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New Paradigms in High Rise Design

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Abstract

Tall Buildings are perhaps the most keenly debated building typology currently in existence. Opinion on their contribution to the urban agenda is usually clearly divided; strongly for, or strongly against. Since September 11th and the World Trade Centre towers' collapse, the suitability of Tall Buildings in our future cities has become even more of a key issue. This is especially true of London, a city which has only embraced tall buildings in relatively recent times, and only in limited number. Although there have been strong moves in parts of the world to create tall buildings rooted to the specifics of 'place', London has tended to cling to the import of the commercially-driven, rectangular, air-conditioned 'box' model typical of most North America cities. This paper presents alternative options for tall building design. It takes, as its vehicle, theoretical design research projects developed at the University of Nottingham. Based on the Heron Tower project currently being developed in the City of London, and working together with Kohn Pederson Fox architects, the paper outlines the differing design approaches developed, and charts similarities in these approaches. By relating this to recent tall buildings internationally, the paper concludes by suggesting new paradigms for high rise design.

Keywords: tall buildings; design; urban; paradigms

1. Introduction

The popularity of tall buildings in the UK has seen dramatic pendulum swings over the past 40 years, from a time when the genre could not disassociate itself from the loathed, ubiquitous post-second world war council tenement towers, to the heady days of the 1980's when the commercially-driven policies of the Conservative Thatcher government led to the huge docklands redevelopment, with the American architect Cesar Pelli's Canary Wharf Tower as its flagship (*Pelli and Crosbie 1994*).

Today, under the enthusiastic endorsement of the Mayor of London, Ken Livingstone, tall buildings seem to be enjoying a popularity unlike anything seen previously in the UK (*GLA 2001*). The docklands development has recovered from the effects of the early 1990's recession to expand at a rapid rate, and public opinion seems to be warming to the idea of tall buildings in the City of London and elsewhere in the capital – something unthinkable only a decade or two before as Prince Charles galvanised public opinion against modern architecture generally, and tall buildings specifically. The high level of public interest in the Norman Foster-curated High Rise exhibition at London's Royal Academy in the summer of 2003 (*Abel 2003*) surprised many.

Not everyone is convinced though. The Heritage Lobby, and in particular English Heritage, are concerned with the impact tall buildings will have on the historic fabric of London, and for every report that is issued in support of Tall Buildings in the UK (*CABE 2001*), there seems to be a contradictory report condemning them (*UASC 2002*). The project that perhaps best typifies this battle of opinions in recent times in the UK is the Heron Tower project, which is the starting point for the theoretical design project which is the essence of this paper (see *Section 2.0*). Originally granted planning approval from the Corporation of London's planning committee in 2001, the submission received objections by English Heritage, amongst others, for the detrimental impact it would have on strategic back-drop views of St. Paul's Cathedral. It was eventually called in for a lengthy Public Enquiry (costing £4 million) and, over a year after the original submission, was finally granted Planning Permission in July 2002. Work on site is anticipated in 2004, but it is still considered by many to be an inappropriate addition to the London skyline (*Gates 2002*).

Whilst this theoretical battle over the appropriateness of tall buildings in the UK rages, however, little has been done to improve the actual design of the built projects. Towers are appearing at an amazing rate within the Canary Wharf / docklands development, yet the whole project stands as a testimony to commercialism, with little high rise

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design of quality. It seems to be a piece of downtown America adrift in the east end of London. Carol Willis's 'Form Follows Finance' play on Louis Sullivan's maxim, in relation to the early skyscrapers of New York and Chicago (*Willis 1995*), is seemingly also relevant on this side of the Atlantic.

The City of London and its environs have faired better than the docklands development in the high rise quality stakes, perhaps with the added scrutiny required through the historic setting. But, even with notable high rise examples such as Norman Foster's 2003 Swiss Re Tower and Renzo Piano's 'Shard of Glass' (scheduled for 2007), one is left with the feeling that these tall buildings could be situated in any city of the world (for more on both buildings, see *Abel 2003, pp 64-69*). Exciting edifices of steel and glass they may be, but what makes them right for London? What makes them specific to the time and place in which they are set, rather than just another part of the 'global' high rise mono-culture which is sweeping the world and homogenising 'local' cultures in its path?

The tall building is obviously not a typology to 'blend in' with its context. It is inevitably going to soar above, and dominate, its surroundings. But that does not mean it cannot become a positive element in the urban composition. It can and should relate to its surroundings as positively as a high-quality, low-rise building, taking its cue from site and environment, as well as client and brief. The following paper gives examples of projects that, in the author's opinion, achieve just that. Taking the Heron Tower brief and site as the starting point, they are a sample of theoretical design research approaches undertaken by architectural research students at the University of Nottingham, under the guidance of the author, and working together with the lead architects responsible for the live Heron Tower project; Kohn Pederson Fox.

2. Project Brief

The Heron Tower project, currently being developed by KPF Architects for the Heron Corporation, is situated in the heart of the City of London (*Gates 2002*) at 110 Bishopsgate, on a prominent corner at the junction of Bishopsgate, Houndsditch and Camomile Street. Across from the Grade II-listed St. Botolph's Church with its accompanying gardens and in view of the London Wall development, close by are the 'Eastern High Rise Cluster' duo (see *Fig.1*) of Richard Seifert's 1981 Tower 42 and Norman Foster's 2003 Swiss Re (*Abel 2003, pp64-67*).

Replacing the existing 1960's low-rise Bishops house and Kempson House on the site, the real Heron Tower will provide 63,135 metre-squared of office space over 37 floors at a total height of 222 metres, however the theoretical design research project departed from this brief and asked for a mixed-use tower incorporating both residential, office and retail space, to encourage a more varied design approach (for more on the actual theoretical project and design brief, see *Wood 2002*). It was left to the research students themselves, in considering the size and proportion of the tower to determine exactly how much space would be provided, but the brief asked for a minimum of 45,000 squared-metres of space, contained in a tower of 30 to 40 stories in height. Guidelines were given on the total number of office workers and residences to be housed.

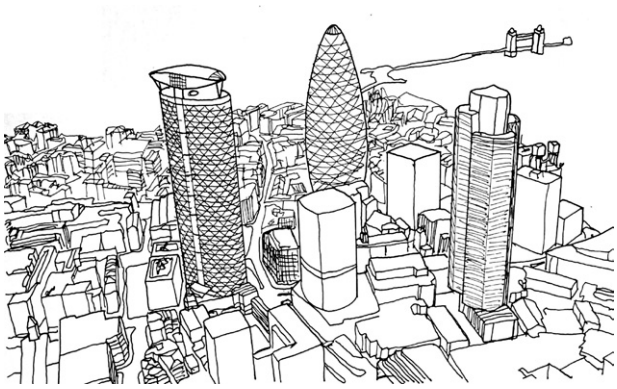


Fig. 1. The new City of London 'Eastern Cluster'; Heron Tower (left – theoretical project), Swiss Re Tower (middle) and Tower 42 (right).

3. Design Responses

The research students' design responses were, on the whole, highly creative and well thought through, especially considering that they had only 8 weeks for the whole design process; from site study to final presentation. Most, if not all, of the best schemes considered aspects of all four general design approaches as outlined below.

They have been grouped according to their predominant design concept:

(i) Those predominantly inspired by the relationship between the building and the physical characteristics of site (Designs 1 - 2),
(ii) Those predominantly inspired by the relationship between the building and the environmental characteristics of site (Designs 3 - 5),
(iii) Those predominantly inspired by an organising principle for the internal spaces (Designs 6 - 8).
(iv) Those predominantly inspired by the relationship between the building and an abstract / practical philosophy (Designs 9 - 10),

Design 1: "Urban Axes"

This scheme (see *Fig.2*) is firmly rooted in its physical site context by creating two vast atriums whose axes are centred on two prominent London landmarks; Tower bridge over the River Thames and the dome of St. Paul's Cathedral. The floor plate accommodation is thus divided into four 'corners' by

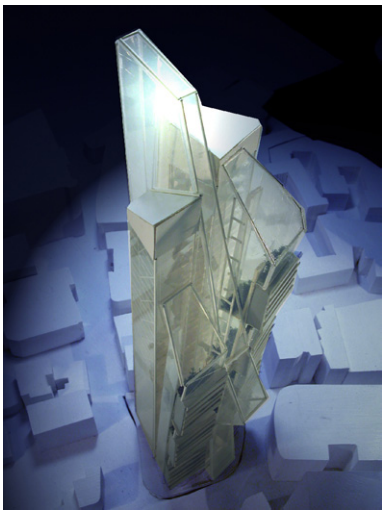


Fig. 2. Final Model

these atriums, linked by flying bridges on strategic levels which add drama to the tall, angular spaces. The alignment of the bridges along the axes of the atrium is such that users are perpetually offered the views out over the city, specifically focussed on the landmarks. Additionally, the orientation of the main "St. Paul's" atrium to the south offers sun / heat gain to the large vertical space which serves as an 'environmental tower', assisting to naturally ventilate the office / residential space through the stack effect.

On an urban sculptural level, the changing angular geometry of mass and atrium with height in the tower is certainly a rejection of the banal singular 'shaft' which typifies many existing tall buildings. The building would certainly become an icon for London.

Design 2: "Building as Billboard"

Fig. 3. Conceptual Model

This design (see *Fig.3*) partly takes as its inspiration the pulsing, neon night-time imagery of East Asian cities such as Tokyo or Hong Kong. In relating to site, it acknowledges that a high rise building has a relationship not only to the direct site context as its base, but hundreds of other sites around the city through the visual linkage. In setting up a dialogue with several significant 'places' around the city, both near (e.g. St. Botolph gardens across the street) and far (e.g. Primrose Hill), the building becomes a billboard, the façade 'planes' of which are positioned in both plan and sectional angle to 'speak' to the reciprocal place, often several miles away.

Internal functions are arranged so as to maximise the opportunity of solid areas for billboard coverage (e.g. lift / service cores etc), whilst allowing light and air into the building, and views out, for internal occupants. The building comes into its own during the night-time, when huge liquid crystal screens, positioned on the façade of the building and within atria for the occupants, pulse out over the city.

Design 3: The "Sun Splice"

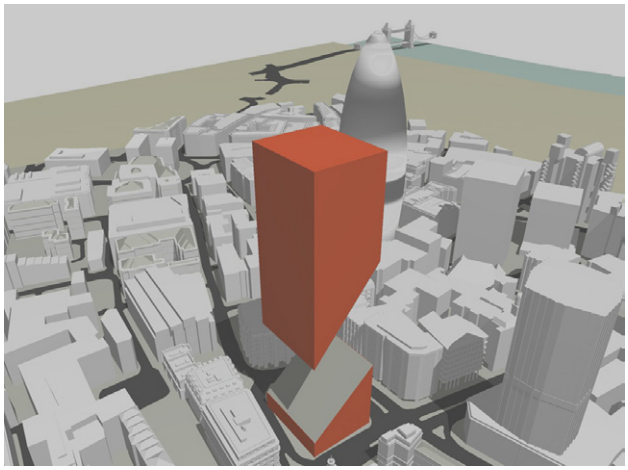


Fig. 4. Conceptual Model

This scheme (see *Fig. 4*) challenges one of the major problems of high rise buildings; the fact that many towers create an unfavourable urban environment at the ground floor plane. The shear bulk of a tower, combined with existing commonly within dense urban fabric, acts to cut out sun, light, air and, often, even a view of the sky. Although this has been acknowledged from the moment that the massive Equitable Building in New York prompted the introduction of the Zoning Laws of 1916 and ushered in the era of the set-back block (for a further discussion on this, see *Landau and Condit 1996*), it is still true that the vast majority of tall buildings have a detrimental effect on the ground level urban environment around them.

The Sun Splice scheme sets out to change that, by creating a high rise building that has a minimum negative effect at ground level. Rejecting the idea of lifting the building up on pilotti, which often only creates a dark, overwhelmed space beneath, the design explores the sun path at different times of the year and responds by creating a huge slice in the tower's mass – punctured only by structure, services and vertical circulation – to allow sun and light to penetrate the form and project to the street level below. The size and

angles of enclosing planes of this huge void are informed by the trajectory of the sun and the desire for a minimal shadow path considered in conjunction with existing surrounding buildings. Further, the lower sloping plane of the open void becomes a vegetated park, giving green space back to the city.

Design 4: "Shell and Core"

Fig. 5. View in Urban Context

This project (see *Fig.5)* explores the differing optimal relationships between shell and core for the differing office and residential function, in relation to both environmental context (in this case, sun) and physical context (view). It takes as its starting point the principle that, in the UK, residential space would optimally be orientated towards the sun (south) for the benefit of its inhabitants, whereas office space – with its high internal heat gains (workers, equipment) and need to reduce glare – would be optimally orientated away from the sun (north).

Thus, in a residential tower, it would be beneficial to have the core placed to the north of the floor plate (to maximise useable space on the south side) and, with an office tower, vice versa. Since the theoretical brief requires a mix of office and residential space on this approximately north-south orientated site, this project solution provides alternating six-storey 'blocks' of each function which are shifted towards north or south relative to the static core, depending on the function. Each block is also twisted in plan to be orientated towards a specific city view relative to the height of the block within the tower.

Structurally the tower works on the 'corbel' principle, with each block of 6 floors being a structural independent 'unit' which simply sits on (and cantilevers out from) the block below. The bracing elements evident within the facades of each block are in fact continuous inclined columns, transmitting vertical loads from roof to base. The tower resulting from this design solution is both complex and daring, but the placing of each element is firmly grounded in a practical philosophy rooted to both brief and context.

Design 5: "Wind Tower"

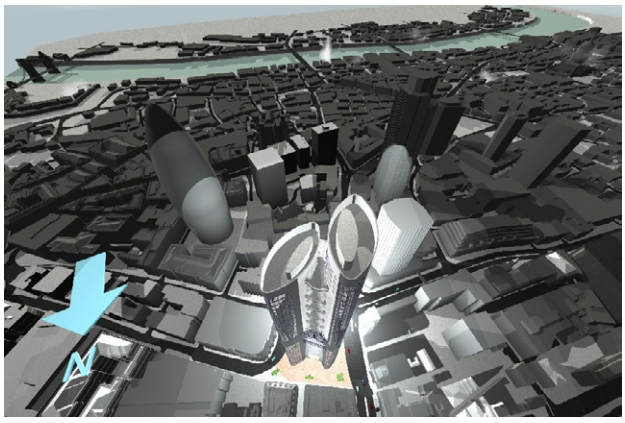


Fig. 6. View in City Context

The sustainable credentials of high rise buildings are constantly being called into question. On the one hand there are organisations who believe that tall buildings are inherently sustainable and positive for the environment, since they accommodate many people in a concentrated area and thus reduce urban spread, encroachment on green belt land etc (*Pank 2002*). On the other hand there are organisations who believe the opposite; that the high embodied energy expenditure in building tall does not justify the tower's existence.

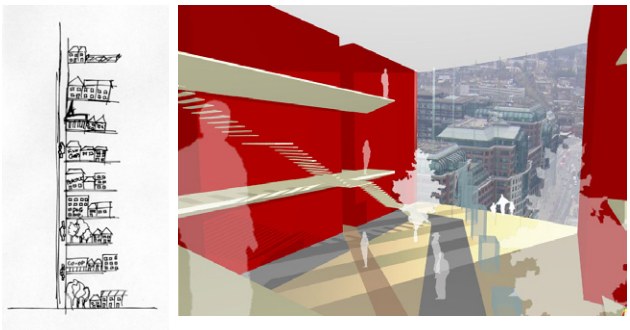
Irrespective of whichever of these arguments hold the most truth, the 'sustainable high rise' is probably the sub-set of the tall building genre that has seen the most research and development in recent years. Primarily through the work of Ken Yeang, amongst others (*Yeang 1999*), investigations into how tall buildings can draw positively from climate – sun, wind, vegetation – are now well documented.

Within this growth area of the sustainable high rise, a sub-area that has seen much research in recent years is the harnessing of wind energy in the tower, since wind velocities – and thus the potential for energy generation – increase with height. Drawing on the work of Stephan Behling in the School of Architecture at the University of Stuttgart (*Campbell and Stankovic 2001*), this particular design response (see *Fig.6*) is inspired by the wind in three respects; in its orientation to the predominant wind direction, in the aerodynamic plan-form of the separate petal-shaped masses, and in the incorporation of a huge wind turbine, suspended at mid height between the two forms.

The aerodynamic shape of the towers act to channel the wind into the turbine area, and further assist in natural ventilation of the interior spaces through the differing pressure potential of windward and leeward faces.

Design 6: "High Rise Villages"

The interior spaces of many high rise buildings, despite accommodating hundreds of people, are often monotonous, characterless spaces. Disorientation through the repetition of identical spaces is common,



Figs. 7 & 8. Concept sketch and View of Internal Atrium

and the personalising of space – especially in the office genre – is rare.

This design solution (see *Figs. 7 & 8*) seeks to change the negative homogeneity of interior high rise space by considering the tall building as a series of autonomous 'villages' in the sky, each with a differing space configuration, atmosphere and character.

It achieves this with a series of atriums, in differing places relative to the floor plate, around which several floors of either office or residential space are orientated. The atriums themselves vary in size and scale, and are orientated to different aspects of the city, climate and environment, thus giving a different character to each space.

Design 7: The "Preferable Corner"

Fig. 9. Image in Context

In both office and residential space, especially at elevated levels, the most sought after location is often that at the corner of the floor plate, since this location usually gives views in two directions. This particular design solution (see *Fig.9*) acknowledges this and exploits it, by creating a polygonal plan form with many corners, offering view panoramas at perhaps a dozen locations on each floor level, rather than the usual four locations typical of the ubiquitous rectangular box tower. This angular, polygonal approach to the plan form is continued into the third dimension, with the tower becoming a sculptural form of truncated crystals, illuminated to glow out over the city in the evening.

Design 8: "Hydroponic Towers"

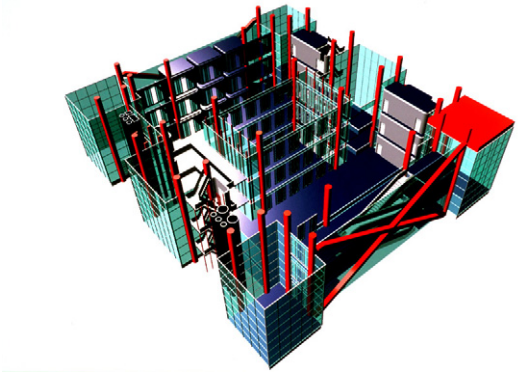


Fig. 10. Floor Plate Axonometric

This design solution (see *Fig. 10*) is inspired by both the sustainable agenda and a desire for a high quality of interior space. In an attempt to provide green space which is most often lost in high rise buildings once the ground floor is departed, the design creates four vertical 'hydroponic' towers at the corner of the floor plate, where inhabitants can grow vegetables and flowers, accessed by perforated metal decks suspended within the continual vertical space.

These huge vertical 'greenhouses', in effect, become the dominant feature of both the exterior and interior, adding linear high rise 'lungs' for the benefit of both the city as a whole and the office / residential tower occupants.

Design 9: The "Tree House"

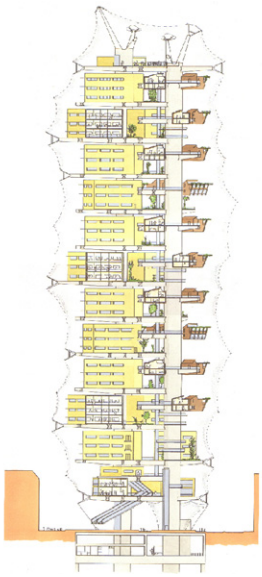


Fig. 11. Section

Inspired by the exhilarating childhood feelings of height and liberation encapsulated in the tree house, this scheme (see *Fig. 11*) seeks to capture that excitement by recreating the tree house on a vast scale. Accommodation is subdivided into cellular 'houses' which are positioned out on structural 'branches' emanating out from the huge central structural 'trunk' which contains the services and primary vertical circulation. The tips of the tapering structural branches (whose upper surfaces contain walkways out to the houses) support a huge tensile net which is hung from the top of the structural trunk and acts in symbiosis with the structural branches, hanging the part-cantilever beams from one another from base to top.

The positioning of the houses within this 'open' net (thus primary weatherproofing occurs within the facades of the cellular blocks) is such that they are orientated to sun or a specific view, depending on their location around the tower. Though this is obviously a highly experimental / theoretical approach, whose translation into built form in the real world is doubtful from a financial perspective, it is certainly an exciting proposition.

Design 10: "Prefabrication"

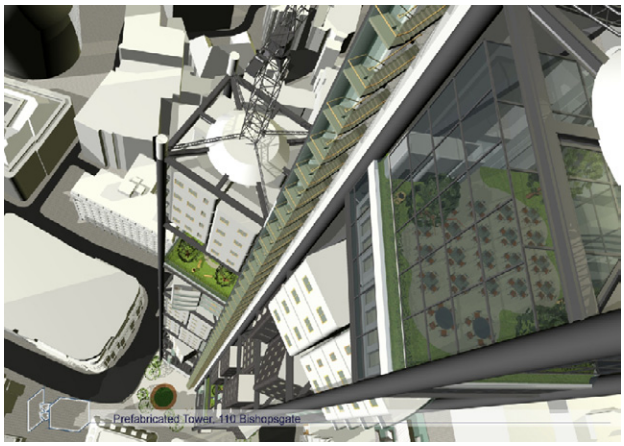


Fig. 12. View looking down.

This project (see *Fig.12*) tackles issues of life-cycles and flexibility of building spaces and materials, which becomes of increasing concern in high rise buildings with the inevitable access problems. In a desire to create a structural 'framework' in which 'pods' are inserted, the final design incorporates a triangulate plan, each tripartite tower housing a huge crane on its roof which would lift the prefabricated pods from lorries at the ground floor plane.

The design of the pods themselves thus became influenced by a consideration of vehicular transportation constraints, with the final design embracing a standard prefabricated pod (which, in itself, would contain several floors) which could be joined together with other pods to create space / volume as required for office or residential communities. This project is indicative of strong moves within the UK construction industry towards prefabrication, which is embracing the possibilities of the system in a vertical arrangement (*Bailey 2003*).

4. Conclusion

Since the beginnings of the high rise building movement in Chicago at the end of the 19th Century (for more on this, see *Condit 1964*), tall buildings have been primarily dictated by commerce and pre-occupied with their role as a stand-alone piece of sculptural urban imagery. There has been very little design consideration of their appropriateness to a setting, and how they could be inspired by – and relate to – that setting. Even the treasured high rise buildings of the 'heroic' pre-war periods of Chicago and New York (e.g. the Chrysler Building, 1930) showed little development from the commercial model in terms of both form and internal space. For the best part of a century, most high rise buildings have exhibited a splash of money at the base of the tower, a splash of money at the top, and very little in between.

The situation is, however, changing. The commercial, rectangular, air-conditioned, high rise 'box' which has proliferated around the world is dead. Or, at least, it should be. For a building typology that has only been in existence for the past 120 years, it is perhaps not surprising that it is only in the past decade or so that we have seen a conscious move away from the import of the North American model, towards a high rise expression which is rooted to the setting; design inspired by the physical, environmental, cultural and/or philosophical climate of the 'local' as opposed to the 'global'. Now, in small pockets of creativity around the world, we are seeing exciting developments of 'local' skyscrapers – with much more diversity in the genre as a result.

It is perhaps not surprising that it is the regions that have more recently adopted the tall building typology, unshackled by the constraints of the past, that are leading this quest for a more relevant high rise expression. In regions such as Asia and the Middle East predominantly, architects and philosophers are looking at local parameters to inform their tall buildings, increasingly rejecting the exports of the west, with exciting and inspiring results (*Abel 2003*).

But where does this leave the West? Where does this leave countries such as the UK, which were not pioneers of the tall building movement and yet have blindly imported the American model? Where does it leave America who, in the quest to re-build the World Trade Centre in New York, have rejected the most exciting design approaches (*Protech 2002*) to select from the competition process a project by Daniel Libeskind which relies heavily on non-relevant abstractism and nostalgia. As if this wasn't disturbing enough, it now seems that even these ideas will become watered down by commercial realism (*Blacker 2003*).

Currently, the UK stands at a cross-roads in high

rise development. With very few tall buildings of significant design quality in the capital, it is yet to convince a sceptical public of the need for them. Whilst controversy rages about the pros and cons of building over ten stories in height, we are in danger of once again closing the door to tall buildings. It is only in widening the debate – with the ultimate aim of creating inspiring tall buildings which both cities and their inhabitants can relate to – that our urban centres can become enriched by tall buildings.

This paper, in examining the results from a theoretical high rise research design project, has shown a number of approaches to design which may help cities such as London in their quest for an appropriate high rise expression. These approaches are summarised in the paragraphs below, and expanded by considering other World examples, in an attempt to categorise current design paradigms for high rise buildings:

1. *Abstract Sculpturalism*: Tall Buildings which are still pre-occupied with their role as a piece of three-dimensional art in the city, but are at least moving away from the commercially-dictated, monotonous 'shaft' approach. A good example is the changing angular form of Christian de Portzamparc's 1999 LVMH Tower, New York (*Garreta 2002, pp330-335*).

2. *Cultural Symbolism*: Tall Buildings which are inspired by an element of the indigenous culture of the location, which is unfortunately often taken quite literally (and thus with limited success) in the translation. Towers with Corinthian capitals and Islamic domes proliferate around the world, but perhaps more successful examples include the Chinese pagoda-inspired 1998 Jin Mao Tower, Shanghai by SOM Architects (*Dupre 1998, pp116-117*).

3. *Abstract Symbolism*. Towers which take an element of the culture as inspiration, but incorporate this in a subtle, 'abstract' way. This often leads to a deeper, more refined approach e.g. the Islamic skin of BEP Architects' 1984 Menara Dayabumi, Kuala Lumpur.

4. *Abstract Conceptualism*. Towers that take a strong philosophical idea for the building, which is not necessarily related to the setting but, if well executed, becomes *synonymous* with the setting, e.g. Norman Foster's 1986 Hong Kong and Shanghai Bank Headquarters, Hong Kong (*Garreta 2002, pp224-229*).

5. *Structural Expressionalism*. High Rise Buildings whose predominant aesthetic and organising principle is informed by an expression of the structural system e.g. I.M.Pei's 1990 Bank of China, Hong Kong (*Campi 2000*).

6. *Locationalism.* Tall Buildings that are rooted in their context by responding to the physical characteristics of the site and surrounding area (considering that tall buildings have relationships to sites several miles away due to the visual connection). Common design devices used include the generation of axes from physical entities, manipulation of form to respond to 'place' etc. A good built example is the 1984 National Commercial Bank building, Jeddah, Saudi Arabia, by Skidmore Owings and Merrill (*Garreta 2002, pp360-365*).

7. *Environmentalism.* Tall Buildings that are inspired directly by the climate in which they are located; responding to the opportunities offered by sun, wind, rain etc. Ken Yeang is the main protagonist of this approach, with his 1997 MBF Tower in Penang, Malaysia, a good example (*Richards 2001 pp54-61*).

8. *Sustainablism.* Closely related to the previous category, this type of tall building is often inspired by a response to climate, but takes on the additional specific agenda of sustainability in the construction and operation of the building. Approaches include a consideration of use and material life-cycle flexibility in the building. Good theoretical examples include the UK-based Marks Barfield Skytower and Bill Dunster's Skyzed project (*Gates 2003*).

9. *Internalism.* Tall Buildings which are inspired by a concept / organising principle for the internal spaces of the building, which dictates the design and external expression etc. This approach often includes elements such as atria, skygardens etc. One of the best built examples is Norman Foster's 1997 Commerzbank, Frankfurt (*Zukowsky 2000*).

10. *Materialism.* Tall Buildings which are concerned predominantly with an expression of materials and, often, skin – which may or may not be linked into the environmentalist / sustainable debate. A good example is the intelligent-skin façade and motor-driven windows of Ingenhoven Overdik and Partners' 2003 Uptown Munchen Building, Germany (*Abel 2003 pp79-82*).

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Fig.1.	Design solution	Mark Rinaldi
Design 1	Urban Axes	Julien McGuiness
Design 2	Bldg as Billboard	Konstantinos Evangelou
Design 3	Sun Splice	Tom Pickford
Design 4	Shell and Core	Eva Young
Design 5	Wind Tower	Simon Mok

Design 6 High Rise Villages	Richard Vint
Design 7 Preferable Corner	John Pedder
Design 8 Hydroponic	Robert Luck
Design 9 The Treehouse	Alex Robertson
Design 10 Prefabricated	Suzanne Li

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