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Arch 384
December 10, 2006

Skyscraper of the Future : the Garden Tower

Figure 1: A common scene in major cities - the sun radiating thru a thick layer of smog

Economic expansions, out-of-control population growth, increasing speed of transportations are some of the major measures of human progress. However, amid the rapidity of today's world, the Information/Digital Age, our convenience, luxury, and indulgence are causing the city to swell to a disproportionate size to it's natural surrounding, endangering an utopian dream to become an uninhabitable mirage. Increasing demands for urban spaces pushed the environment to grow vertical and compact. The traditional front-lawn houses are cut away and rearranged into skyscrapers, losing their greenness and their "neighborhoodness". The sky becomes thick with people coalescing into incestuous conditioned rooms overheated by their own comfort. The heat becomes unbearable.

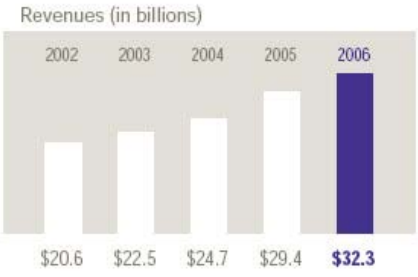

Figure 2: Fedex and other couriers have exhibited substantial growth, an indicator that the internet has created a global market resulting in increase transactions and movements.

Source: http://www.fedex.com/us/investorrelations/fin

The skyscraper is a major component that makes up a city but unless its meaning can go beyond what it means today, the city will continue to grow with ever mounting waste. The construct of a city have always been a reflection of its citizen's ideology. From ancient Egypt monumental stone tombs, symbolizing human immortality, to ancient Athens human metamorphosis within an untamed nature, nowadays it is the opposite. The wild is subdued. Contemporary high-rise exist as blunt instruments, unbound from nature thanks to the invention of air-conditioning. Modernism has turned the city into an unceasing machine, an economic

power house over shadowing it operator with the smog it exhales. In danger of intoxication, society changes its economic paradigm, from profit driven to environmental partnership—equal growth. Emerging from the city's center, the Garden Tower represents a new era of skyscrapers shaped by an eco-conscious political agenda, inverting the hierarchy of power and placing the importance of green space over commercial real-estate.

The primary strategy of the Garden Tower is to improve air quality by reducing the heat within the city, heat that is generated by hard surfaces, mechanical systems, and cars. There are two reasons why reducing heat is the focus. First, studies have shown a direct relationship between pollution and air temperature. The hotter it gets the smoggier it is due to photochemical reaction of the pollutants in the air. For example, in Los Angeles, as temperature rises above 95º F, smoggy days measuring above the national standard also increases (figure 3) [1]. The second reason is the city is seen as an inefficient machine due to rampant commercial development. This intensity and rapid growth of the economy have destabilized the environment to a point that makes the city no longer a desirable place to live as densification of buildings and people pollute the air. As observed in an ecological view by Guy Brattle and Christopher MaCarthy, "It is not a question of the presence of pollutions or poisons—which abound in nature—but in their concentration."[2] This is to say the city, as it grows or densify, fails to address its by-product, resulting in a poorly functioning environment; like that of a computer lab with inadequate air-conditioning or a library lacking reading light. The design

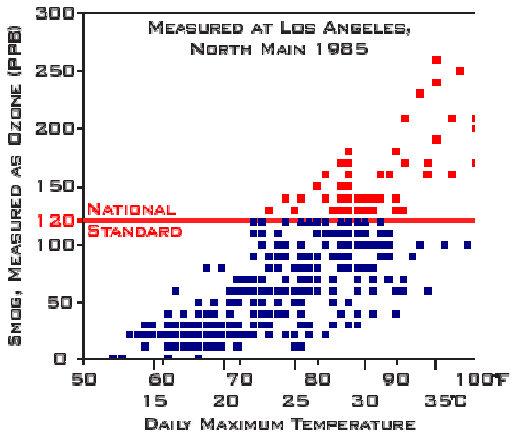

Figure 3: Significant increase in smog as temperature goes above 95ºF in Los Angeles

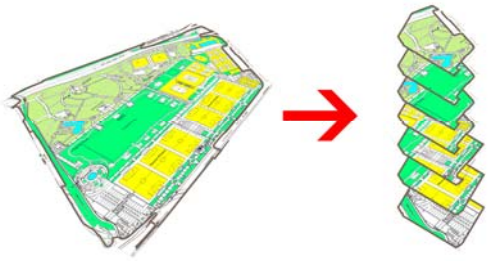

Figure 4: Conceptual diagram of the Garden tower as a flat park turned vertical

[1] Learning About Urban Heat Island. p. 1-2.
[2] Battle, Guy and Christopher MaCarthy. Sustainable Ecosystems and the Built Environment. p. 71.

of the Garden Tower proposes to replace what normally would be valuable commercial areas with vegetation in order to alleviate the current and future problem of pollution in a city.

By dispersing green areas horizontally and vertically into urban core, the air will become cooler. Typical high-rise construction has increase "profitable" floor area by many folds without compensating for the additional strain on the "natural" environment. As vehicles, pedestrian, and buildings condense, plants and trees become insignificant when compared to hard surfaces in an urban context. Vegetations are sparse on the streets; parks add minimal relief and exist only on a singular plane, never on a multi-level structure. There have been attempts to create sky gardens but usually the end product becomes sky lobbies with few plants and limited access for the public. As a result, these imbalances exasperate the heat island effect and air pollution. The Garden Tower counteracts this problem. Ken Yeang, in *Reinventing the Skyscraper,* have pointed out that plants can reduce air temperature by as much as 5º Celsius thru absorption and evapotranspiration, potentially cutting air-conditioning cost by 25% to 80%[3]. This reduction will have an accumulative effect further promoting a cooler climate as the use of air-conditioning contribute noticeable warming to the surrounding especially in dense cities like Hong Kong where virtually every residence and business is equipped with a unit. Moreover, the shading provided by the tree canopies will help further reduce heat absorption. In addition, plants have the ability to clean the air of harmful particulates. For instance, research by Nasa found that Spider plants can absorb formaldehyde, a major component of smog and a cause of asthmatic symptoms[4].

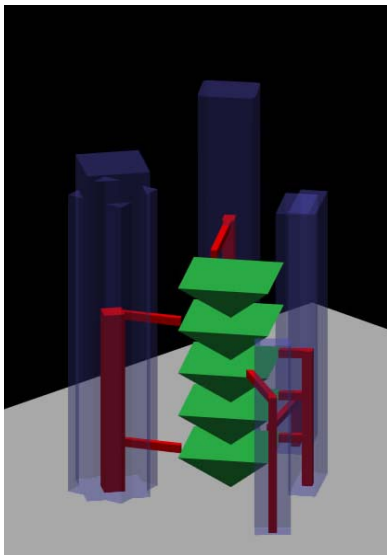

Figure 5: 3D study of how sky bridges can link to surrounding buildings, utilizes their cores as an elevated circulation network.

A complimentary benefit to the towers method of dispersing greenery is improved circulation. The system of sky bridges is like a neighbourhood in the sky. By physically

[3] Yeang, Ken. Reinventing the Skyscraper. P. 133-34.
[4] Battle, Guy and Christopher MaCarthy. Sustainable Ecosystems and the Built Environment. P. 71.

connecting to near-by buildings, the Garden Tower establishes not only lateral stability for its structure, but also manifest as a suburban sprawl within a congested downtown core. The array of sky bridges creates multiple paths of travel and exit points for pedestrians, utilizing other building's elevators to form a complex network of movement above the ground. With the decrease in ground and vehicular transportation, heat and toxic pollutant is also reduced.

Along with its environmental impact, the Garden Tower also address a common social issue in high-rise living—alienation and isolation of inhabitants from each other[5]. The popularity of standard central core layout offers little chance or appropriate spaces for social interaction, spaces like the such as the elevator or the hallway. In the Garden Tower, these spaces have an opposite quality akin to the openness of living in suburban neighbourhoods. The importance of achieving a sense of a "neighbourhood" relates to the ultimate goal of architecture or "utopian" living condition. In the book *Impossible World*, Stephen Coates and Alex Stetter wrote about our aspiration for utopia, that our nature is to yearn for things absent from our daily life, that one such utopian quality is to have freedom and a piece of land to do as we please, to live off the land[6]. What could have been an narrow corridor now becomes an outdoor public sidewalk with private gardens. These sidewalks, found along the sky bridges, have front lawns and rows of residential entries, creating a intimate scale within the city thru individual expression and private properties, reminiscent of a neigbourhood community rather than a conduit of interior of gypsum wall board. Crossing from one bridge to another from multiple entry points, the private and public realm overlap, stimulating social interactions. Breaking down further the barrier of alienation are the intersections at the tower which become large open areas of public amenities similar to a plaza found at ground level.

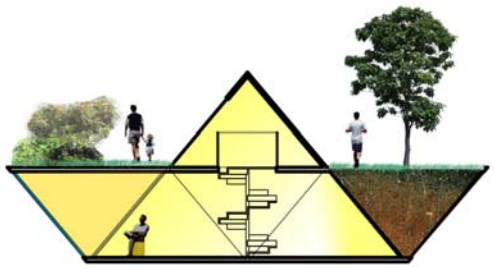

Figure 6: Cross section of the sky bridge shows residential unit s below and sidewalks and lawns above

[5] Yeang, Ken. Reinventing the Skyscraper. P. 140.
[6] Coates, Stephen and Alex Stetter. Impossible World. P. 8.

In technical matters, the Garden Tower form and structure, in part, is determined by the advancement of material and technology. The discovery of new materials had always had an enormous impact on the shaping of skyscrapers. Historically, skyscraper construction went thru three periods with each reaching greater height and efficiency. The first is the use of masonry in the 19th century, then steel in the 20th, and now, reinforced concrete[7]. This project predicts the emergence of nano-carbon tubes and the mainstreaming of nanotechnology. Nano-carbon tubes will dramatically alter the look of future skyscrapers and open up new functional possibilities because of its light weight and strength hundreds of times stronger than steel (figure 6). This allows for the inverted pyramid and thus achieves several advantages to sustainable design. The angled wall helps reduce heat gain to the interior spaces while allowing maximum sun exposure to the trees. The angle is determined in accordance to the seasonal solstice of the region. In order to maintain structural stability due to the tremendous point load created at each apex of the pyramids, a system of primary and secondary truss is devised. The downward force of the stacked pyramids are taken up by a main truss that runs thru the tower from bottom to top in a diamond formation, dispersing the force to the center and bat to two points (figure 7). Remaining compression are then taken up by the skin of the pyramid, a mesh of triangles. To keep the tower from tipping over, lateral forces are braced by the north wall and by the sky bridges. Because there is no perimeter column on the east, west and south face, views and sunlight are not interrupted.

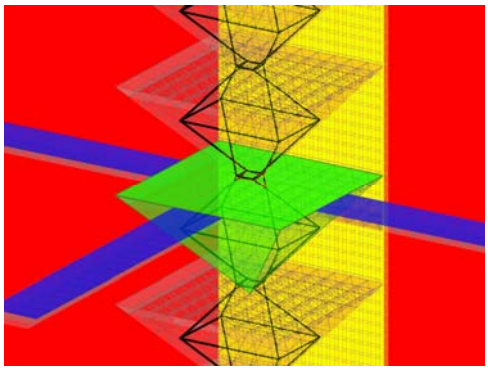

Figure 7: Main truss (black) transfers weight of the pyramids to the ground. Bio-wall (yellow) and sky bridges (blue) maintain lateral stability. Skin mesh (green) directs remaining forces onto main truss

Aside from having a gymnasium in each pyramid for recreational activities, other floors are for environmental research that uses the tower itself as a testing ground. This entails the application of nano sensors to monitor individual plants and trees in extreme details. From nutrient intake to off gassing, researchers can modify the plant's food, and even alter its genetic to best suit the surrounding environment. For example, the north

[7] Lin, Michael Chew Yit. Construction Technology for Tall Buildings. P. 1-4.

wall, which houses the stairs and elevators, is covered in vegetation with each plant connected to sensor. Together they act as a massive bio-wall. The wall can filter and sniff out clean air to decide which side of the building with the least pollution to breathe in.

While new technology and material make significant impact on construction, the other major force, one unseen and intangible, will be the political and social trends of the time. In the future, the form and function of the skyscraper will be of an integrated structure, not only within itself but with the entire city, embracing its surrounding to work

in unison for both economical and ecological needs, furthering the principles of globalization, that is, to perfect the art of economy. This analysis is in part based on many sociological theories trend to create links between the macro and the micro[8]. If corporations, in order to compete in the current state of the economy, are searching and relocating their various tasks overseas based on efficiency and cost, shouldn't cities be developing in a similar fashion? In Cities and Society, Nancy Kleniewski explains globalization allows developing nations to become industrialized because of new job creation. More jobs mean more people moving to cities as they can no longer support themselves on the farm. To cope with the changing economy, cities strategy is to attract and retain jobs by embracing new industries (tourism), strengthening existing industries (banks) and attracting mobile industries (high-tech manufacturing)[9]. As a result, the political need to sustain the economy by redeveloping makes the city more attractive and efficient. The Garden Tower is a part of this change. Instead of a stand alone building, the tower's gardens and bridges create efficiency in movement and in environmental regeneration. Any improvement to the land will benefit the land owners, and therefore, makes the Garden Tower a viable project economically. Considering a perspective taken from Harvey Molotch theory, "the city as a growth machine," the greater the quality of the land, the better the economy. Pointing out how government policies and social interest are essentially related to the physical land as he writes,

> Each member of a community is simultaneously the member of a number of others; hence, communities exist in a nested fashion (eg. Neighbourhood within city within region), with salience of community level varying both over time and circumstances…The scarcity of developmental resources means that government becomes the arena in which land use interest groups compete for public money and attempt to mold these decisions which will determine the land-use outcome."[10]

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[8] Wallace, Ruth A. and Alison wolf. Contemporary Sociological Theory: Expanding the Classical Tradition. P. 424

[9] Kleniewski, Nancy. "Introduction: Contemporary Issues in Urban Sociology." Cities and Society. P. 6-7.

[10] Molotch, Harvey. "The City as a Growth Machine: Toward a Political Economy of Place." P. 19.

The future policy of city planning could involve drastic requirements of green area for high density land use, a trend that is slowly graining momentum at present.

In summary, the Garden Tower concept is inspired by the desire to live in a cleaner urban environment. Its main strategy is to reduce the heat generated within the urban core and thereby lessening the photochemical reaction that causes smog, which then also reduces energy consumption due to less use of air-conditioning. By having large green area in the sky, the tower is like a multilevel public park, creating a building typology that challenges the political and social forces that shape our cities and emphasizing the need for balanced economic growth and environmental renewal. Further benefits to the public would be flexible movements and reduced traffic congestion as the tower acts as a hub between other buildings, connecting them at various levels; the tower becomes a fully integrated structure in term of addressing social issues and urban dynamic. Its public gardens and arrays of habitable sky bridges establish a "neighbourhood" in the sky helps break social isolation and alienation. Ushering the skyscraper into a new age of construction, nano-technology and the development of nano-carbon material will give the tower its structural integrity and function. Its massive bio-wall, which extends from ground to the top, can monitor and cleanse the air accordingly thru its micro connection to the plants, applying genetic enhancements to boost the extraction of harmful particulates from the atmosphere.

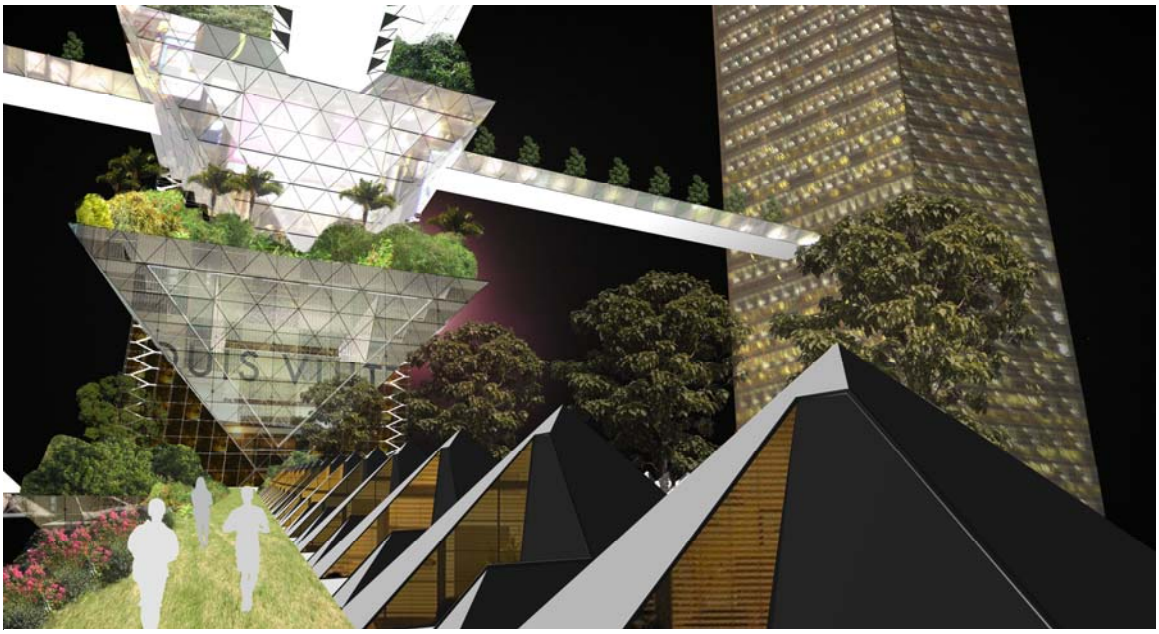

Figure 8: Greening of the sky with multi-level gardens and lawn skywalks put city dwellers closer to nature

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