

Tall Building Sustainability? An Exploration of Design Possibilities.

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Abstract.

The tower has endured as an architectural form for more than four thousand years. In the development of new cities during the last century, the tower was appropriated as capital by entrepreneurs, dislocating it from the realm of primarily symbolic-religious architecture to that of commodity architecture. Although the tower has become a place of work in the form of the tall commercial office building, it still lingers as symbol of modern civilisation.

Over recent decades, numerous office towers have been constructed that are now seen as major liabilities in terms of a sustainable built environment. Typically, office buildings designed in the resource-rich past failed to consider vital design considerations such as non-renewable resource depletion and the impacts of global atmospheric pollution. Energy efficiency was often of minimal importance.

The configuration of the tall commercial building's external envelope is a key contributor to the overall success, or otherwise, of achieving the required aims of 'sustainability'. This paper explores some of those design possibilities in essentially temperate climate conditions, together with examples of recent buildings which may provide clues as to a possible shift towards a new tall commercial office building type.

(i) Introduction: Sustainability, the built environment, and the tall building

Our buildings, and the infrastructure that supports them, represent the great bulk of our accumulated capital stock. These artefacts of the human ecosystem are our principal life support systems and as such commit us to future patterns of behaviour and particular levels of environmental impact. For this reason the use, construction and refurbishment of commercial buildings must be recognised as critical factors in our commitment to a sustainable future.

World wide in recent decades, in a time when the use of non-renewable forms of energy was of reduced concern, our commercial buildings were designed to be reliant on mechanical systems to produce acceptable internal comfort conditions. The resulting buildings made heavy demands on fossil fuels whilst ignoring the needs of the occupants to have individual

control of their thermal comfort conditions. The energy crisis of the 1970's led to concerns over the limitations of finite energy resource limits, heightening research into passive low energy architecture. More recently global interest has shifted to 'sink limits' - more specifically the concerns over carbon dioxide emissions and climate change - reinforcing the view that continuation of past attitudes is not sustainable. The continuance of life as we know it may well depend on the way we respond to these global constraints¹.

The world has changed and yet, with a few exceptions, our built environment including commercial buildings remains unchanged and unchanging. At the very best the attitude of architects and building developers is likely to be increasingly embarrassing in the international arena². The way we design, build, use and, particularly, retrofit our commercial buildings must change. Commercial buildings, throughout their *first useable life* and both during their construction and *reuse* stages, contribute significantly to the emission of carbon dioxide and other greenhouse gases. They certainly cannot be ignored in any exploration of the built environment connection to climate change³.

In terms of the public's overall awareness, the commercial building sector is vital. Commercial buildings, particularly the office towers of the central business districts, are often seen to reflect the attitudes, development and (economic) state of a nation.

If a sustainable architecture is to come to the fore, then architects must be convinced that there is an aesthetic or type associated with this emergent environmentally concerned culture. In terms of the influence that the tall building has on architects, Jencks notes that the tower is the flagship of the battle between styles - most recently exemplified by the Postmodern Humana Building by Michael Graves versus the Late Modern Hong Kong and Shanghai Bank by Norman Foster⁴. If the tall office building is seen as a stylistic leader on the edge of any movement, it seems crucial that the tower changes in form, if a 'sustainable aesthetic' is to flow through into all other facets of the built environment.

It is the contention of this paper that the subtle psychological impact of these structures is at least as important as their real contributions. Any response that aims at a sustainable future will only be possible if tall commercial building type is investigated and modified.

(ii)The tower

One may question whether 'tower' buildings are a necessary component in our built environment or have any part to play in our future society. Although it is reasonable to suggest that towers are inherently unsustainable, requiring excessive structure and services when compared to horizontal buildings, it is the authors' belief that tower type cannot be deemed irrelevant for a number of reasons.

The tower's historical and symbolic importance-

(a) Culturally/Socially

From the times of the Tower of Babel and the Pyramids, human culture has had the need to reach up towards the heavens. For thousands of years obelisks, minarets and ziggurats have signified the triumph of settlement, civilisation and a defiance of the forces of nature. For example, Pharos, the 140m high Lighthouse of Alexandria, was recognised as among the 'Wonders of the World. Completed in 282BC, it stood for more than 1600 years, finally succumbing to an earthquake in 1306AD. ⁵

Humankind through the ages has sought out extremes of height, pushing the limits of technology as demonstrative of each civilisation's mastery and control over the environment. Moreover the basic emotional response to tower is compelling - there is an exhilaration to be found in extreme verticality - the profound alternative to vertigo.

Our notions of heaven and the underworld, earth and sky, lead us to a both a mythical and psychological appreciation of cellar and attic⁶. These heart felt beliefs have directed architects to realise the potentiality of tower form. The film media - an indicator of popular beliefs and values - reinforces the tower's significance as a potent symbol. For example the enduring images of Harold Lloyd hanging precipitously from the hands of a clock, King Kong swinging off the mast of the Empire State Building, the Hunchback of Notre Dame providing sanctuary to the gypsy queen, and more recently the Bladerunner and Batman climax as cornice and parapet meet the inky sky. Numerous icons of Twentieth Century mass-culture are towers - the Sagrada Familia of Barcelona, previously of religious note, has been more recently identified with sporting achievement after the 1992 Olympics. The famous bell tower at Pisa is now better known as the focus of travel brochure vacations to Europe. Nevertheless, even given a debased reading of the lofty ideals that these towers originally embodied, it is obvious that towers still capture public imagination.

(b) Commemoration and celebration

Hieroglyphics adorn the Obelisk of Luxor (1290-1224BC) in commemoration of victory over the Indo-Germanic Hittites. The Paris Tower by Gustave Eiffel was created to commemorate the French Revolution whilst taking centre stage at the International Exhibition of 1889. 'Tower' forms for commemoration are not limited to Western or Eastern cultures. The Maori, the indigenous people of New Zealand, produced 25m tall temporary structures for auspicious celebrations. These structures, known as hakari stages, were constructed for the purpose of displaying gifts and comestibles.

(c) Tower as a display of national/civic/corporate wealth and pride

In the Modern world, universalism and internationalism have driven tower building. The tower as symbol of city, has become synonymous with the hierarchy of success within the new world - an international display of *symbolic capital*⁷. In America the Monadnock building, Masonic Temple, Fuller Building, Woolworth Building, Chrysler Building, Empire State Building, World Trade Centre and the Sears Tower are all examples of corporate one-upmanship. The owners and builders of towers do so to assert their status - height equating to dominance and superiority. Hence the battle to have the tallest tower with the most imposing skyline presence within the city or for that matter the world - compels developers towards greater feats. For example the desire to have the tallest tower in Hong Kong still continues- The Shanghai Bank, the Standard Chartered Bank, The China Bank - symbolic of the mainland reasserting its power over the colony - are now being challenged by Central Plaza a recent development in Wanchai. It seems unlikely that the corporate desire to have the largest tower will diminish, whether or not one agrees with the politics underlying design and construction.

For economic reasons-

There are strong economic reasons for the development of tall buildings. This is predominantly due to land prices in the centre of many cities being maintained at artificially high levels through zoning regulations and the particular legal system of small site ownership. Given the break-up of the Eastern block and the reduced influence of socialism/communism in conjunction with the increased dominance of the capitalist free market economic paradigm, the present economic and legal structure is unlikely to change in the near future.

For practical reasons -

(a) Landmark

The tower's ability to act as a landmark is especially significant in flat regions, where it may be difficult to find ones bearings. It may define centre or boundary/edge to settlements, for example Munster Cathedral⁸, and the Empire State Building define the centre of city and island respectively. The CN Tower and The World Trade Centre define the limits of city and island. On a smaller scale, the town hall or church tower, facing on to a village or city square aids the definition of civic/sacred space

(b) Outlook and the third dimension

In the past tower/fortresses were used defensively. Today they offer the third dimension, providing views over and across. For example from CN Tower one can look out onto the whole Toronto region. Alexander suggests the importance of this third dimension in Pattern 62 "High Places" - He notes that being able to 'climb to a high place and survey the landscape in which we live is an important human experience'.⁹

(c) As an existing resource

The most convincing reason to accommodate and sustain the tall building type is that there is an existing stock of them. Given any argument against tower form on technical grounds or because of the tower's symbolic content, the tall building must be recognised as a valuable resource. Rather than simply abandon the tower, and as a consequence abandon the city centre, it must make sense to upgrade and reuse them. An architecture of sustainability must never be thought of as utopian projects on virgin land. It would be ethically questionable to waste the energy embodied within existing artefacts. For this reason in particular, one cannot deny the tower as an existing resource.

(iii) The tall office building

Energy efficiency responses

The primary focus of this paper is restricted to the tall office building - the most common of the tower types.^{10 11}

Any consideration relating to the potential sustainability of the tall commercial building type, either new or retrofitted, must develop from our understanding of energy efficiency responses. (Sustainability and energy efficiency are interconnected, although the energy use factor is but a segment of the total problem.) In the 1970's it was correctly recognised that the energy use in buildings was a significant proportion of a developed country's energy consumption. In the 1980s the rush to develop new approaches to the design and use of commercial buildings slowed worldwide because of a belief that energy consumption was somehow less of a problem. The best that happened in most countries was the development of so-called energy efficient glazing systems and quite impressive increases in the energy efficiency of auxiliary systems such as lighting. Typically energy use reductions of 20 - 25% were common.

Architecturally the energy efficient option remained unpopular and difficult to argue in the face of mechanical air conditioning systems capable of creating consistent, if boring, internal environments. Technology was to be used and to be seen to be used. As the mechanical systems became more efficient and the management systems became more sophisticated, energy savings were easily achieved in commercial buildings without modifying the form of the building in any way¹². Architects continued to produce commercial towers that responded to fashion, not function, leaving us with a collection of largely inefficient buildings, unable to respond adequately to the needs of the 1990s. This appeal to 'fashion' is exacerbated by the essential nature of the Modernist tower and the strategy implicit within the architect's design process.

Climate rejecting building stock from a design process of internationalism and commodification

The commercial office tower is the archetypal *commodity building* and due to this essential commodity nature the designer is required to maintain a degree of product differentiation¹³. The design strategies of iconic and analogic design which makes use of international exemplars are prevalent in commodity type buildings¹⁴. In Australasia during the building boom in the mid-1980's many interesting and individualistic towers were designed from an analysis of existing commodity buildings - typically from different climate zones - that were proven to be financially successful¹⁵. For example New York's Lever House is debatably the most influential and possibly the most destructive of climate-rejecting tall building icons¹⁶. The internationalist nature of recent office towers demonstrate a rejection of regionalist design philosophy.

In New Zealand it has been suggested that due to architects looking overseas for design models much of the design work has been carried out using what Broadbent terms an *iconic design process*¹⁷. The Customhouse Tower scheme has been identified as a local example of a building designed employing an iconic process. Its form was closely derived from the exterior envelope of Seidler's South Tower scheme for the Hong Kong and Shanghai Bank, in conjunction with the 'sky garden' motif from Graves' Humana Building - the two having been fused to create a new scheme - which unfortunately generated a one hundred percent glazed west facing curtain wall. Other towers may tend more towards an Analogic *design process* with the adaptation of existing exemplars¹⁸. For example New Zealand's tallest building, Coopers and Lybrand Tower, was based upon the design of Seidler's earlier Riverside Centre in Brisbane - adapted through the removal of the sun screens, and by the orientation of the tower away from the view, in order to meet strict daylighting building controls.

Because of the iconic and analogic nature of the design process, in conjunction with the prevalent modern philosophy of internationalism which underpins the design process, the occurrence of regionally inspired form is considerably decreased. This has resulted in a building stock that is essentially climate rejecting. It is hoped that this situation will change because of the absolute need for the producers and owners of commercial buildings to respond to the global greenhouse gas emissions which are related to energy production and usage¹⁹.

(iv) Design Models:

In the consideration of the environmental design of tall commercial buildings there are two basic design scenarios available²⁰: -

Climate adapting buildings where the purpose is to use the climate to advantage to serve the needs of the building occupants. The positive and negative climatic influences are selectively filtered and balanced at the building's boundary to provide internal environment control.

Climate rejecting buildings (typical of the building stock described above) where the purpose is to insulate the building from the environment with the form and envelope serving solely as barriers between the exterior and the artificially conditioned space.

Climate adapting buildings provide a more interesting and stimulating internal environment with energy costs potentially lower than the climate rejecting building type. Typical climate adapting commercial buildings, depending on climate zone and actual usage²¹, tend toward:

- increased perimeter area;
- a thick 'friendly' wall - the envelope being a filter not a barrier;
- efficient daylighting;
- good orientation;
- efficient solar radiation control - glare, overheating, passive heating;
- natural ventilation;
- more efficient artificial lighting systems;
- clear zoning of different activities.

(v) Conclusions:

If one accepts that it is possible for tall building type to be sustainable what then are the design possibilities? Given that architects use existing buildings and images to cue off for their designs, it may be desirable to locate a new tall building icon that will force a paradigm shift away from the conception of the wall as an environmental barrier, or of mechanical devices as the only means of environmental control; towards the exterior envelope as a *filter* of daylight, solar energy, air and sound. Already partial design models/icons are emerging which give some indication as to the direction of a sustainable tower type. The fundamental question for designers is what model or part of such an exemplar is relevant to their particular situation? (Refer to appendix)

Implicit within this argument for continued cultural and practical relevance both of the tower and city, is the belief that *sustainable* architecture must be *good* architecture. Good urban and civic architecture has to capture public imagination, and continue to capture public

imagination through various stages of cultural evolution. On that basis alone the tower, if it is to remain culturally relevant, must reveal the new environmental paradigm²² - necessitating the retrofit of present building stock in favour of overtly climate accepting models, and for new tower buildings (if any) to clearly refer to a 'sustainable aesthetic' of some kind.

Sustainable urban settlements of the future will have to be derived from our existing buildings and urban systems but in their form and long term operating characteristics they may well be significantly different from those of the past. Technologically developed countries and the less developed countries both face the need for major transformations. Neither has developed built environment systems that are friendly to people or to the environment. The problem facing all humanity, rich and poor alike, is to devise new and sustainable alternatives. It is a task common to all: all have contributions to make. Certainly, economic development as we have known it has not resolved the problem of sustainability.

Everyone has a vested interest in the total success of this venture because the consequences of failure will accrue to all. The considerate retrofit of our tower buildings must be a vital part of any sustainable future.

Appendix: Sustainable tower type- design exemplars ?

(i) Norman Foster The Commerzbank Headquarters, Project, 1992

The Commerzbank Headquarters Project, Frankfurt am Main, Germany, designed by Norman Foster makes some attempt to embrace 'green ideals'. The building which is essentially a petal plan and has a central atrium that varies up through the tower for the purposes of natural ventilation. There is some notion of garden in the sky to which all building users have visual access²³. This building as a item of commodity architecture is perhaps the most seductive of green tower images, making it an exceptionally dangerous architectural icon. It selectively addresses green issues - such as the building user's connection to the external environment, and the energy efficiency of the completed building whilst displaying (i) high energy embodied materials in its polished metal surfaces, and (ii) the maintaining an overall appearance of climate rejection with 100 percent glazed exterior envelope, undifferentiated elevations, and gardens and atriums. The Commerze Bank Project is an a assertion of misguided technological optimism - high technology as the saviour of the environment.

(ii) Menara Mesiniaga, Ken Yeang 1992

Ken Yeang's recent design of a 14 storey owner occupier office building in Malaysia for an IBM related company is a sound example of the possible model for a sustainable climate adapting commercial building. Yeang's research into ecological approaches to design and a

regionalist architecture for Malaysia has clearly influenced the design of the Menara Mesiniaga.²⁴

Yeang bases his design around precepts of tall building typology, and concepts allied with climate responsive design, especially that of hot-humid climates. He interrogates a number of ideas through sketching - the notion of a tropical high rise building, building orientation, core position including natural ventilation and sunlight to services-cores, an open ground floor, recesses and skycourts, atria, air spaces and wind-scoops, adjustable openings, materials and thermal insulation. Yeang considers the crucial design problem of the tower type - the junction between earth and sky. In his solution he attempts to connect the tower to its local surrounding with vertical landscaping, and relate the building to its urban context.²⁵ The result is a harmonious integration of tower, technology and landscape. This building could be a suitable iconic/analogic model for other tropical regions. More importantly the design process Yeang espouses is an emphatic indictment to designers in other climate zones to consider design issues from **first principles** in preference to the uncritical adaptation of foreign models. Given that Menara Mesiniaga may be inappropriate within a temperate climate, the sophistication and eloquence of the architectural language it exudes lends it to being at least a partial model of a green tower type.



Norman Foster Commerze Bank Headquarters Project,1992 Ken Yeang Menara Mesiniaga, KL Malaysia 1992

Footnotes

- ¹ Refer to Rodger A.(1990), 'Towards Sustainable Systems of Settlement: Physical Forms and Social Organisation'. Fundamental Questions Paper No. 11, CRES. Canberra. Also Rodger A.(1991). 'Urban Consolidation in the context of Sustainable Development'. Conference Proceedings, Urban Consolidation: Myths and Realities, Australian Institute of Urban Studies, Belmont, Western Australia.
- ² The planned UN Conference on Environment and Development, Brazil, June 1992, is likely to provide a base for action. The U.I.A. [International Union of Architects] Project Group 'The Implications for Architecture and the Built Environment of the Greenhouse Effect' will be presenting the built environment arguments for achieving sustainability.
- ³ Ministry for the Environment (1991), Climate Change, The Consensus and the Debate, Wellington.
- ⁴ Jencks, C. Architecture Today, Academy, London, 1988
- ⁵ Hienle, E. Towers, Butterworth Press, London 1989.
- ⁶ Bachelard, The Poetics of Space, Bloomer and Moore. Body, Memory and Architecture.
- ⁷ Dovey, K. 'Corporate Towers and Symbolic Capital', Environment and Planning B, 1992
- ⁸ Stratsbourg, from 1176, Heinle, E. Towers, Butterworth Press, London 1989.
- ⁹ Dovey K. "The Pattern Language and its enemies", Design Studies, January 1990 pp3-9, Alexander appears to contradict himself in Pattern 21 where he recommends a four storey maximum height be applied.
- ¹⁰ In this paper tall buildings are taken to be buildings over 10 storeys in height. Yeang notes that the Council on Tall buildings and Urban Habitat defines tall buildings as *being buildings of ten-storeys or more because that is the cut off height for fire fighting from ladders in New York City* Yeang K. "Designing the green skyscraper", in Beedle, L. S. (editor. in chief) Tall buildings: 2000 and beyond, The collected papers of the Fourth World Congress of the Council on Tall Buildings and Urban Habitat, New York, Van Nostrand Reinhold Company Inc 1991 p114
- ¹¹ Each building type will be different in terms of limitation and impact. It is dangerously simplistic to group all non-residential building types and consider them as one. Residential buildings and can be expected to respond in relatively easily predictable ways determined largely by aspects such as building design and climate zone. Non-residential buildings will always be more complex and demand very detailed consideration.
- ¹² Gillingham, D.S, President of the Chartered Institution of Building Services Engineers, U.K., presented an excellent plenary paper on this topic to the First World Renewable Energy Congress, Reading, 1990. Also Alan M. Brown, Enersonics Pty Ltd, Hawthorne, Victoria, Australia, has widely written on his impressive energy savings as a consultant to a range of commercial premises.
- ¹³ Heath, T. Method in Architecture, Wiley 1984
- ¹⁴ Broadbent, Design in Architecture, Wiley, 1973, Heath, T. Method in Architecture, Wiley 1984
- ¹⁵ Refer to Diprose, P. Auckland's tall office buildings: A design decision making model, Unpublished thesis Auckland 1992, and Doveys, K. "Corporate Towers and Symbolic Capital", in Environment and Planning B, June 1992
- ¹⁶ Hawkes, D. "Types, Norms and Habit", in March L. Form in Architecture, Cambridge University Press, 1976, and Broadbent, G. Design in Architecture, Wiley, 1973
- ¹⁷ Diprose, P. Auckland's tall office buildings: A design decision making model, Unpublished Thesis, Auckland 1992
- ¹⁸ Broadbent, Design in Architecture, Wiley, 1973
- ¹⁹ See IPCC Report 1990.
- ²⁰ This is a relatively simplistic view but is useful if only to highlight the differences.
- ²¹ An increased internal load makes this statement more generally applicable.
- ²² The notion of an emergent new environmental paradigm is elucidated in Milbrath, L. Envisioning a sustainable society: learning our way out, State University of New York 1989
- ²³ As an aside the idea of 'garden' embodies an essentially domesticated view of nature, which may be contentiously an inherently unsustainable conception of non-human nature.
- ²⁴ Yeang K Tropical urban regionalism a building in South-East Asia city, Singapore, Concept Media 1987
- ²⁵ Yeang K. "Designing the green skyscraper", in Beedle, L. S. (editor. in chief) Tall buildings: 2000 and beyond, The collected papers of the Fourth World Congress of the Council on Tall Buildings and Urban Habitat, New York, Van Nostrand Reinhold Company Inc 1991