, No 2, 103-107

International Journal of
High-Rise Buildings
www.ctbuh-korea.org/ijhrb/index.php

Sustainable Buildings - or Sustainable Cities?

Mark Schwettmann†

Skidmore, Owings & Merrill Llp, One Front Street, San Francisco, CA 94111, USA

Abstract

China's rapidly growing cities offer a unique opportunity to create highly sustainable communities. Architects and their clients, typically real estate developers, are highly focused on strategies that are effective at reducing energy and water usage at the scale of the individual building or within a master plan of multiple related buildings. However, a closer look at energy consumption reveals that transportation uses more energy worldwide than residential and commercial buildings combined. In light of this, it is appropriate that China is making massive investments in transportation infrastructure like heavy rail rapid transit and grade separated expressways, but the end result of these investments to date has been to enable people to live further from where they work and shop rather than closer - while simultaneously not creating walkable communities. Using positive and negative examples from Asia and the rest of the world, this article will investigate the specific urban design policies such as height limits, setbacks, land use restrictions, parking ratios, and parcel size which might change to enable the creation of truly sustainable communities for China's 21st century.

Keywords: Walkable, Diverse, Sustainable cities

The migration of China's population to its major cities is by now a documented phenomenon, with 54% of Chinese living in cities. The government plans to increase this to 60% by 2020.[1] These 800 million urban dwellers make the sustainability of those cities a key issue for China and the world in the 21st Century. Sustainability in the context of the built environment is dependent upon reducing our use of raw materials, water, and energy.

This article focuses on energy, which is perhaps easiest to quantify, and at some level serves as a proxy for the other two. China's largest use of energy by far is in industry, which could be more fairly attributed to the rest of the world, since China is the world's largest exporter, producing so many of the rest of the world's consumer goods. After industry, transport and buildings are by far the largest users of energy in China.[2]

On the surface, the tall building seems to be the ideal response to reducing energy usage in both of these areas. It allows more people to live closer together, presumably reducing the distance between places. It ought to use less material per person (a skyscraper only has one roof, after all), it allows larger-scale and more efficient building systems, and it reduces the amount of land consumed per person. However, this initial impression is not borne out by data from any of Asia's large cities: there does not appear to be any correlation between tall buildings and reduced energy consumption, or even increased use of efficient mass transit.

The energy consumed by buildings themselves for heating, cooling, lighting, conveyance, and equipment can certainly be reduced through good design, but the easiest (and largest) improvements have already been made. In fact, it is likely that as living standards increase, the increasing area per person will offset any significant gains brought by improved building systems and envelopes.

Beyond the efficiency of building systems, there are two major areas for large-scale improvements in energy usage. The first is the overall form of buildings, which governs not just their sensitivity to internal loads and climatic factors, but also the maximum density achievable on a given piece of land, through height, bulk, and spacing limitations. The second is transportation, which is driven in large part by the relationships between buildings, the rules that govern their use, and the transportation systems (including people's feet!) that connect them.

Much more than their total height, the form of buildings at their lower 8 to 12 levels and the relationships between buildings drive the overall density of cities. As China's cities have grown, centralized planning has focused on preserving light and air at the ground and setting aside a significant portion of each site for open space. This has generally resulted in fairly tall buildings, set back

†Corresponding author: Mark Schwettmann
Tel: +1-415-981-1555; Fax: +1-415-398-3214
E-mail: Mark.schwettmann@som.com

[1]"The Great Transition." The Economist, 22 Mar 2014

[2]David Fridley, Mark Levine, Hongyou Lu, Cecilia Fino-Chen. *Key China Energy Statistics*. Lawrence Berkeley National Laboratory, 2012. https://china.lbl.gov/sites/all/files/key-china-energy-statistics-2012-june-2012.pdf

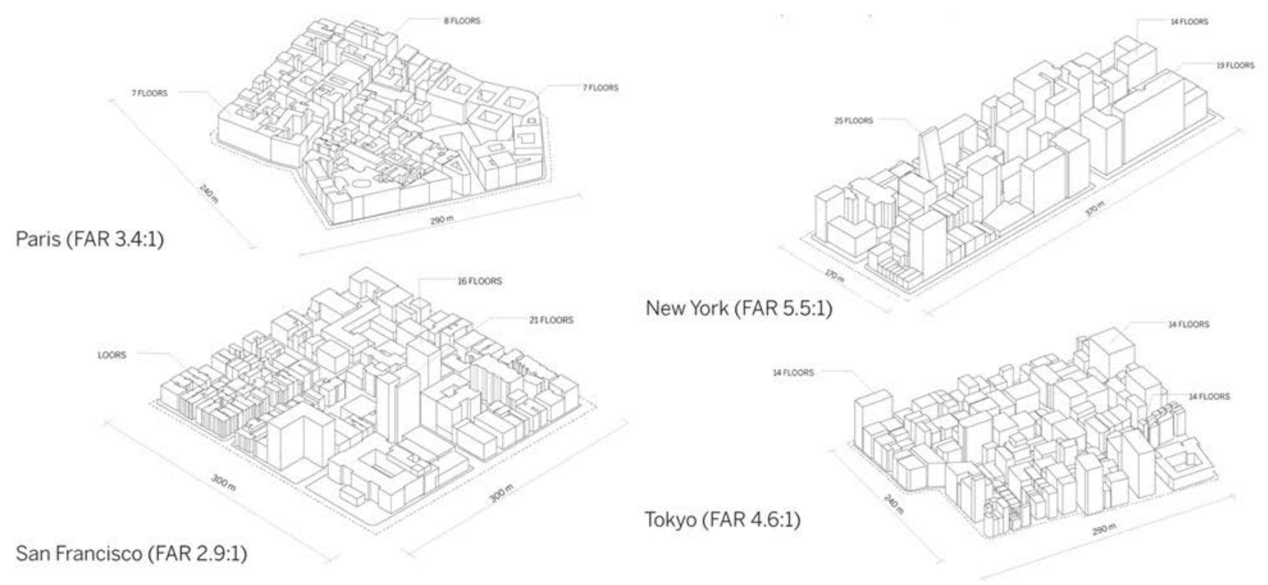

Figure 1. Traditional City Forms of Selected world Cities.

significantly from streets and from each other. These relatively open street levels have a significant effect on transportation, which will be discussed later, but the most obvious and immediate consequence is significantly less net density in Chinese cities than in other world cities.

This pattern of buildings is compounded by the secondary effects of other well-intentioned regulations. The requirement for direct sunlight in dwelling units codified in GB50180-93 results in essentially single-loaded buildings, which at any given height and spacing have less than half the actual density of the double-loaded or courtyard-style apartment blocks seen throughout most of the world. Coupled with the structural and other design requirements for high-rise buildings, the true density of residential neighborhoods in China is surprisingly less than expected.

Around the world, there are examples of desirable, economically vibrant, and intellectually rich communities in which buildings are much more closely spaced. In fact, the most prestigious parts of most of the world's "alpha cities" tend not to feature widely-spaced towers or blocks, but rather a continuous street wall of three to eight stories, with individual smaller buildings aggregated into a single block form, with an open space at the center to allow light and air into the "rear" units. In Paris, for example, this form yields an FAR, including rights-of-way, of around

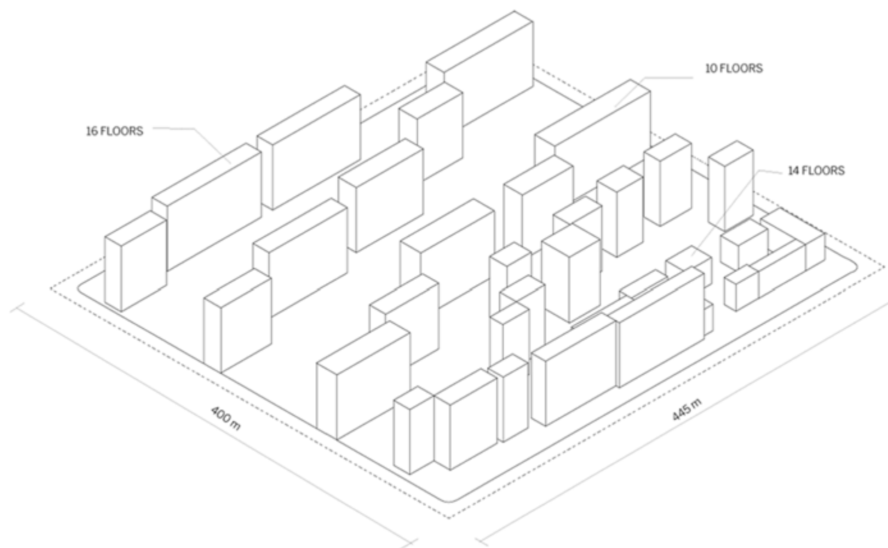

Figure 2. Typical High Density Beijing Residential Neighborhood (2.5:1).

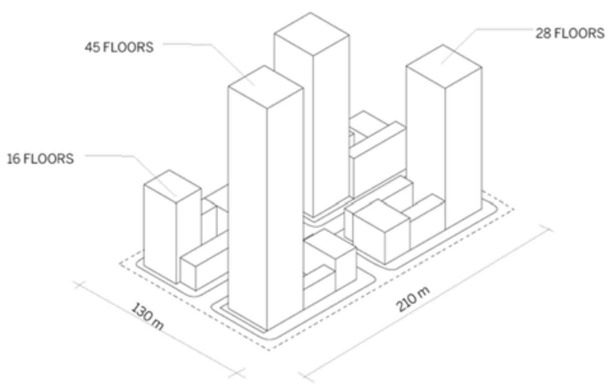

Figure 3. Hybrid Tower and Street Wall Development Model.

4.0:1, as illustrated by Fig. 1. Modern Chinese large-scale residential complexes of the type illustrated in Fig. 2 feature buildings of up to 30 stories, but the wide building spacing and much larger rights-of-way yield less FAR - about 3.5:1 - than Paris' 200-year-old, six-story blocks.

In response to this, many cities around the world have begun pursuing a hybrid of these models, with very dense, high site-coverage podiums of four to 10 stories, topped by relatively slender and widely spaced towers of 30 to 50 stories. In San Francisco, which has fairly wide rights-of-way compared to older European or Asian cities, this model, as illustrated by Fig. 3, yields a district FAR of close to 10.0:1, even with tower spacing of more than 30 meters and heights well under 200 meters.

Even more interestingly, the amount of built area available at the ground for the kinds of activities that encourage walking and transit use is vastly higher in the mid-rise model. Although the increased coverage of the ground floor reduces the total amount of open space available, a significant amount of space is often provided at the second or third level of the interior block, and rather than distributing relatively unusable buffers of planting around and between buildings, a better model is to set aside a small fraction of the blocks of an entire district for truly public parks, which act as centers of a larger community. Fig. 4 illustrates the ratio of interior to exterior ground-floor space through several of the world's major cities, revealing particularly that the ratio of active street-facing enclosed space in modern Chinese cities is significantly less than their global counterparts.

Beyond encouraging walking and using less land, building at higher densities both at and above the ground floor allows the economic construction of efficient fixed-guideway mass transit systems. China is in the midst of the world's most ambitious plan of construction of public transport, and the mode selected for most major cities is significantly more efficient than the private automobile, at around 0.48 MJ/ km versus 2.33 MJ/km based on similar systems in Asia.[3]

However, despite the construction in an extraordinarily short time of one of the world's most extensive subway systems, the modal share for automobiles (private and taxi) in Beijing is increasing rather than decreasing, from around 20 percent at the turn of the century to almost 40 percent in 2012.[4] Why might this be? Rising wealth need not result in decreasing transit usage. Tokyo, which has been mostly rebuilt in the 20th Century with a mix of mid-rise buildings and tall towers, and has seen an enormous increase in wealth in the same period, has a combined modal share of walking, cycling, and mass transit of 88% - among the highest in the world.[5]

There are certainly cultural factors at play here, in particular the emulation of North American cities and consumer patterns, but even these are beginning to break down. The opportunity for mobility is still considered a luxury in most of the world and it is superficially epitomized in some cultures by the private automobile, which enables transportation over large distances with ease. On the other hand increasing traffic congestion has revealed that the necessity of traveling so much; for example, living 50 miles from the nearest market or workplace, is not seen as a luxury. Today's most desirable urban environments are those in which a wide range of uses are clustered closely together, and there is a great enough critical mass of consumers to support different types of shops, restaurants, entertainment venues, and healthcare services. Ideally, all of these "amenities" are within walking distance, but more realistically, some are local and others require the use of transport. The rise of Walk Score as a contributor to real-estate value in some Western countries is a direct reflection of the ultimate convenience of walking. Walking costs nothing, requires no equipment, has obvious health benefits, and is extremely predictable: a 10-minute walk takes 10 minutes regardless of traffic, headways, or weather.

Of course, not all trips can be made on foot. With or without efficient public transport, energy consumption, costs, and use of land resources are driven by the length of the trip itself. The length of trips is driven in part by market factors such as dissimilar land values throughout the city, but equally by the arrangement of different uses within the city. Most trips originate and end in zones of different uses, whether it be from home to work, work to home, home to market, work to entertainment, or other

[3]Jeff Kenworthy. "Transport Energy Use and Greenhouse Gases in Urban Passenger Transport Systems: A study of 84 Global Cities." Third Conference of the Regional Government Network for Sustainable Development, Notre Dame University, Fremantle, Western Australia, September 17-19, 2003. Print.

[4]Kyle Mackie, "Beijing's Modal Share Changes: 1986-2011," *TheCityFix*, Web. January 13, 2014.

[5]"Passenger Transport Mode Share in World Cities." *Journeys*. November 2011: 60-70. Web.

Figure 4. The density at the ground of many of China's large scale developments is a radical departure from the patterns of most of the world's most successful cities, resulting in a significantly less walkable environment.

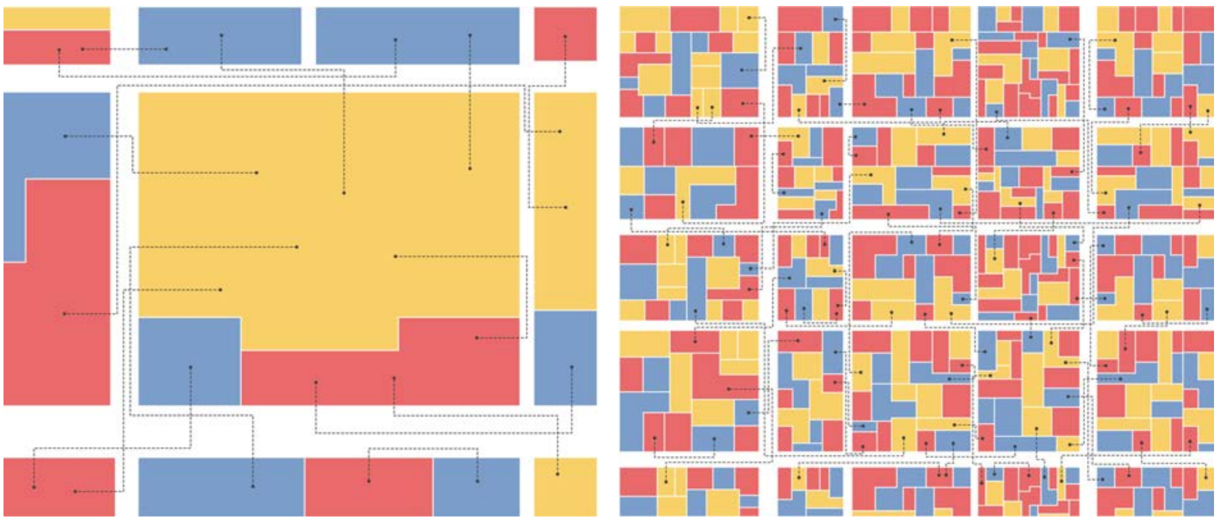

Figure 5. The larger the homegoneous block of uses, the longer the average trip between uses (e.g. commuting or a trip to a retailer) will be. The average distance between the nearest zones of different types is more than twice as long in the upper diagram.

combinations. According to the 2009 American NHTS survey on household travel, more than 60 percent of trips are related to commuting, shopping, and trips to school, church, or medical appointments.[6] Fig. 5 illustrates a basic geometric principle: the larger that individual homogenous use zones are, the lengthier on average each of these trips between use zones trip will be. This is a reasonable basis for the fairly typical requirement for ground-floor retail in many districts of the city, but it also suggests that less differentiation between residential and commercial zones could reduce overall transportation demand by increasing the likelihood that a desired complementary use is nearby. The effects of very large homogenous zones and extensive freeway construction can be partly seen in rapidly increasing trip lengths, which have increased 55 percent in Beijing in the 22 years prior to the 2008 Olympics.[7]

In summary, the main factor behind the rise of the automobile against walking, cycling, and transit in large, modern Chinese cities is not cultural or economic, but is in fact poor urban planning. Streets are too wide, buildings are too far apart, there are too few active ground floor uses in proportion to upper floors, and uses are not diverse enough to allow short trips. Finally, despite the very tall buildings being permitted, designed, and built, the overall densities are too low to support truly energy-efficient transport pattern. The path towards highly sustainable tall buildings does not lie only in the buildings themselves, entirely with their architects and developers, but in their relationships to each other, their relationship to the urban fabric, and with the urban planners and government agencies that create the regulatory framework and city structure to which each building connects. Basic policies that would improve the environmental and social sustainability of China's cities would include: (i) the elimination of most, if not all ground-floor setback requirements, (ii) the elimination of homogenous zoning over very large areas, (iii) the reduction of block sizes or a new requirement for publicly accessible privately owned ways through those very large blocks, (iv) the reduction of the widths of rights-of -way, and (v) the adjustment of the sunlight requirement. Ironically, these changes would likely result not only in the consumption of less energy and material in China's cities, but also in higher density, higher land value, and higher quality of life.

[6]United States. Department of Transportation. *Summary of Travel Trends: 2009 National Household Travel Survey*. June 2011

[7]Feng Liguang, Zhang Haozhi, Jiang Yulin, Wang Zhaorong. Evaluation on the Effect of Car Use Restriction Measures in Bejing. *Transportation Research Forum*. 2010 Annual Forum