The revival of high-rise living in the UK and issues of cost and revenue in relation to height

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Contents

Abstract

The following report explores the recent revival of tall residential buildings in the UK as well as issues of costs and revenues for such projects.

The first part of the paper focuses on the background and the preconditions of the revival. The history of tall residential buildings and its impact on the image of high-rise living is explored as well as some of the debate that surrounds the topic. However, the vast amount of related social, urban design and environmental issues are not part of the analysis. The phenomenon of the revival is described in numbers of completed buildings and with examples of built and proposed projects. Characteristics like the new type of occupiers and the provision of affordable housing are highlighted.

The second part of the report and the main part of the research focus on the economic drivers behind tall residential developments. The issues of building costs and sales prices in relation to height are explored and values are gathered in several interviews with professionals. The findings are analysed and applied in a series of model calculations for developments with heights from 5 – 50 storeys.

It seems that the disadvantages of building high are not balanced out by a premium in sales prices for height. The evidence found suggests that the economics of tall residential buildings change dramatically above 20 storeys. This corresponds with the height of structures that were built in recent years. However, the paper concludes that the data available was not sufficient to establish robust quantitative relationships between residential developments of different heights and that it is necessary for the benefit of all that more research on this topic is made publicly available.

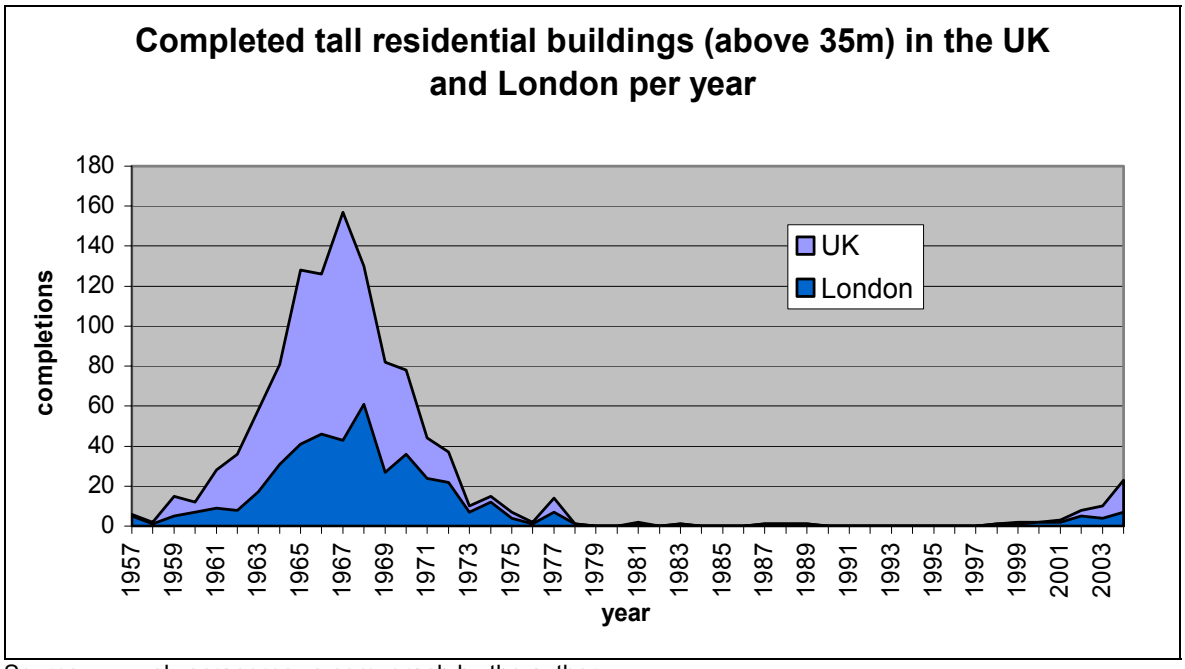
10,758 Words

1. Introduction

It is not long ago that the time for high residential buildings in the UK was regarded as over. Tall buildings seemed only appropriate, if at all, for offices. The examples of failed 60s housing tower block schemes made high-rise accommodations unpopular for planners and developers alike and a demand for such buildings was virtually not existing. Yet, there are clear signs for a revival of the type. The output of new tall residential buildings has increased again and former office buildings as well as failed housing tower blocks have been converted to successful residential developments.

On the other hand, as illustrated in Figure 1, the phenomenon can by no means be compared with the boom of residential towers in the 60s.

Figure 1



Source: www.skyscrapernews.com, graph by the author

The new residential sector is acknowledged by professionals and professional reports. Articles in the daily press and on the internet have picked up the topic -and sometimes exaggerated the extent of the phenomenon. However, it has not reached the academic debate. Academic publications as well as policy documents in the UK have not yet discussed the recent development.

The research undertaken for this report seeks to explore the preconditions and characteristics of the phenomenon. Yet, the main focus of the research is on issues of cost versus revenue in relation to height. The understanding of the economics of tall residential buildings is regarded as a condition for a sophisticated analysis of what role tall residential buildings can play under current conditions in urban planning as well as property development.

There are several other important issues that are clearly related to the topic. Such is the impact of the volumetric dimension on the neighbourhood or the role tall buildings can play in the skyline. There are significant possibilities and threats that arise from

living in them. Shading and wind turbulences are intrinsic problems and questions of embodied energy and transport are hardly separable from the subject. Fear of terrorist attacks on tall buildings has been an issue in the aftermath of the 9/11 events and is mentioned again since the latest attacks in London.

Some of these points are discussed in the literature review where raised in recent publications. However, while of no less significance, these issues are beyond the scope of this paper and have not been covered in the research.

The problem of defining high-rise, tall buildings and towers

The sources consulted for this paper use various definitions for the subject of interest. The thresholds above which structures are assumed to be tall buildings range from six storeys (Church and Gale, 2000) to 35 metres (Skyscrapernews.com)

Davis Langdon (Davis Langdon & Everest et al., 2002) states that it is not possible to define tall buildings using absolute measures. They believe that “tall buildings are therefore best understood in relative terms as buildings whose planning, design, construction and occupation is influenced by height in ways that are not normally associated with more typical, local developments.” (page not numbered)

For the sake of this report, the terms tall building and high-rise shall be used for structures with approximately eight or more storeys (unless otherwise stated) while towers are tall buildings with a slender shape.

2. Methodology

Published research

To date, very limited amount of research has been undertaken on the revival of tall residential buildings in the UK. In fact, no academic literature has been found that explicitly describes the topic.

A professional report by Knight Frank and EC Harris (Knight Frank, 2004) explores the phenomenon and the economic drivers. It is acknowledged by professionals and experts from other companies that this document is currently the best available examination of the subject.

Yet, although based on thorough knowledge of the subject, the report has limitations with regards to academic standards. As can be expected from such type of literature, information is not sourced and complex issues are summarized in short paragraphs. The authors of the report answered various questions and were helpful and open minded when discussing the topic. But Knight Frank and EC Harris, as well as the quoted engineers Expedition-Engineering, did not have or did not want to reveal the

underlying research. Samples or other original data were not available for actual numbers of completed buildings or the indicative cost and revenue analysis.

The research questions

The research was inspired by a lecture of Marks Barfield Architects on the Skyhouse project - a truly innovative, elegant and potentially sustainable concept for residential Skyscrapers. After some initial research it became clear that the project was not realized although the Skyhouse group had significant reputation, the project had gained public attention and was proposed at the right time when the political climate was favourable for such projects (with the exception of the local level) and demand for housing was extremely high. In fact, just before the beginning of the Skyhouse project in 2000 the revival of tall residential buildings started and then constantly gained momentum.

The “failure” of the Skyhouse project increased the interest in the economic drivers for high-rise residential buildings. A thorough understanding of the developing market sector of new built high-rise accommodation is helpful for several reasons. It could allow a more sophisticated analysis of what role tall residential buildings can play under current conditions in urban planning and property development. For example, whether and how they can contribute to the much acclaimed urban renaissance or whether there is scope for investments in green technologies. Furthermore, it must be in the interest of all those involved in developing such structures to base their appraisals and plans on profound knowledge. Finally, it is certainly to the benefit of the public when new elements of the built environment have been designed and assessed by informed experts.

The research question for this analysis is split in two parts. First, the attempt is made to describe the phenomenon as thoroughly as possible. To explain its preconditions and characteristics as well as its scale in relation to the existing built environment. The second part of the research focuses in more detail on the analysis of the costs and revenues in relation to height.

The research

In order to understand and describe the phenomenon, it was necessary to consult the literature on the history of residential buildings. This is crucial not only to understand the background in terms of the history and perception of tall residential buildings in the public. It also explains why such buildings were not erected throughout the eighties and early nineties.

A clear distinction between literature review and analysis section was not chosen. To explore the background of the phenomenon it was necessary to extract data from other sources and analyse and present it in a way that it supplements the arguments presented.

The analysis of the phenomenon itself uses a variety of tools. A large amount of information was drawn from interviews with experts from the fields of surveying, architecture, planning, property development and consultancy. The interviews gave

insight in the characteristics of the market. Because of the absence of published values for building costs and house prices in relation to height, the interviews were an important source of such data. Furthermore, the interviews provided information on specific projects, in particular on the so called Skyhouse project.
This approach was supplemented by analysis of data from various sources:

- The website of the Office of the Deputy Prime Minister (ODPM) provides data gathered for the English House Condition Survey 2001. These figures were used for the analysis of the existing stock of units in tall buildings. The data is only provided on the stock of the existing built environment. Demolitions are not counted and the data does thus not give a full picture of what has been built at what time. A further limitation is that the information is provided in age bands and not in years of completion. The website also provided the house price index.

- Skyscrapernews.com is a free database on the web that provides data for structures of a height of 35 metres or more in the UK. The total number of completed tall buildings in the UK on the Skyscrapernews database was 2,605 on 10 September, 2005. The total number of completed tall residential buildings in the UK was 1,669, of which 528 were missing information about the year of completion. The administrator of the website expects that the database can be trusted to be comprehensive for buildings above 40 metres. The findings from this database were compared with the data from the ODPM, the National Housing & Town Planning Council (NHTPC, 1996) and data provided directly by London Residential Research (LRR, 2005). As far as possible, the other sources seemed to support the information from Skyscrapernews.com.

- London Residential Research provided lists of tall residential buildings in London as well as those that are under construction and have planning permission. Furthermore, detailed data on sales prices and planning history of specific buildings was provided. This allowed the calculation of sales prices per floor for four buildings. The samples were supplemented by a fifth building that had published sales prices on the internet.

Finally, a model calculation was undertaken to test the combined effect that the results of the research on costs and revenues in relation to height have when applied in one calculation. The model compares the economics of residential developments with 5, 10, 20, 30, 40, and 50 storeys. The calculation uses a range of inputs and assumptions that can differ significantly from the extremely diverse conditions of property development. The importance of the results is not in any particular value but in the relationships that can be found between cost, revenue, and height.

3. Literature Review

Introduction

As discussed above, the professional report “High-rise residential towers” by Knight Frank and EC Harris (Knight Frank, 2004) is by far the most comprehensive publication about this topic. Given that a remarkable change in output of new buildings has only taken place since 2002 (see Table 3) it is no surprise that no other professional publications could be found that cover the topic. Nor has the recent revival of residential towers in the UK been discussed in academic literature so far.

On the other hand, various articles in the daily press, on the internet and in professional magazines have highlighted the topic. *RICS Business* (2004, p.22) writes “the last few years have seen a revival in the fortunes of high-rise residential buildings. Many councils have invested in improving … their blocks, and developers are creating a new generation of elegant, high-quality private residential towers.” The article describes the success of tall residential buildings by the Liverpool-based Beetham Organization, a developer that specializes in residential towers.

In the same year the *BBC News Online Magazine* (news.bbc.uk) publishes an article titled “The return of high-rise Britain?”. It features both the Beetham developments as well as the Skyhouse project. (see chapter: The Skyhouse project) Another article in the Manchester section of the BBC webpage (www.bbc.uk/Manchester) even declares “the beginning of the high rise renaissance” while the magazine *Building Design* (2005, p.6) detects “the race … to build the tallest residential tower in London as … architects are turning once again to high-rise homes”

Policies and academic debate

The tall buildings debate

In contrast to the lack of recognition for the “rapidly developing sector” (Knight Frank, 2004, p.1) of high-rise accommodation, the issues of tall buildings in general have been subject to debate. Many authors agree that the doubt about the future of tall buildings in the aftermath of the world trade centre attack was not for long and that there “has been no slackening of the drive towards building high.” (McNeill, 2005)

In Britain, tall buildings are an important topic of debate and nowhere more so than in London. In June 2005, The House of Lords has regarded a possible threat to the skyline of London as so important that it scheduled a debate to discuss the planning decision for a new tower near Vauxhall Bridge. (www.publications.parliament.uk)

Reports commissioned by the Corporation of London, *Tall buildings and sustainability* (Pank, 2002), and by Development Securities PLC, *Tall Buildings: Vision of the Future or Victims of the Past?* (LSE Cities Programme, 2002), are recent contributions to the debate. The LSE report emphasises the necessity of highest design standards for tall buildings while the Corporation of London report calls for a

more sustainable design. However, they agree that "tall buildings could certainly make an important contribution to the necessary new wave of redevelopment." (LSE Cities Programme, 2002, p.10)

The following table briefly summarizes the advantages and disadvantages of tall buildings as laid out in the *Tall Buildings and Sustainability* report. (Pank et al., 2002):

Advantages of tall buildings	**Disadvantages of tall buildings**
Economies of scale in construction and procurement	Shading -shadows on other buildings, right to light issues
Efficient land use - more space at ground level at similar density	Floor area efficiency -lower net:gross floor area ratio
Potential for Combined Heat and Power (CHP) technology	Wind effects –wind funnelling at ground level and greater wind speeds at height

With regards to energy consumption of tall buildings, Pank et al. believe that:

> "Sustainable energy options, such as CHP, borehole cooling and fuel cells, can cut fossil fuel consumption. … Day-lighting, natural shading, energy-efficient and PV facades, wind power systems, and sky gardens within buildings add up to a significant shift towards more sustainable design of tall buildings." (Pank et al., 2002, p.53)

Yet, this very optimistic view is not generally accepted. Instead, doubt is expressed whether tall buildings can really be sustainable, that in fact high buildings "are likely to have more embodied energy and use fewer renewable materials." (Edwards et al., 2004, p.11, see also Troy, 1996)

The reports mentioned above represent the views of two powerful groups in favour of tall buildings in London, the property developers and the Corporation of London. Most importantly though, is the attitude of the mayor himself:

> "I made my view absolutely known - I raised it again and again at meetings - that I would favour higher buildings and higher densities." (Ken Livingston in Minutes of London assembly meeting, 18 July 2001, quoted from McNeill, 2002, p.330)

In the London Plan the official policy on tall buildings reads as follows:

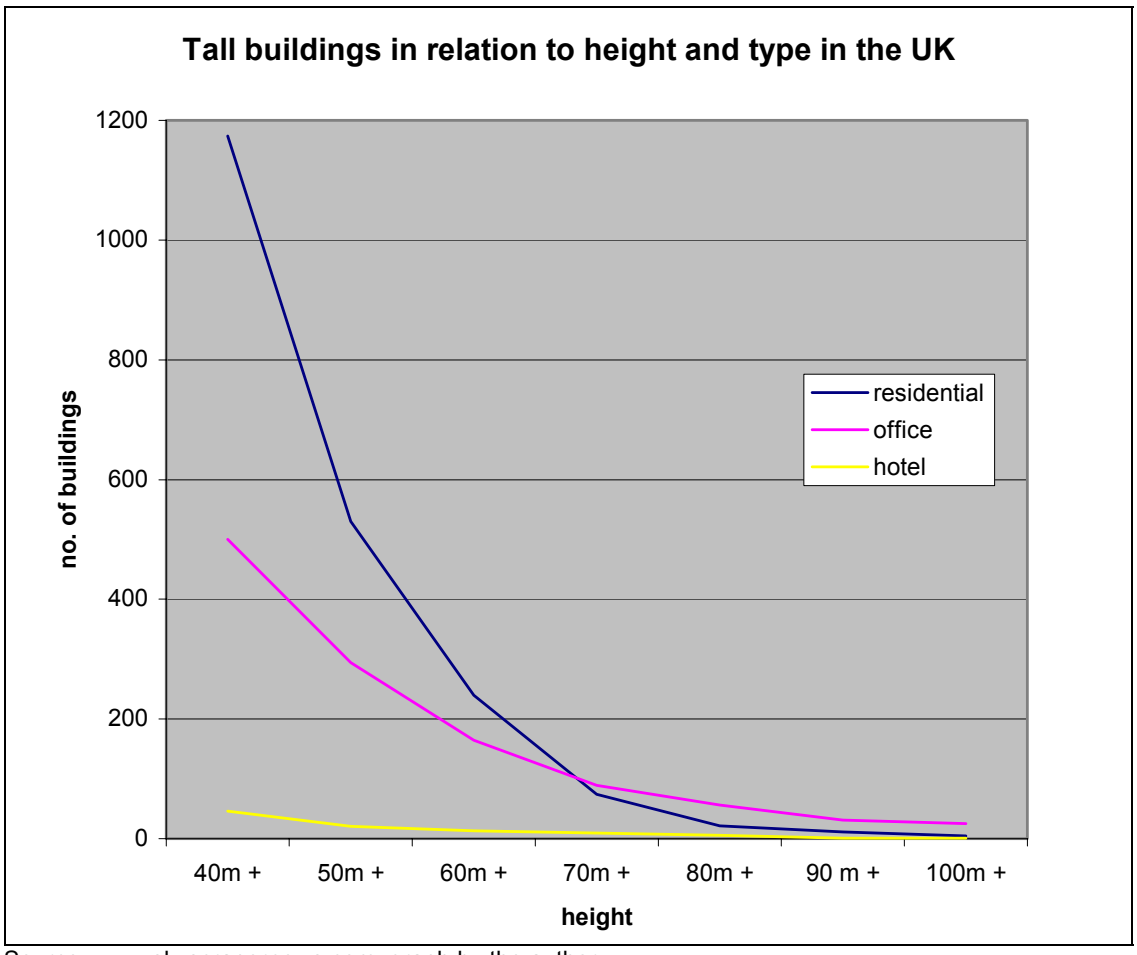
> "The Mayor will promote the development of tall buildings where they create attractive landmarks enhancing London's character, help to provide a coherent location for economic clusters … or act as a catalyst for regeneration and where they are also acceptable in terms of design and impact on their surroundings. … [The boroughs] should not impose unsubstantiated borough-wide height restrictions. … The compact city and intensive development does not necessarily imply high-rise buildings. ... However, tall buildings can be a very efficient way of using land and …can support the strategy of creating the highest levels of activity at locations with the greatest transport capacity." (GLA, 2004a, p.181)

Opposed to this strategy McNeill (2002) identifies an “anti-height conservationist lobby … from three sources: the media, the statutory conservation body English Heritage, and various conservation-minded borough councils.” (p.329) Another strand of criticism claims that the mayor’s planning decisions pro skyscrapers are not reached in public. (McNeill, 2002)

London might dominate the discussion but several other cities in Britain are following a similar route. Manchester, Liverpool, Leeds, Birmingham and Newcastle have adopted a more development-friendly approach to planning and have discovered tall buildings as “symbols of civic pride and economic progress.” (Knight Frank, 2004, p.3)

It is worth noting that contributions to the general debate about tall buildings often focus on office buildings. These are regarded as having the main influence on skylines. As symbols of economic power and as focal points of professional networks they fascinate authors and the public alike. (see for example: McNeill, 2002 and 2005, LSE Cities Programme, 2002, Pank et al., 2002) While the total number of high residential buildings in Britain is far greater than tall office buildings, the relationship changes with buildings higher than approximately 70 metres. The database Skyscrapernews.com lists 25 office buildings of 100 metres or higher and only 5 residential structures, respectively. (see Figure 2)

Figure 2



Source: www.skyscrapernews.com, graph by the author

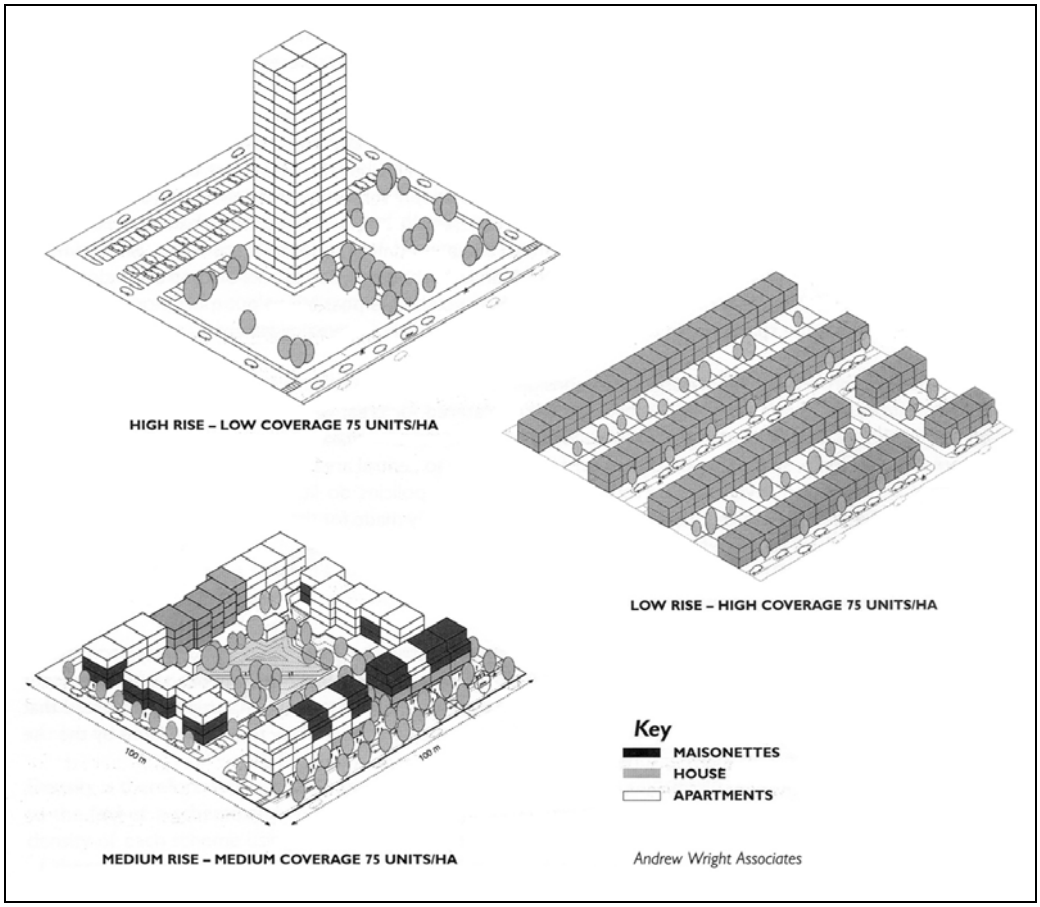
Tall buildings and density

Tall buildings are typically regarded as dense developments, but at the same time it is often emphasized that high densities can be achieved with a variety of urban forms. (GLA 2004a, GLA 2003) The LSE Cities Programme (2002, p.10) states that:

> "Notting Hill, Lancaster Gate and Earl's Court-with five and six-storey houses … -are among the most densely populated neighbourhoods in the country, but prove that density can be achieved without very tall structures."

Figure 1 illustrates how the identical density can be achieved with three different types of buildings. While this drawing is taken from Cope, 2003, the same diagram is used in Urban Task Force, 1999 and GLA, 2003.

Figure 3



Source: Cope, 2003, p.23

The density debate

Although not a dense type by nature, the tall residential building is often used in dense developments and is thus typically discussed in conjunction with density. The following extracts of the density debate are therefore briefly reviewed.

As early as 1925, Le Corbusier had advocated the concept of the compact city, (although in a completely different form than today's campaigners) in order to reduce traffic: "The higher the density of a city's population, the shorter the distances to be

covered." Ten years later he writes: "The authorities want to force us to live in suburban garden-cities … I propose to turn the city back into itself, enclose it with its own limits, and raise its population level to 400 residents per acre. … This will solve the transport crisis." (1935, p. 107, see also Le Corbusier, 1931)

Today, the claim for higher densities is still motivated by wanting to avoid sprawl. It is argued that this reduces the necessity to travel and thus reduces energy consumption and pollution. (Urban Task Force, 1999) Troy, although opposed to higher densities, provides a good summary of the points in favour of higher density: "They have argued that jobs should be closer to homes: that housing and work places should be mixed together … and, further, that they will be able to satisfy their social and cultural needs close to home." (Troy, 1996, pp. 165) Other advantages of higher densities presented are: more opportunities for interaction and diversity, improved viability of and access to community services, provides economy of infrastructure, supports public transport and reduces car travel and parking demand. (Cope, 2002)

On the other hand, "critics have questioned, for example, whether the particular type of urban renaissance advocated … -based on increased densities, mixed-used areas, and preferential use of brownfield sites … - is in fact desirable and appropriate." (Pierce, 2002) Some of the arguments put forward against higher density are that higher density housing results in reduced privacy, that it trades privacy for location. Construction costs are argued to be higher for high density buildings because of scale and complexity of construction. (Troy, 1996)

Another strand of critique questions the universal approach of higher density as a cure-all: "But this does not mean it [higher density] is an optimum strategy anywhere or everywhere, or for the longer term." (Edwards et al., 2004, p.11)

A crucial question raised is whether "this vision of higher-density urban living [can] be fulfilled even in the face of strong consumer preferences for … suburban, lower-density living?" (Pierce, 2002, p. 956) This seems to be one of the main difficulties as even the Urban Task Force has to acknowledge that a "policy to encourage more house building in urban areas appears to run counter to the expressed desires of the British public" (UTF, 1999, p.1, Pierce, 2002)

Furthermore, Troy (1996) points out that: "The model [of living at high density] seems to be related to an elitist urban life style in which individuals eat out, engage in the pursuits of a romanticised café society, have the time to enjoy morning coffee over the newspaper, explore the antique shops, bookshops and art galleries. Enjoyable as these activities are, they are not the daily options or desires of the overwhelming majority of the population." (Troy, 1996, pp.50)

But the opposite party uses similar allegations: "The … idyllic, self-sufficient, decentralised and autarchic community located in the countryside as a panacea for human settlements remains, unfortunately, a myth." (Yeang, 1999, p.10) And Weiß (2005) is convinced that reasoning against urban sprawl is winning recognition amongst professionals worldwide: "It is remarkable how the arguments put forth in expert circles around the globe converged ..." (Weiß, 2005, p.16)

In Britain, there is no doubt that the official strategy today (at least on national and regional level) includes increasing density to meet the need for additional housing. “British urban and housing policy now seems to be based on the largely untested assumption that building at higher densities is a ‘good thing’” (Edwards et al., 2004, p.10)

The National Government’s planning guidance (PPG3) issued in 2000 as well as the London Plan (GLA 2004a) emphasize the necessity of the use of brownfield sites in locations with good transport links and facilities. This official position is influenced and backed by a number of reports, among them: *Towards An Urban Renaissance* (Urban Task Force, 1999), *High Density Housing in Europe: Lessons for London*, (PRP, 2002), *Capital gains: making high density housing work in London* (Cope, 2002) and *Housing for a compact city* (GLA, 2003).

The British policies are in line with very similar positions expressed by the European Commission (see for example CEC, 1990, 1998) and its member states. The European Spatial Development Perspective (ESDP) is not an official EU document but was formally agreed by EU ministers in 1999. It states clearly that: “Member States and regional authorities should pursue the concept of the “compact city” (the city of short distances).” (ESDP, 1999, p.22)

It can be concluded that in terms of policies and academic debate there seems to be a rather favourable climate for density and tall buildings in Britain.

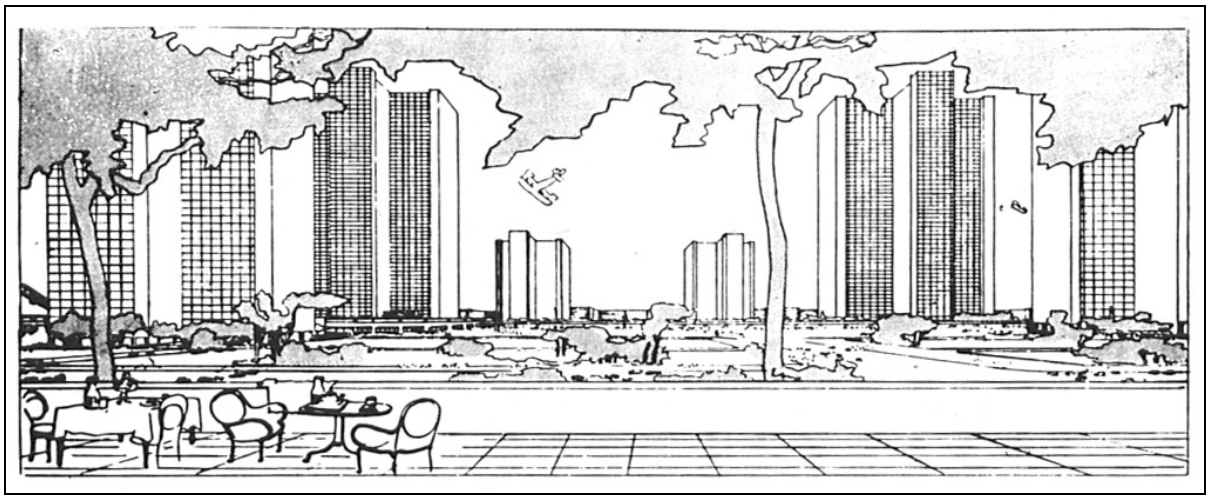
History of residential towers in the UK

Origins

The skyscraper was developed in the cities of the US towards the end of the 19th century. New building heights were made possible by the invention of the lift and the use of iron (later steel) construction techniques. A ten-storey office building erected in 1885 in Chicago is widely regarded as the first structure of this kind. The rapid development of the technology was fostered by a property boom in Chicago that made such projects viable. Mainly used for offices, skyscrapers were also constructed to house other functions in dense urban areas like hotels and even municipal buildings. (Lepik 2004, Bossom, 1934)

Skyscrapers to save us from the past

In the first half of the 20th century modernist architects and urban planners discovered residential skyscrapers as a possibility to replace the overcrowded, damp, and dark accommodations in the industrialized cities. In 1925 Le Corbusier wrote: “we must increase the density of the population, we must greatly increase planted areas. … We must therefore build the city vertically.” (p. 160)



Le Corbusier's vision of the ideal "contemporary city", Source: Guiton, 1981, p.96

The Congrès International d'Architecture Moderne (CIAM) propagated residential skyscrapers, built with methods of mass-production, as an opportunity to allow light, ventilation and green spaces in urban locations at reasonable costs. (CIAM, 1931) The prominent architect Walter Gropius presented studies that argued that at similar density with higher buildings the distances between them can be increased. He claims that the additional space on the ground as well as that on roofs "should be used for planting vegetation, so that … the experience of nature … is not just reserved for the weekend." (Gropius, 1931, p. 47, translated from German by the author)

The confidence of Le Corbusier and his fellow combatants in the ability to solve complex social problems with urban design proposals was extraordinary. When summarizing the view of the CIAM, Giedion (1930) pointed out that the residential skyscraper was not seen as the only suitable form of housing in future cities but emphasised that it is a solution for proving suitable accommodation for the poor.

Model of Le Corbusier's proposal for Paris, Source: Curtis, 1986, p.65

Throughout the 20s, 30s and 40s, the European architectural avant-garde produced numerous proposals for residential skyscrapers. One of the most famous is the provocative “Plan Voisin” by Le Corbusier in 1925 where he suggested to replace a large area of central Paris with a scheme of 18 skyscrapers, illustrating his strong belief in the typology. Due to the economic crises in the 20s and World War II as well as the drastic nature of many of the proposals, hardly any of the projects were implemented. But the work undertaken by the modernist visionaries in these decades prepared the theoretical ground for the later success of the residential skyscraper. “After the war … the modern movement emerged triumphant as the accepted architecture of liberal democracies and welfare states. (Curtis, 1986, p.162)

Tower Blocks

In the post war period in Britain and the European continent, a dramatic housing shortage was caused by bomb damage, demographic growth, and vast amounts of sub-standard stock. Large-scale housing projects, often made of tower blocks, were regarded as a contemporary and effective way of addressing demand. It allowed the use of mass-production and prefabrication and reflected the faith in modernism. (www.sustainingtowers.org)

Until the 1990s around 400,000 flats in 6,500 multi-storey blocks were built in the UK with the real boom lasting from the late fifties until the early seventies. Around 20% of all public housing built after World War II was provided in buildings with 6 or more storeys. (www.sustainingtowers.org, www.odpm.gov.uk, Church and Gale, 2000)

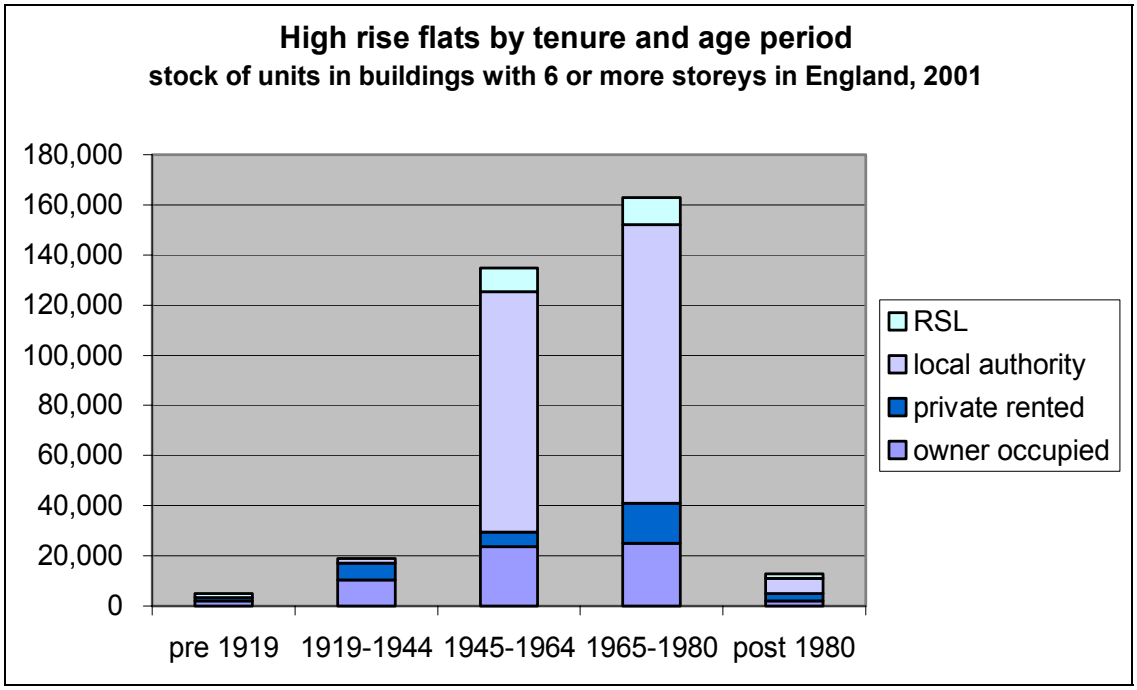
Many authors point out that what was actually built in the name of modernism (whether in Britain or most other parts of the world) falls far short of the original ideas:

> “The rows of clinical housing slabs which now rose out of the rubble were often a travesty of all that Le Corbusier had stood for. … Modern architecture very easily became a thin veneer over the utilitarian box or the developer’s financial calculations.” (Curtis, 1986, p.162)

Moreover, the residential skyscrapers originally envisaged were to allow dense living in the city but instead, very often it was “mass housing on the urban periphery [that] was hit especially hard by the architectonic simplifications of the 1950s, 60s and 70s …” p.19 (Weiß, 2005)

Church and Gale (2000) explain that a considerable number of tower blocks have been demolished and that many councils are still planning to demolish more. (The authors point out that it has not been possible for them to determine the number of demolished buildings more exactly) They estimate that more than 4,000 buildings with more than 5 storeys still exist with roughly 800,000 people living in them. The majority of tower blocks are owned by local authorities and a small number is owned by housing associations. Only very few are private developments.

Figure 4



Source: www.odpm.gov.uk

Figure 4 illustrates the volume and proportion of units in such buildings by tenure. The graph is based on figures from 2001 and it must be taken into account that demolished stock is not regarded and that the right-to-buy policy has shifted tenancy towards owner occupied.

A range of problems associated with the existing stock of tower blocks is mentioned in various articles. The report *Streets in the sky – Towards improving the quality of life in Tower Blocks in the UK* (Church and Gale, 2000) points out that besides the limited quality of the buildings, insufficient financial provision for housing repairs in social housing has worsened the problems. The report notes the following issues on page 9:

Table 1

physical problems	**social problems**
inadequate heating systems	tenant isolation / depression
Asbestos	racial harassment
unreliable lifts	fear of crime as well as crime itself
cockroaches	noise, litter, refuse
building defects	
lack of safety for children	
poor fire safety	
inadequate play facilities	
lack of security	

Source: Church and Gale, 2000

Several publications on multi-storey housing schemes in Britain stress the importance of occupancy as crucial for the success. The report on the opportunities for high density housing in London (Cope, 2002) emphasises the importance of

residents living there by choice as well as low child densities. Jephcott (1971) and Church and Gale (2000) agree that children should not live in high flats. “This is primarily due to the difficulty of ensuring safety from heights, and the problems of giving children easy access to safe outdoor space in which to play.” (Church and Gale, 2000, p.7)

The public image of high-rise living

There is a consensus in the British literature that typical housing tower blocks from the 50s, 60s and 70s have a negative image and that this perception has discouraged high rise residential buildings for years.

A report by the LSE Cities Programme on the future of tall buildings in London (2002, p.1) has no doubt that “the cautious attitude to tall buildings in London is due to … negative attitudes prompted by the dismal high-rises of the 1960s.” Knight Frank (2004, p.2) summarizes the influence of the negative image as follows: “The perceived failure of post-war experiments contributed to a reaction in the 1980’s which, together with increased attention being paid to conservation and heritage issues, led to a rejection of high-rise towers, both residential and commercial for over a decade.”

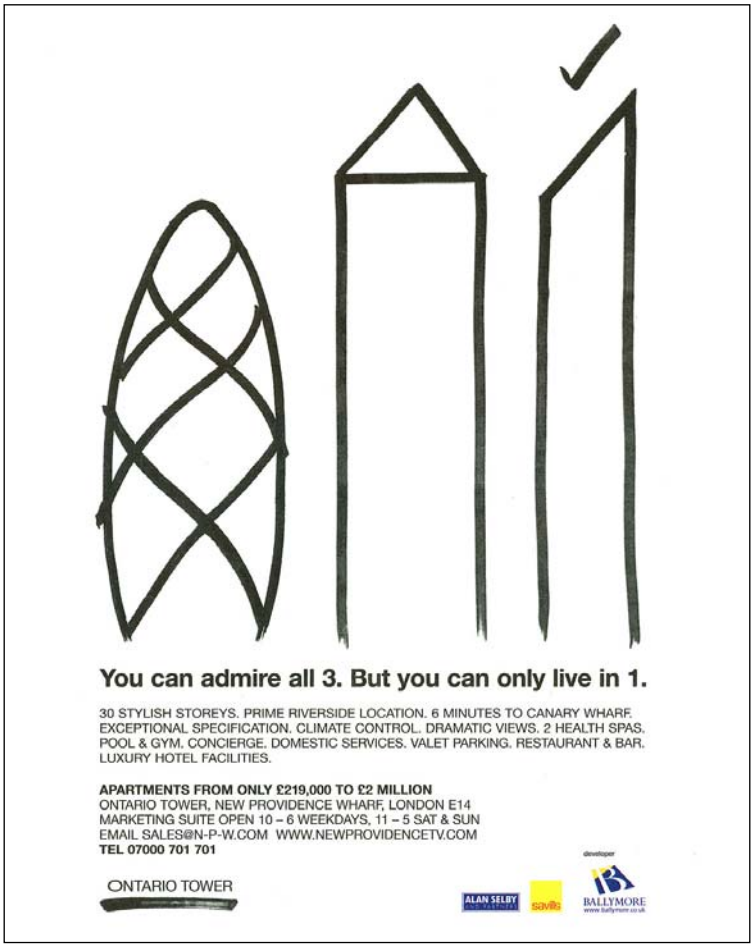
Research undertaken by public opinion research agency MORI and commissioned by cabe (www.cabe.org.uk) in 2002 came to devastating findings for the public image of high-rise accommodation. In interviews with over 1000 people in England they were asked to choose their favourite home. They were presented images of various typologies from a village house to a modern loft style apartment. The high-rise apartment was represented by a rather grey image of a tower block. No one at all selected the tower block. (www.cabe.org.uk, Interview Marks Barfield)

Table 2

Housing preferences in England study by MORI in 2002	
Bungalow	30%
Village house	29%
Victorian terrace	16%
Modern semi	14%
Modern loft style apartment	2%
Tower block flat	0%

Source: www.cabe.org.uk

However, in limiting the typology of high-rise apartments to the 60s tower block, the study did not acknowledge the latest developments. In 2004 Knight Frank stated that “there has been something of a renaissance over the past two to three years … Prompted by the growth in ‘city living’, high-rise apartments have become increasingly acceptable to developers, planners and importantly to purchasers.” (p.2)



Advert for high-rise apartments, Source: Rich City, 2005

Soon after the above findings were published, Marks Barfield commissioned MORI to do more research to figure out under what conditions people do like to live in high rise accommodation. It turned out that the rejection of high-rise living was by no means as unambiguous as suggested earlier. The second study showed that potential purchasers are interested in flats in tall buildings if they offer security, a high level of design and a range of in-house services. (www.skyhouse.co.uk)

The crushing affects of the tower block fiasco slowly seem to fade and allow new opportunities for high-rise living.

4. Analysis

Economic Background

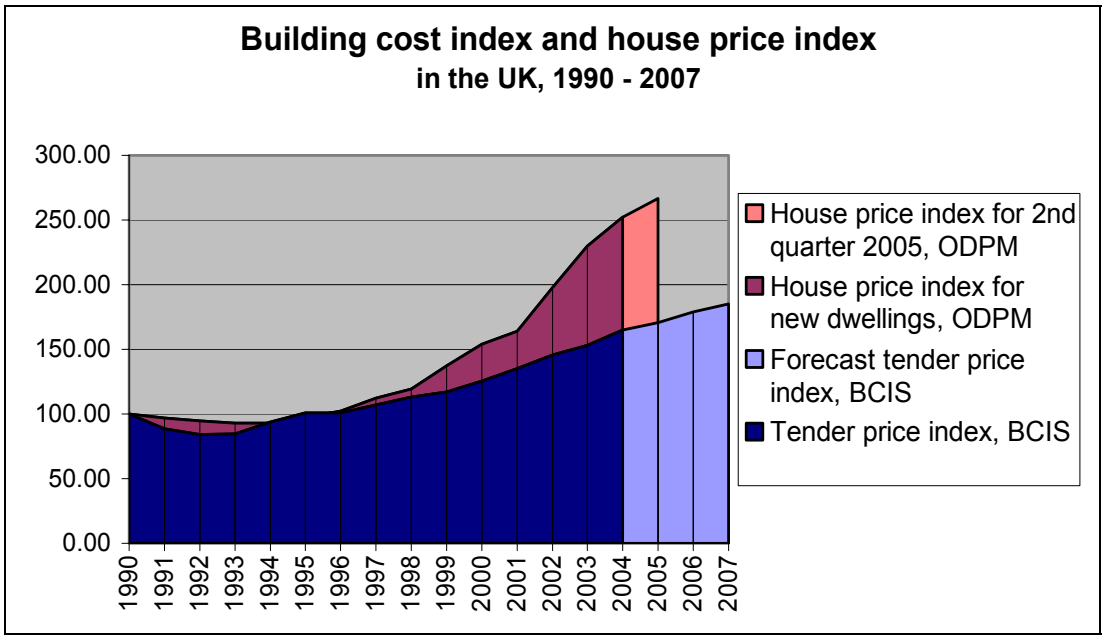
> "The doubling and in some cases the trebling of residential prices since the late 1990's has effectively provided a cushion in development economics which has allowed for extraordinary costs such as the development of high-rise schemes." (Knight Frank, 2004, p.3)

Figure 5 illustrates that since the late 1990's the inflation in tender prices did not catch up with house prices. Liam Bailey (Interview Knight Frank) points out that a "window of opportunity" for high-rise developments had existed up to eighteen months ago. Construction costs for high rise buildings had been in a better relationship to overall construction costs than today. This has changed when cost for high-rise construction rose faster than overall construction costs in the last eighteen months. Unfortunately, the very specific data that would be needed to explore this thesis was not available for this report.

The increase of house prices has certainly had a strong influence on the viability of all property developments. As such, it also supported the niche market of high-rise

apartments. Another explanation that supports the idea that the recent economic indices have been in favour of high-rise construction, is that tall buildings are usually dense developments and in addition have higher construction costs per net area. The share of construction costs plays a much more important role in the overall development costs than for the development of a detached bungalow. Subsequently, the increasing gap between house prices and construction costs could have had a larger influence on the viability of tall residential buildings than on other projects.

Figure 5



Source: www.odpm.gov.uk, BCIS 2005

BCIS expects tender prices to rise around 5% in the year 2005-2006. Furthermore, it is anticipated "that tender prices will continue to rise well above inflation over the following year, as reduced pressure from input cost rises is substituted by above trend new work output in 2006 and 2007." (BCIS, 2005, p.5) A very recent forecast of tender prices by David Langdon comes to similar conclusions. However, some impact of the successful Olympic bid on tender prices is expected to be felt between 2008 and 2012 when prices might rise further as a result of additional workload. (Building, 2005)

With construction cost rising above inflation but not excessively, it seems that the more volatile development of house prices can have a stronger impact on the relationship between the two curves. While increase of house prices has merely slowed down, some predict that the current rate is due to a bubble and may eventually drop. (The Economist, 2005) If it is true that residential towers have become viable because of the divergence of house prices and building costs, than the drop of house prices could certainly close this "window of opportunity".

The phenomenon in numbers

The free database Skyscrapernews.com provides data that allows to compare the number of completed buildings above 35m per year. (Limitations to the accuracy of

the source apply and are discussed in the Methodology) While Figure 1 illustrates the revival of tall residential buildings in relation to the earlier boom of housing tower blocks, Table 3 lists the actual numbers for completed buildings of 35m or more per year in the UK. Of all the buildings completed in this revival since 1998, one is 34 storeys high , one is 30 storeys high and none of the remaining buildings is taller than 23 storeys. (Given that the accuracy of the database increases with height and that the data of LRR supports this threshold, there is no doubt about this judgment.)

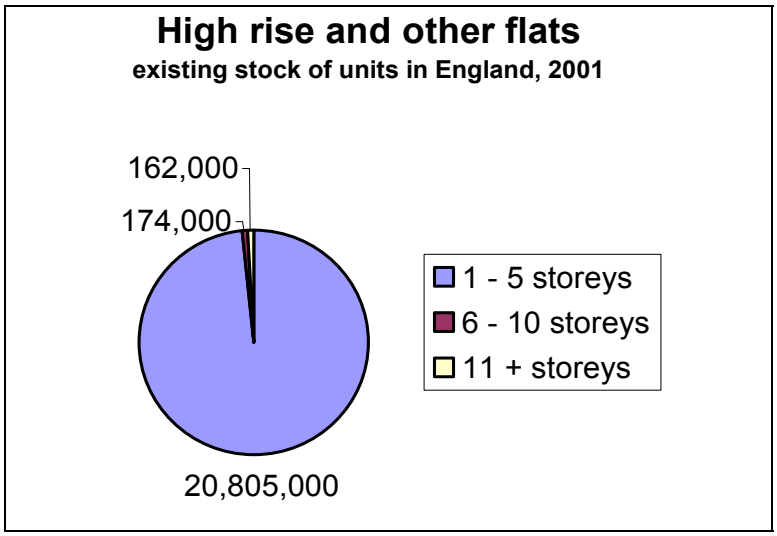
Table 3

Completed tall residential buildings in Britain per year										
Year	95	96	97	98	99	00	01	02	03	04
Completed buildings of 35m +	0	0	0	1	2	2	3	8	10	24

Source: www.Skyscrapernews.com

It is worth noting that the actual numbers of existing units of high-rise accommodation are not overwhelming. Only 1.6% of all dwellings in England are in buildings with 6 or more storeys, less than 1% are in buildings with 11 or more storeys. (see Figure 6). High-rise living is a niche market long dominated by tower blocks in housing estates.

Figure 6



Source: www.odpm.gov.uk, graph by the author

Case studies

The first sign of the phenomenon of the revival of residential skyscrapers was the conversion of a former office tower (built in 1964) into the successful “Peninsula Heights“ in 1996 in London. “It had an influence on the perception of players in the property industry as it made them aware of the opportunity to make money with high-rise residential schemes.” (Interview Marsh) The project comprises 36 units on 15 storeys and is famous for Jeffrey Archer’s penthouse flat, “formerly Frank Sinatra’s

London pad." (Interview Marsh) The 20-storey development "Montevetro" was completed in 2000 and is located in Battersea, London. It is described by LRR as a "first new wave residential building to show that height and design add serious value" (LRR, 2005)


Montevetro and Peninsula Heights in London, Source: www.Skyscrapernews.com

The Beetham Tower in Liverpool is a 30-storey residential tower in a mixed use development. The project was completed in 2004 and is somewhat of a starting point for a series of residential tower projects of the Beetham Organization. The developer has tall residential developments under construction in Liverpool, Manchester and Birmingham and has been able to create a "brand awareness" (Knight Frank, 2004, p.11) for its high-rise projects. (RICS Business, 2004)


The Beetham Tower in Liverpool and Dicovery Dock in London, Source: www.thebeethamorganization.com, www.discoverydock.com

Discovery Dock is one of several tall residential buildings near Canary Wharf in London. The project comprises two buildings, 13 and up to 23 storeys respectively. (www.discoverydock.com.com)

Plans for the highest residential towers in Britain: 1 Millharbour and Beetham proposal for London, Source: Building Design, 2005, p.6, www.thebeethamorganization.com

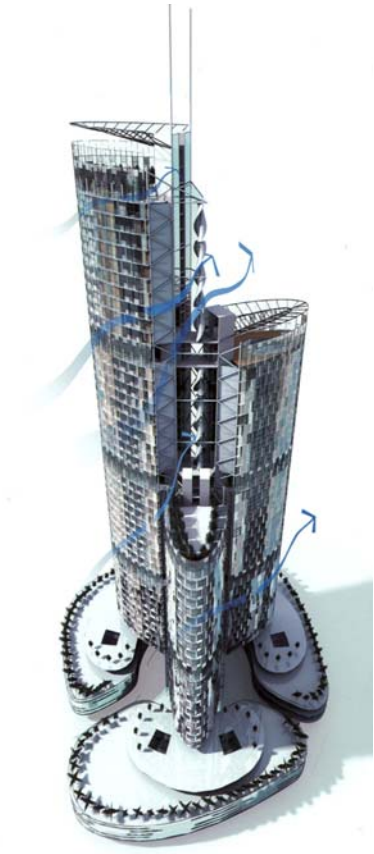
The proposal for 1 Millharbour tower has gained planning permission early 2005. The 50-storey tower will be Europe's tallest residential building when it is completed in 2009. It comprises another residential 36-storey tower on site. (Building Design, 2005) The Beetham Organization has put in a planning application for a 66-storey residential tower with a hotel in the lower half of the building. (www.thebeetham organization.com)

The Skyhouse project

In 2000 the architects responsible for designing and implementing the London Eye started developing a concept for a residential tower that combined high-quality design with various elements of green building technology. In February 2003 the project called Skyhouse was re-launched and promoted as nothing less than "the answer to the [British] south-east's housing crisis" (The Guardian, 2003, p.7)

The MORI-research discussed above that showed potential interest of purchasers in high-rise flats was an important part of the Skyhouse proposal. The concept was developed with ABROS (financial advisors), The Babtie Group (structural and civil engineers), Battle McCarthy (environmental engineers), Gardiner & Theobald (cost consultants), FPDSavills (development agents). It was not designed for one particular site. When the press campaign was launched in February 2003, the consortium was in discussion with different developers about possible locations. (Interview Barfield, 2005)

The unique design comprises three slender towers with a foot print of a three-leaf clover. The three towers are linked which maximises lateral strength and stiffness while keeping the impact on usable space to a minimum. (Interview Marks Barfield Architects, 2005)



Source: Marks Barfield

The proposal combines a variety of ecological measures such as a wind turbine, solar panels, high insulation, and rain catchment with storage in an underground reservoir. Communal areas would comprise a swimming pool on the roof and health clubs, cafes and crèches in the building. Furthermore, skygardens, a double height space between each 10 storeys with trees are a crucial element of the design. The bespoke external envelope allowes balconies and natural ventilation on all floors. Other selling points are a 24-hour concierge service and floor to ceiling glazing with integral solar shading. (The Guardian, 2003, Skyhouse, 2003)

The proposal put forward in 2003 had 35% earmarked as housing for key workers subsidised by better-off purchasers and thus the provision of affordable housing is one of the scheme's "main political selling point" (The Guardian, 2003, p.7) The Skyhouse group was confident it could provide these affordable units at prices of £75,000 for a one-bedroom flat and for £115,000 for two bedrooms. (The Guardian, 2003)

The project received a remarkable media coverage and attention in the professional world. One reason is that Marks Barfield Architects had delivered the London Eye, one of the most popular modern icons in London, against constant opposition of various interest groups. The second reason is that the authors of the concept offered a solution for the prevailing housing crises.

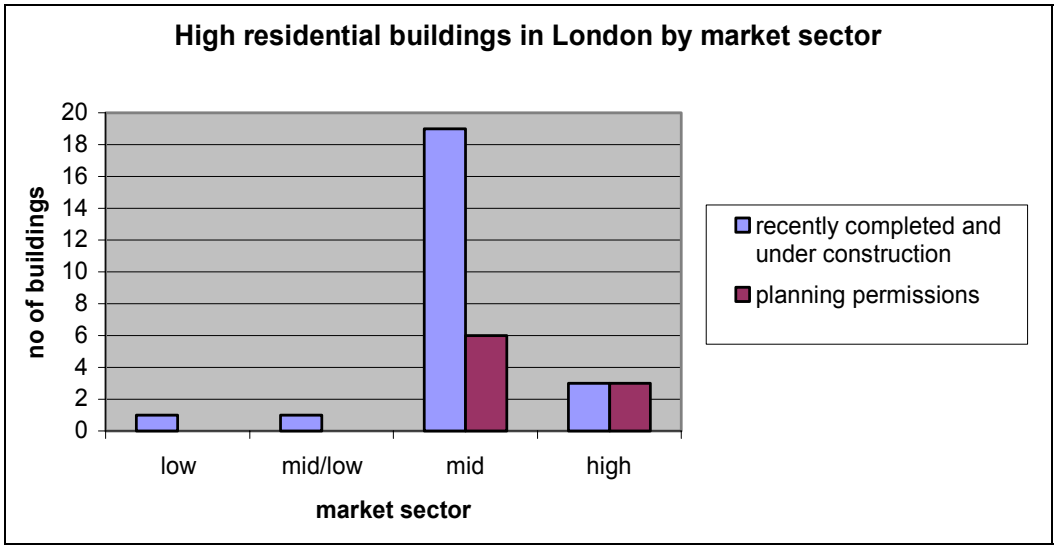
Yet, despite significant effort by the Skyhouse consortium, so far no developer has committed to delivering the project on a specific site. Marks Barfield explain that the project might have been too "ambitious" or "idealistic". While the designers point out that some of the green technologies did not contribute significantly to cost per floor area, the bespoke external envelope was very expensive. The size of the building would have afforded a tremendous investment in an unconventional project. A smaller version was developed to counteract this problem eventually but could not be implemented either. (Interview Marks Barfield Architects, 2005, Interview Denton, 2005)

The new occupiers

Research by LRR (2005) examines 24 recently completed tall residential schemes in London (since 1998) and 9 with planning permission. Out of the total number of 33 only one is aimed at the lower market sector (see Figure 7).

Interviews with property consultants confirm that new high-rise developments are usually up-market schemes. Knight Frank (2004) estimates that in general a 10% average price premium can be expected in high-rise developments. (Interview Knight Frank, Interview Marsh, Interview Hamptons)

Figure 7



Source: London Residential Research, graph by the author, see interview Marsh, Geoff

The analysis of the problems of existing British tower blocks above concluded that high-rise accommodation is not suitable for families with children. According to Church and Gale (2000) "This leaves two main options: young people without children, and middle aged or elderly people. … They can be particularly popular with elderly people, if a high standard of security is maintained." (p.1)

In fact, property consultants report that the new occupiers are just that: "Young professionals without kids, singles and couples and 'empty nesters', people that used to own a house but whose kids have left for university." (Interview Hamptons)

Affordable housing

Despite the fact that property developments in London must provide affordable housing, research undertaken by LRR (2005) on six case studies indicates that developers of tall residential structures have avoided providing it within their building, even by making cash payments in lieu. Some of these were earlier schemes and it can be anticipated that affordable housing rules are applied much more strictly today. Yet, interviews with London Boroughs illustrate that there are still ways to build affordable housing in schemes nearby instead. Planners and property consultants confirm that many developers will use such opportunities to avoid providing affordable housing in their high-rise development. (Interview Marsh, Interview London Borough of Tower Hamlets, Interview London Borough of Lambeth, Interview London Borough of Islington)

Contribution to the compact city model?

> "The decision to opt for home ownership beyond the city boundaries, a voluntary choice it would seem, is in truth a flight from the insufficient housing options in the city, and less a rejection of the city as a place to live." (Weiß, 2005, p.13)

The purchaser of an expensive flat with great view in a residential skyscraper could afford a larger flat or house in a low-rise or medium rise development. The high-rise option offers an attractive alternative that is likely to use less space per person because less space can be afforded for the same price. Furthermore, the new tall residential developments are all located within in city-locations, with rather good public transport connections.

Adrian Owen of developer Hamptons explains that the “empty nesters” mentioned above are substituting Victorian terrace houses against high-rise apartments. “Their property has risen in price over the years and by downsizing to a city-apartment they can free some of the capital value and invest it somewhere else. (Interview Hamptons)

As discussed above, a crucial problem of implementing ‘urban renaissance’ policies is the desire of the majority of the public that prefers low-density environments. The contribution of the new private high-rise residential development to the compact city model is that is sells a dense scheme (at a high price) to people that have a choice to live in much less urban environments.

Building costs in relation to height

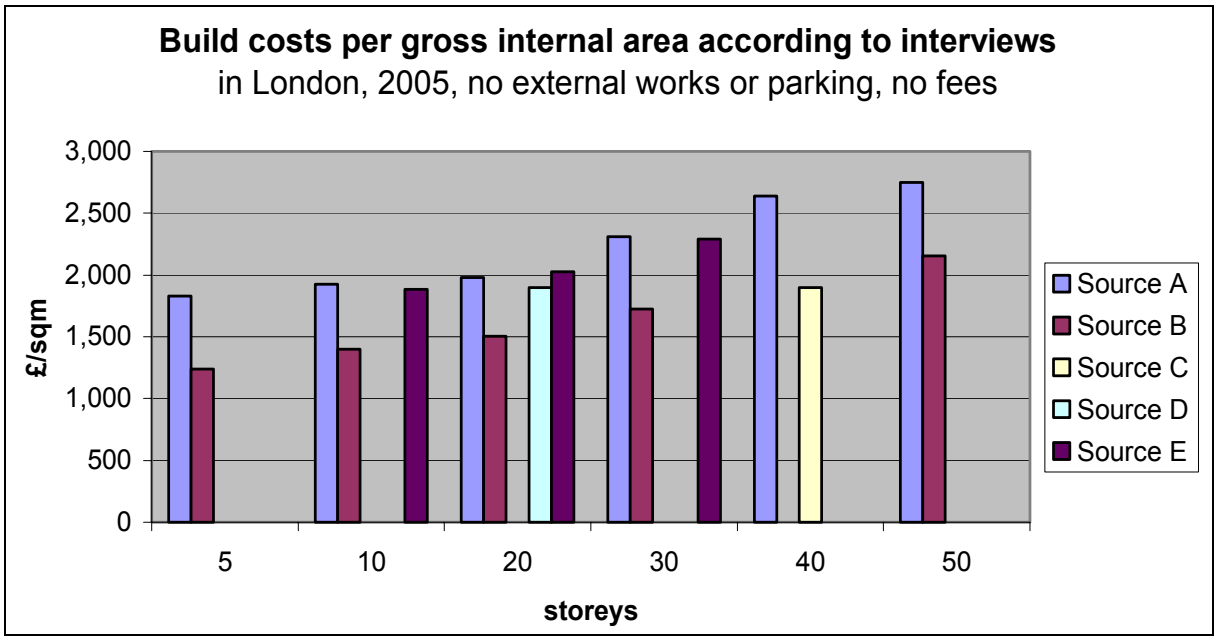
“The construction costs of tall structures are greater than those of low-rise buildings offering a similar amount of accommodation” (Ashworth, 2004, see Ferry et al. 1999) This relationship of construction cost to height is postulated as a rule by the leading literature on construction cost planning and is not disputed by any other publication. Unfortunately, hardly any quantitative statements are made on the relationship of cost to height for tall buildings in the recent literature reviewed.

A book on cost modelling from 1999 (Skitmore and Marston) features an article on the relationship between construction price and height for office buildings. It is worth noting that this article was taken from an older publication from 1978 and that obviously no more up-to-date material was available. The article comes to the conclusion that construction costs per floor area fall up to a height of five to six storeys and than rise with increasing height. (Flanagan and Norman, 1999) Morton and Jaggar (1995) expect construction costs to rise above three to four storeys but quote a study from 1972 that estimates prices of office space to rise steadily above two storeys with the most dramatic increases at the lowest floors. None of the publications discussed provide specific information on tall residential buildings.

Actual average costs in relation to number of storeys for residential buildings above 6 storeys could not be found. All professionals interviewed pointed out that they used their own databases or calculations and that they do not know of published material. One reason is the lack of data due to the limited number of tall building projects. While the BCIS Tender Price Studies draw construction cost data from around 3500 three-storey projects, they have only four samples with ten storeys. (www.bcis.co.uk) Some property and cost consultants have databases that allow to make precise estimates but the scarcity of such information is the basis of their business. (Interview Davis Langdon, Gardiner Theobald, EC Harris)

The professional report *High-rise residential towers* (Knight Frank, 2004) is the only publicly available document that provides quantitative information on the relation of building prices of tall residential buildings to height in the UK. The authors provided further and more detailed information upon request. Figure 8 shows this data as well as information from further interviews.

Figure 8



Sources: Source A- interview EC Harris, Source B- interview Gardiner Theobald, Source C- interview Denton, Source D- interview Davis Langdon, Source E- interview employed professional, some data adjusted for comparability

Cost drivers for building high

The reasons for building costs to increase with height are manifold. Because of the different ground conditions, the shape of the building and the various conditions under which these are implemented, the cost drivers are of different relevance for each project. The list of cost drivers below is compiled after consulting the following sources: Davis Langdon et al. 2002, Knight Frank 2004, Ashworth 2004, Ferry et al. 1999, and Interview Davis Langdon.

1. Construction
Complex logistics and special safety requirements add a premium to construction costs. Examples for the former are: vertical transportation of material and workers to the workplace and provision of welfare facilities for workers at those levels to reduce travel time. Concrete needs special pumping techniques if transported to significant heights. Strong winds at higher levels can cause further difficulties on the construction site.

2. Limited competition
The limited pool of building contractors and specialist sub-contractors with expertise in constructing residential towers in the UK reduces competition and leads to a cost premium. There are fewer than ten construction companies in the UK capable of delivering towers.

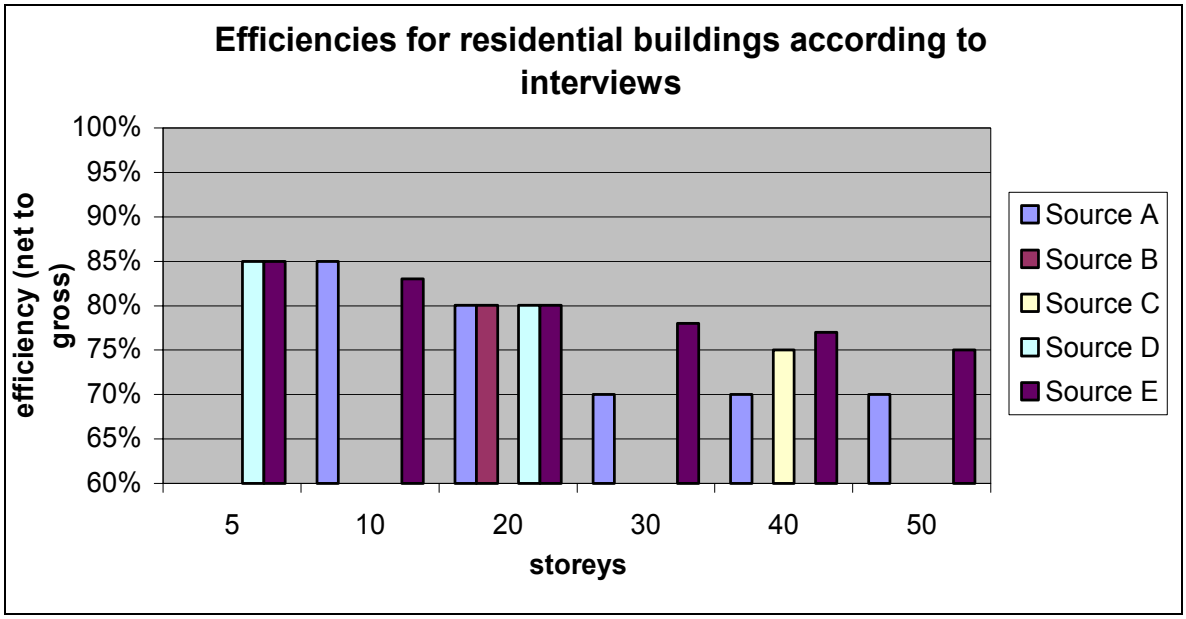
3. Structural costs
The slender shape of tall buildings requires especially stiff structures. At the same time these buildings are subject to extreme wind loads. As a result, structural costs related to lateral loads rise disproportionately with increasing height.

4. External Envelope
Additional costs for the external envelope result from high wind loads and building movement. These increase with height and require robust, expensive, cladding systems. In the absence of scaffolding, the façade must be installed from the inside involving special techniques and costs. Solutions that allow window cleaning in high buildings add further cost. According to Knight Frank (2004) the wall to floor ratios are generally inefficient in tall residential buildings meaning that external walls have a disproportionately high cost. This view is not shared by all because depending on the shape, exceptions from this rule are possible.

5. Service infrastructure
The cost of mechanical and electrical engineering service installations increases disproportionately above around 100 metres. Requirements for the provision of fire fighting equipment increases costs in all high-rise buildings. Refuse disposal installations or garbage collection rooms on each storey are expected in high-value schemes and add further costs. Lifts need to be faster the more storeys they serve and the number of lifts increases.

6. Service area
Taller buildings are intrinsically less efficient than lower rise schemes. Efficiency (net to gross area ratio) is typically worse than with lower buildings because of the necessary space for circulation areas (wider stairways for more people), lifts, and other vertical installations. Figure 9 shows values for efficiency levels for tall residential buildings that were obtained in interviews.

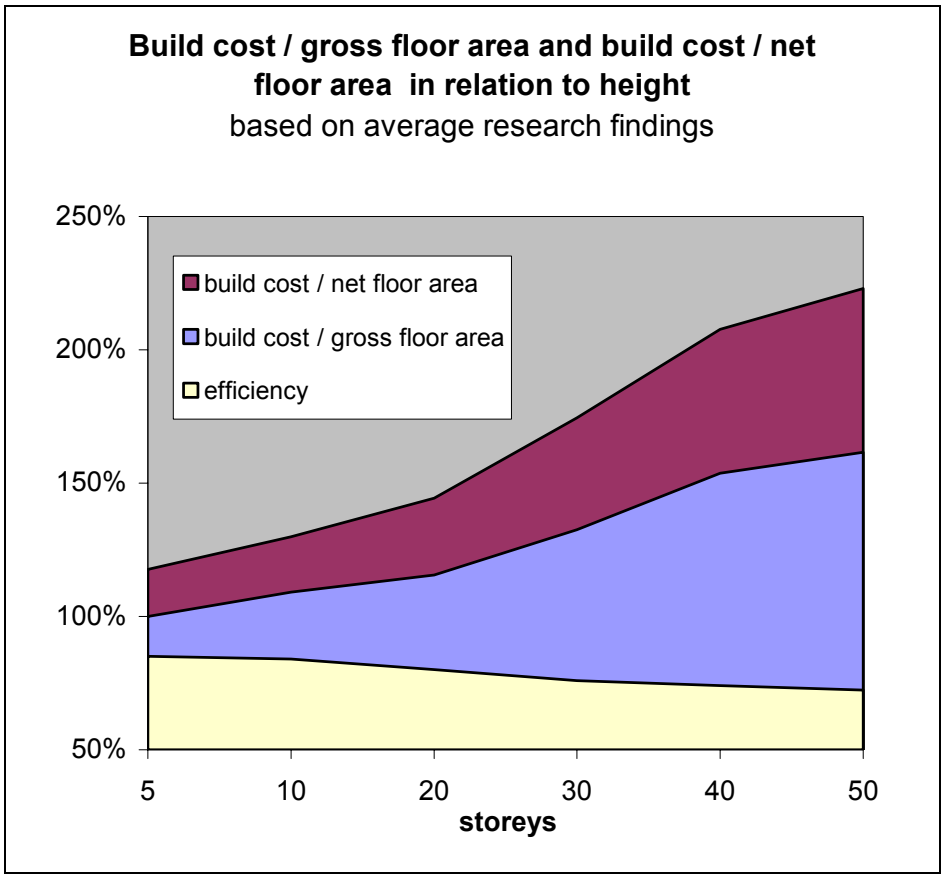
Figure 9



Sources: Source A- interview EC Harris, Source B- interview Gardiner Theobald, Source C- interview Denton, Source D- interview Davis Langdon, Source E- interview employed professional

The effect of changes in efficiency on cost per saleable area is considerable. The relationship is illustrated in Figure 10 based on the average values gathered in the research for this analysis. The efficiency levels are used to calculate the values for the net floor area building costs based on the gross floor area costs. Both efficiency and gross floor area costs have the strongest changes of values between 20 and 40 storeys and the resulting costs for net floor area (saleable area) display an even stronger S-shape.

Figure 10



7. Land holding period

Because of the impact of towers on the skyline as well as their surrounding neighbourhood, planning is a particular long process. Limited work areas, limited crane availability and concrete cure times extend the construction period. The longer financing cost of land as well as other project related costs contribute to higher development costs. Finished units can not be used before completion of the whole building. If sold earlier they incur a discount.

8. Risk

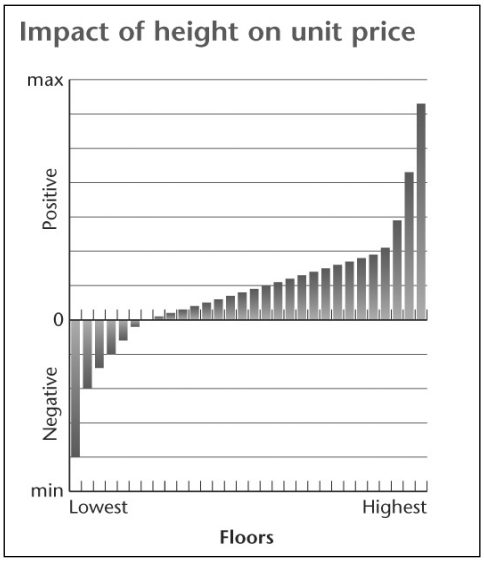
High-rise buildings do not allow phasing of the investment or changes in the development strategy during the construction period. It is not possible to interrupt the construction process without significant costs or to finish only part of the project as a reaction to unforeseen circumstances. This exposes the developer to a higher degree of risk and thus the required return on the investment is higher. During the interviews two professionals estimated that returns required by property developers under current conditions in London are around 15% for medium rise and up to 30% for very tall buildings with 40-50 storeys. (Interview Denton, Interview Pocket)

9. Opportunities to reduce costs through economies of scale
Repetitive design in towers lends itself to standardization which brings benefits of economy of scale. This can be through standardization of working processes, pre-fabrication or modularization. However, some claim that such advantages can be used with any large scheme and are not intrinsic to tall buildings. (Knight Frank, 2004, Davis Langdon et al., 2002)

Revenue drivers for building high

Additional floors on residential buildings do not just add the same amount of sales revenue as lower floors. Higher storeys allow better views. At the same time the ability to be watched by neighbours and the noise level from the surrounding city is reduced. In a way, high-rise apartments allow to avoid the trade-off of dense city-living that often swaps privacy for location. Knight Frank and EC Harris (2004) provide an indicative graph (Figure 11) of what the relationship between height and sales price per saleable area might look like. However, they did not provide quantitative relationships between sales prices and height.

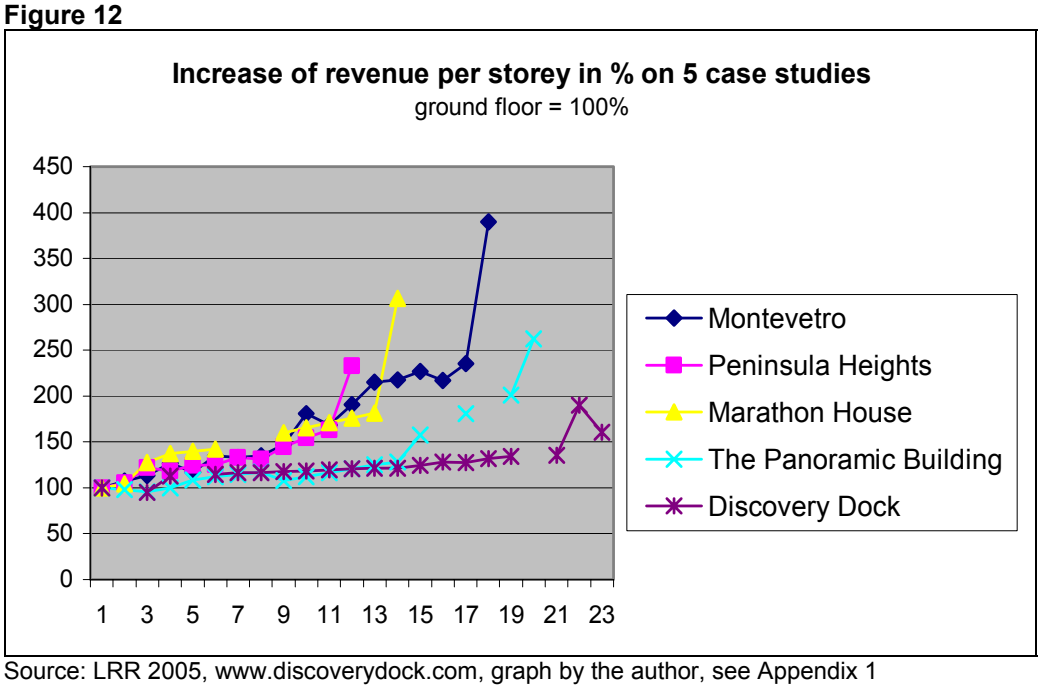
Figure 11



Source: Knight Frank, 2004, p.9

To assess the economics of the current generation of tall residential buildings it is essential to understand how much revenues increase with height. An analysis of data provided by LRR on sales prices of apartments in recent tall residential developments was undertaken. The research on this subject is described in Appendix 2. Figure 12 illustrates the findings for five case studies.

Figure 12



Source: LRR 2005, www.discoverydock.com, graph by the author, see Appendix 1

Analysis of costs and revenues

The results of the research on costs and revenues in relation to height are helpful in the attempt to explore the economic drivers behind tall residential developments. Yet the crucial question is how these values interact.

A model calculation was used to test the combined effect that the values have when applied in one calculation. The model compares the economics of residential developments with 5, 10, 20, 30, 40, and 50 storeys. The calculation as well as all input variables and assumptions made are documented in Appendix 3.

Given the values that were found in the research for this paper and the assumptions made, the calculations suggest that the economics of very tall residential buildings are much less favourable than those of lower structures. With the input variables used, the premium revenue for height does not compensate for the disadvantages of tall buildings. This is not surprising as it reflects the strong increase of construction costs and the lower efficiency of taller buildings. Yet, there are considerable differences between the outcome of the different calculations.

As discussed above in the chapter Building costs, efficiency decreases and building costs increase most significantly between 20 and 40 storeys. These two curves overlap and enhance each other. The strong changes between 20 and 40 storeys are clearly visible in Figures 21-25 when the IRR is calculated with varying input variables.

In Figure 13 and 14 the minimum density as well as the minimum house price level are calculated for reaching a required IRR. This required IRR is increasing with height to reflect the added risk for long, expensive projects that do not allow a change of strategy as a reaction to unforeseen circumstances. (see chapter Cost drivers for building high – 9. Risk) Figure 13 and 14 show little changes between 5 and 20 storeys yet a steady and strong increase of density and house price level, respectively, above 20 storeys. The steady increase in required return reduces the similarity between the economics of 40 and 50 storeys. The resulting graphs point more towards a continuous change than the original S-shape. In comparison between the effect of changes in density versus changes in house price levels in order to reach a required IRR, the relative impact of house prices on the viability of the scheme is greater as it has a more direct impact on revenue.

These results suggest that there are vast differences in the economics of tall residential buildings between medium height towers up to 20 storeys and very tall structures. Only if height is used to increase density significantly in an environment of high land prices, very tall residential buildings can be the most profitable use of land. Morton and Jaggar summarize the general relationship between density, height and land cost as follows: (1995, p.212)

> "where there is an intense demand for accommodation, … such as near the centre of a prosperous city, the very possibility of building high, … itself pushes up land prices. This in turn means that tall building becomes cost effective, as the high cost of the land is distributed over a greater lettable floor area of building."

Under certain conditions even very tall residential buildings can be made viable. But based on the evidence that was gathered in the research for this paper, it can be concluded that the effort to reach this viability increases considerably between 20 and 50 storeys.

Figure 13

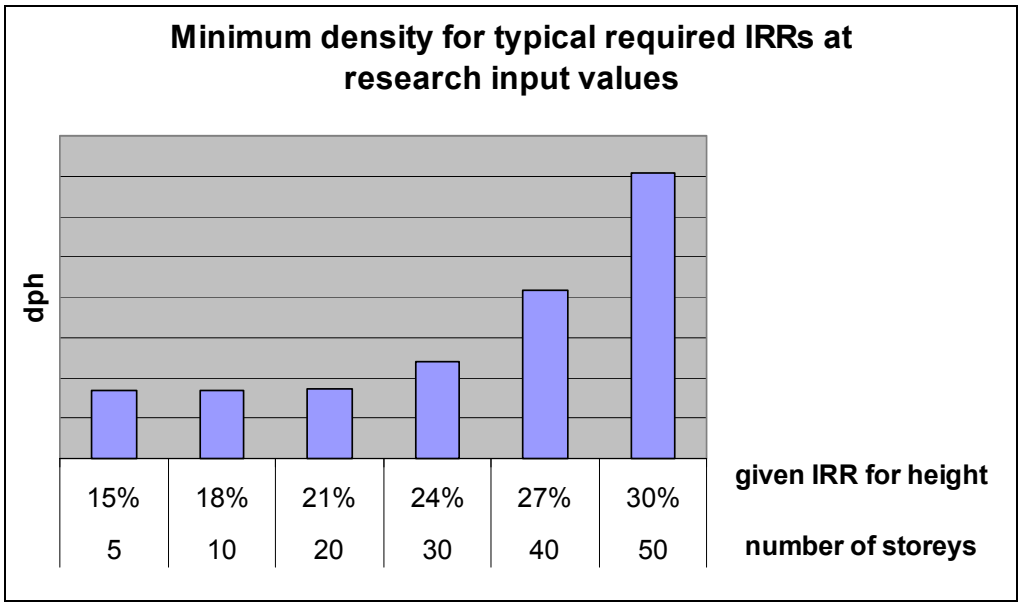
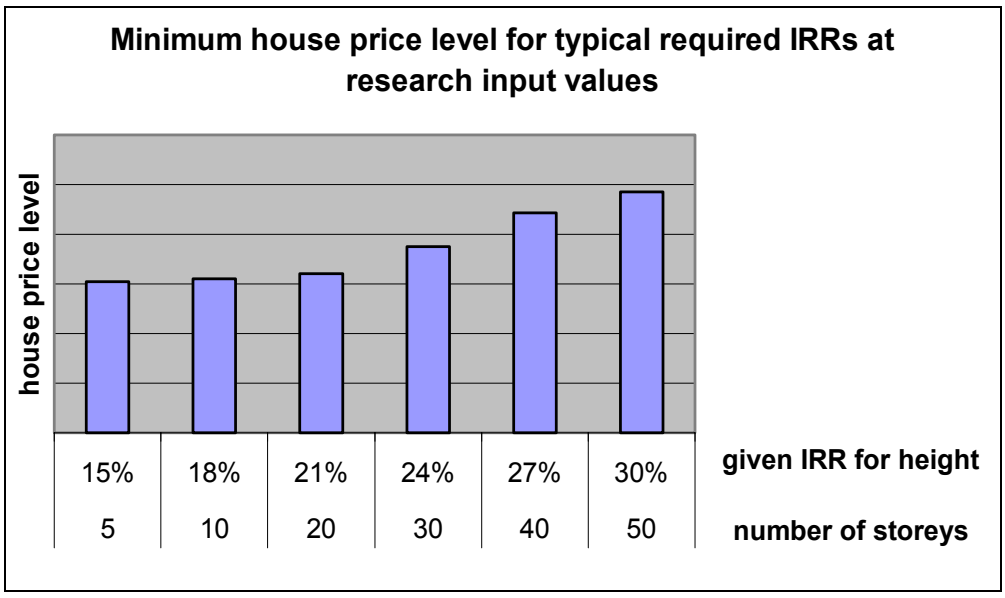


Figure 14



Lower market sector tall residential buildings

Only up-market projects have been discussed so far. This is due to the overwhelming empiric evidence analysed (with strong bias towards London). However, other strategies for high residential buildings might work as well. High-rise living could meet the demand for student and young-professional flat-shares. These are often so

efficiently used that people can afford high prices per square metre by using limited space per person. Other possibilities might arise if modern methods of construction make lower building costs possible.

Another opportunity for high-rise residential projects does derive from planning departments allowing very high densities in return for the provision of affordable housing or other planning gains. Depending on the size and shape of the plot, such very high densities may only be reached with tall buildings and would make them a viable solution. The developer First Base is currently planning a high-rise scheme with focus on key worker housing. The 43 storey development will reach a very high density of around 800 units per hectare, clearly only possible with a planning department kindly disposed to the project. (Interview Denton) A planner at the London Borough of Lambeth explained that planning permission for a 17 storey tower in Vauxhall with 44% affordable housing within the tower was recently given. He believes that the development is only viable because of the very high densities achieved. (Interview London Borough of Islington)

5. Conclusions

The phenomenon

The aim of this report was to analyse what seems to be the revival of tall residential buildings in Britain. It explored how the negative experience with large numbers of failed housing tower blocks had led to a devastating reputation of high-rise accommodation in the British public. Information analysed from a free internet database suggests that virtually no residential buildings above 40 metres were built during the late eighties or early nineties. Since the second half of the nineties, fostered by a favourable policy climate and perhaps inspired by the successful conversion of an office tower in London, tall residential buildings are being build again (or converted from former office towers and failed housing tower blocks).

The new residential skyscrapers hardly have any of the flaws that made their predecessors such a failure. Physical problems, maintenance issues, and security concerns can not be expected in the new generation of tall residential buildings. Yet the most important difference from the housing tower blocks is that the occupiers pay high prices to live in these buildings. Instead of applicants for social housing, they appear to be predominantly young urban professionals or elderly, both without children. Furthermore, there is strong evidence that the large majority of developers of high residential buildings avoided providing affordable housing on site in the past and will continue to do so.

The second part of the research was aimed at exploring the economics behind the development of tall residential buildings. With the resources available, this study has focussed mainly on the private costs and revenues to the developer: wider social and environmental impacts are referred to but not quantified. The availability of data on tall residential buildings turned out to be extremely limited. This is partly due to the fact that there are still very small numbers of construction projects that provide evidence of real costs and other characteristics. Another reason is that much of the existing knowledge is accumulated by consultancy companies that live of selling such information.

The information collected was mainly drawn from interviews with professionals. Values for efficiency, building costs and revenue in relation to height were gathered. The data is subject to several limitations but qualitative conclusions can be drawn from it. Not only is the overall price level of the new developments rather high, in addition, revenues per unit of floor area increase significantly with height. Similar to sales prices, building costs rise in relation to height while efficiency ratios decrease. Both efficiency and building costs change most between 20 and 40 storeys.

The gathered data was fed into model calculations that tested the implications for different heights. It seems that, everything else being equal, the advantages of a premium for height are not balancing out the combination of decreasing efficiency ratios, increasing land holding periods, and higher required rates of return with increasing height. The results suggest extreme differences in the economics of tall buildings of different height. With the input variables used, much higher densities and/or house price levels were necessary to make a building of 40 storeys viable compared to one of only 20 storeys.

If tall residential buildings are used to increase density in an environment of high land values, they might become the most profitable use of the land. However, the findings suggest that if there is a possibility to reach the same density with two 20-storey towers rather than with one 40-storey tower, it would be a far more economical solution. This thesis corresponds with the actual built stock of tall residential buildings in the recent revival. With two exception, all buildings were below 24 storeys.

The findings also lend themselves to being one explanation why the extremely ambitious (and beautiful) 50 storey Skyhouse project has not been realized despite considerable public attention. Affordable housing, a series of green technologies, various amenities and a contribution to solving the housing crises could probably not be achieved with a building type that needs such significant effort to make it viable.

Despite the results from the calculations the goal to explore the economics of tall residential buildings could not be reached. The variables used can not be based on large sample sizes to meet scientific standards. The gathered data and the results of the calculations indicate a tendency that might well be true but much further research is needed to allow the establishment of robust up-to-date quantitative relationships between residential developments of different heights.

What next?

During the research of the topic it became obvious that the data available on tall residential buildings is insufficient. The necessary research would have to increase knowledge about costs and cost drivers in relation to height as well as about new construction technologies and possibilities in this field. Much of the knowledge exists within companies but is not accessible to others. To allow exchange to happen, research would have to be publicly funded and published. Finally, more data about the existing buildings of the type is crucial to all those involved in the research. Only with sufficient data on the existing built environment can we learn from it for future projects.

Anecdotal evidence from the interviews suggests that the residential skyscraper in general has a potential to contribute to current planning goals. Albeit only for a limited number of urban dwellers, by providing this unique form of habitation the residential skyscraper increases the options of dense urban living and attracts people that might otherwise use forms of housing that consume more space and incur more traffic.

To develop and provide the best forms of high-rise accommodation it is essential to draw on thorough knowledge about the existing buildings as well as the economics of the buildings in relation to height. There is no doubt that as an addition to the variety of the urban mix, residential skyscrapers will play an important part in the future. How useful the projects will be to developers, users, and public, depends in part on the information available before they are built.

6. References

Printed references

Ashworth, A. (2004) *Cost Studies of Buildings, 4th edition*, Harlow: Pearson Education Limited

Bossom, A., Baron (1934) *Building to the skies: the romance of the skyscraper*, London: The Studio Limited

BCIS (2005) *Quarterly review of building prices, July 2005, issue No 98*, London: BCIS

Building (2005) Market forecast, in *Building 29 July 2005, pp. 58-60*

Building Design (2005) "Homes on high", in *Building Design, March 11, 2005*, p.6

CEC (1990), *Green Paper on the Urban Environment*, Brussels-Luxembourg: Office for Official Publications of the European Communities

CEC (1998) *Sustainable Urban Development in the European Union: A Framework for Action, Communication from the Commission*, Brussels: Commission of the European Communities

Church, C., Gale, T. (2000) *Streets in the sky - Towards improving the quality of life in Tower Blocks in the UK,* Birmingham: National Sustainable Tower Blocks Initiative, available at: http://www.towerblocks.org.uk

Cope, H. (2002) *Capital gains: making high density housing work in London*, report for the London Housing Federation / Helen Cope with Avebury International, London: London Housing Federation

CIAM (1931) *rationelle bebauungsweisen,* published by CIAM, Frankfurt: Englert & Schlosser, reprint by KRAUS REPRINT, 1979, Nendeln in Lichtenstein

Curtis, W. (1986) *Le Corbusier: ideas and forms*, Oxford: Phaidon Press

Davis Langdon & Everest, Arup, Mott Green Wall (2002) "Cost model", in *Building, 6 September 2002*

Edwards, M., Magahaes, C., Karadimitrou, N., Rehman, K. (2004) *The funding and development of the built environment : the research agenda*, London: RICS Foundation

ESDP (1999) *European Spatial Development Perspective. Towards Balanced and Sustainable Development of the Territory of the EU*. Brussels: Committee on Spatial Development.

Rich City (2005) *Rich City, Homes & Property, 16 March 2005*

Ferry, D., Ferry, J., Brandon, P. (1999) *Cost planning of buildings, 7th edition*, Oxford: Blackwell Science

Flanagan, R., Norman, G. (1999) "The relationship between construction price and height", in *Cost Modelling* by Martin Skitmore and Vernon Marston, eds., London: E & FN Spon, the article was first published in 1978 in *Chartered Surveyor B. and QS Quarterly*, Summer, p.69-71

Gropius, W. (1931) flach-, mittel- oder hochbau? in *rationelle bebauungsweisen,* published by CIAM, Frankfurt: Englert & Schlosser, quoted from reprint by KRAUS REPRINT, 1979, Nendeln in Lichtenstein

Guiton, J. (1981) The ideas of Le Corbusier, New York: George Braziller

GLA (2003) *Housing for a compact city*, London: Greater London Authority

GLA (2004a) *The London Plan*, London: Greater London Authority

GLA (2004b) *Affordable Housing – Development control Toolkit 2004/5 version*, London: Greater London Authority

Jephcott (1971) *Homes in high flats*, Edinburgh: 1971

Knight Frank (2004) *High rise residential towers*, Knight Frank LLC and EC Harris (eds.), available at www.knightfrank.com

Le Corbusier (1931) Le parcellement du sol des villes, in *rationelle bebauungsweisen,* published by CIAM, Frankfurt: Englert & Schlosser, quoted from reprint by KRAUS REPRINT, 1979, Nendeln in Lichtenstein

Le Corbusier (1935) *La Ville Radieuse* (The Radiant City), Vincent, Fréal & Cie., Paris

Lepik, A. (2004) Skyscrapers, London: Prestel

LSE Cities Programme (2002) *Tall Buildings: Vision of the Future or Victims of the Past?*, report by the London School of Economics for Development Securities PLC available at: http://www.lse.ac.uk/collections/cities/pdf/tall_buildings.pdf

LRR (2005) Tables on tall residential buildings in London, recently completed, under construction, and in the planning pipeline; also selling prices per apartment for six tall residential buildings, all published on the web but made available directly in print

Marks Barfield (no date) *marks barfield architects,* company brochure

McNEILL, D. (2002) The Mayor and the World City Skyline: London's Tall Buildings Debate, in *International Planning Studies, Vol. 7, No. 4, pp. 325–334*

McNEILL, D. (2005) Skyscraper geography, in *Progress in Human Geography 29, 1 (2005) pp. 41–55*

Morton, R., Jaggar, D. (1995) *Design and the Economics of Building*, London: E & FN Spon

NHTPC (1996) *Still rising high*, London: NHTPC

Pierce, S. (2002) Selling urban housing in London. Can high-density urban living be sold to a sceptical British public?, *European planning Studies, Vol. 10, No.8, 2002, pp. 955-970*

Pank, W., Girardet, H., Cox, G. (2002) *Tall Buildings and Sustainability, Report* London: Corporation of London

PRP (2002) *High Density Housing in Europe: Lessons for London*, London: East Thames Housing Group

RICS Business (2004) "Living the high live", in *RICS Business, July/August 2004, p.22-24*

Skitmore, M., and Marston, V., eds. (1999) *Cost Modelling*, London: E & FN Spon

Skyhouse (2003) press package by the Skyhouse consortium, London: Marks Barfield Architects

The Economist (2005) After the fall, in *The Economist, 18 June 2005*

The Guardian (2003) "Lofty solution to housing crises" by Paul Brown, in *The Guardian, 11 February 2003*

The Sunday Telegraph (2003) "Room at the top" by Ross Davis, in *The Sunday Telegraph, 9 February 2003*

The Times (2003) "60s tower blocks are reborn as skyhouses" by Anthony Browne, in *The Times, 11 February 2003*

Troy, P. (1996) *The perils of urban consolidation : a discussion of Australian housing and urban development policies*, Sydney, NSW : Federation Press

Urban Task Force (1999) *Towards an Urban Renaissance,* London: Routledge

Weiß, K. (2005) From isolation in the Peripherie to the Highrise of Homes in the City, in *High-density housing : concepts, planning, construction*, Schittich, C. (ed.) München: Detail

Yeang (1999) *The Green Skyscraper*, London: Prestel Verlag

Internet *(last checked 14 September 2005)*

http://news.bbc.co.uk/1/hi/magazine/3490580.stm
"The return of high-rise Britain?" article by Duncan Walker, in *BBC News Online Magazine, 1 March 2004*

http://www.bbc.co.uk/manchester/content/articles/2004/11/24/high_rise_living_hys_feature.shtml
"A cut above: high rise living is back" by Yakub Qureshi, in *BBC Manchester*

http://www.discoverydock.com/site/disc_home.php
website promoting development Discovery Dock

http://www.odpm.gov.uk/stellent/groups/odpm_housing/documents/page/odpm_house_022945.hcsp
"Supporting Tables: Profile of the Stock", Excel-Document by Office of the Deputy Prime Minister, 2001

http://www.publications.parliament.uk/pa/ld199900/ldhansrd/pdvn/lds05/text/50628-23.htm
"Lords Hansard test for 28 June, 2005" in *The United Kingdom Parliament*

http://www.skyhouse.co.uk
official webpage of Skyhouse group, run by marks barfield architects

http://www.skyscrapernews.com/index.php
free database with images and figures on tall buildings in the UK and Ireland

http://www.sustainingtowers.org
webpage of organization "Sustaining: tower blocks"

http://www.thebeethamorganization.com/
website of property developer The Beetham Organization

http://www.voa.gov.uk/publications/property_market_report/pmr-jul-05/residential.htm
"Property Market Report July 2005" by the British government's Valuation Office Agency

Appendix 1 – Interviews

BCIS (Building Cost Information Service, division of RICS)

Telephone interview 6 Sptember 2005 with Lindsey Pollin, technical expert and Ian Pegg statistics.

The data of BCIS on tall residential buildings is limited. This is probably the reason why averages of total building cost per sqm are not broken down for residential buildings above 6 stories. The table with factors for adjusting costs of buildings by number of stories (BCIS TPS – Building Height) is NOT appropriate for this. It is an average across all typologies, it does not incorporate the quantity of work or design issues, and the sample size above 8 stories is very small. The table only measures the cost for a certain piece of work, say a sqm brick wall. It indicates that it is 4% more expensive to build this on the 10^{th} floor in comparison to the second floor. It does not take account of the fact that stronger walls are needed for a ten storey building.

Davis Langdon (Construction and cost consultant company)

Interview with Davis Langdon on 19 August, 2005.

James Barton is consultant and expert on residential developments at Davis Langdon. In the informal discussion in the London office of the firm, he explained cost drivers in residential high rise schemes.

What are rules of thumb for cost in relation to height? Hardly any exist because of the bespoke nature of such schemes. The (14 storey, curved, fat, slab) Albion Wharf Development has a cost per square meter in the same range of other residential tall buildings in London.

The range for building costs for a residential tower in Central London would be £170 - £200 per square foot. This number includes all building costs without professional fees and is per gross area. The costs for fit-out are £90 - £100 per square foot in a scheme without air-conditioning. (£110 with air-conditioning) The cost of fitout is measured in relation to *net* area.

To adjust the cost for fitout per net area to the cost per gross area, multiply the net-cost with the net:gross ratio. A normal net:gross ratio for a residential scheme is around 84%. A good ratio for a residential tower is 80%. (Attention: Knight Frank has a bigger spread!)

The big cost consultants have databases with costs for real projects. If figures or rules of thumb exist, they are internal knowledge of consultant companies. This is the kind of knowledge that consultants sell and therefore do not share with the public.

Literature/source for costs? Spon's price book, but nothing so specific that it allows to look up building prices in relation to height.

Other: structurally, a tower is a building with more than 12-16 storeys. Below this height, the structure is similar to a "normal" house.

What are drivers for cost in relation to height? (some notes went directly into thesis paper)
structure, concrete has to be double pumped up, it needs to be more rigid
external wall, installing is more complicated at height, process of installing (no scaffolding, installation of façade from inside) and logistics (to bring material in place. Air-conditioning needs space for ducts and increases floor height. This increases costs for façade, structure and other.

Building time for project increases with height, land holding period increases because of more complications during planning process

Typical wall to floor ratio is 0.4 to 0.6; Important influences on cost: Apartments per core, Lifts per core, from of heating

Denton, Ben (Cost consultant company ABROS, developer First Base)

Ben Denton is part of a team of professionals that are setting up a development company called First Base with a focus on delivering affordable housing. He is also director of the financial consultancy firm ABROS that advised the Skyhouse consortium. The interview took place on 31 August, 2005 at the First Base office.

A draft of the thesis paper and model calculations on developments in relation to height had been sent by email and Ben Denton had studied the material before the meeting.

Please comment on cost models as tool for comparing developments with different heights.
-Certainly legitimate, the impact of site-specific issues such as contamination or ground conditions even decreases for high-rise projects.

Please comment on the model in particular
- Average unit size is 60 sqm
- building times estimated seem reasonable
- returns required by developers are 15% for medium rise and 25%-30% for very tall buildings (40-50 storeys)
- include affordable housing, even if just as a percentage wise reduction of revenue
- typical model for revenue is three bands: first band with bad views, upper band with approximately 15% higher revenue for good views, and special premium for penthouses on top.
an increase of 2.5% per storey seems a reasonable substitution for the band-model.
- professional fees are paid as follows: 40% in the second month and 60% in month eight, even for long projects.
- Floor plate usually increases for tall buildings because efficiency demands more units per core. Can that be incorporated in the model?

Why was the Skyhouse project not implemented?
- Developers shy away from very tall buildings because of the risk involved, the Skyhouse project was envisaged much taller than the skyscrapers built in recent years in London.
- The list of green technology and other costly packages was probably too long. However, certain green elements were not expensive in comparison to the whole project. The most important cost driver was probably the external envelope and the very bespoke specifications for it.

Building costs
First Base work with £2100/ m^2 for net area for their 43 storey tower project which is equivalent to £195/ sq f. This number is
- for net area (saleable area)
- at todays prices
- including parking, external works
- excluding professional fees
- good quality, medium specifications (not luxury)

Using an efficiency ratio of 75% the number equals to £146/ sq f per gross space. The building costs cover parking and external works. Ben Denton estimates the average for this height is at about £2,400/sq m net, representing £1800-2000/sq m (167 - 185£/sqf) gross.

Other
Example of tower at Elephant and Castle. 420 units on half a hectare, thus a density of 840 units per hectare. This is extremely high. To increase density to the extreme is another possibility to make skyscrapers viable, besides very expensive flats for rich people.

advantages of high density schemes: CHP, car schemes, networking solutions

EC Harris, Keith Brooks (Property consultant company)

Keith Brooks is head of residential sector. Telephone interview on 18 July, 2005.

original or more detailed data available?
No, speak with Paul Moore.

Comments on study "High-rise residential towers" (Knight Frank, 2004)
residential towers are a new trend
they are usually aimed at the luxury end of the market "the increased building cost has to be paid for"

In London, now there are some schemes where affordable units might be offered as part of the 106 agreement

EC Harris did cost- Knight Frank did revenue part of report.

In figure 5, efficiency is not yet applied, the cost per sqm saleable area would rise more sharply if efficiency were applied.

EC Harris, Paul Moore (Property consultant company)

Paul Moore is head of cost research. Telephone interview on 18 July, 2005.

original or more detailed data available?

No, could not find the data that is underlying figure 5. General statement: "Cost increases substantially with height."

Paul sent email on 18 July with numbers for figure 5 – but could not find (?) further material

On second interview, on 7 September, 2005, Paul Moore provided supplementary information to his email:

1. If costs for a 10 storey development are 100%, then a five storey building would range around 95%. The structure would be similar, but "constructing a 5-storey building is still easier."

2. Costs per sq f for a 30 storey residential tower are around 200£/sqf. This is per gross internal area excluding fees, excluding external works, excluding parking. Prices are adjusted for the South East with a factor of 1.06. The factor for Greater London is 1.14, the factor for inner London is 1.21.

Employed professional of highly regarded company in the building industry

Interview with employed professional on 8 September, 2005. The professional supplied information on build costs and efficiency ratios. The knowledge was mainly drawn from a report that a reputable property and cost consultant company had prepared. The person wishes to remain unknown. The following values for building costs for residential projects in London were given:

10	175 £/sqf
20	188 £/sqf
30	213 £/sqf

the numbers are for:
- for gross internal area
- at todays prices
- excluding parking, external works
- excluding professional fees
- for developments in London

The following values for efficiencies (net to gross area) were given:

5 storeys	83.5%

10	81.5%
20	79.5%
30	77.5%
50	76.5%

Expedition Engineering (Construction engineering company)

Expedition-engineering provided height to structure cost ratio in Knight Frank/ EC Harris report (Knight Frank, 2004).

Is there any specific research carried out by Expedition Engineering on this topic?
What sources were used to produce Figure 6 in the Knight Frank/EC Harris report (height to structure cost ratio)?

After telephone and email contacts Maggie Railton, responsible for publications at Expedition Engineering, came back with feedback from the directors:

No specific research was carried out or consulted by Expedition Engineering. The graph shows basic trends from experience on several schemes.

Gardiner Theobald (Cost consultant company)

Telephone interview with Ian Pertin, cost consultat, on 6 September, 2005.

What are construction costs per floor area in relation to height?
Rough estimate of construction costs for residential schemes in relation to storeys are:

5 storeys	115 £/sqf	1,238 £/sqm
10	130 £/sqf	1,400 £/sqm
20	140 £/sqf	1,506 £/sqm
30	160 £/sqf	1722 £/sqm
50	200 £/sqf	2152 £/sqm

These are figures are
- for gross internal area
- at todays prices
- excluding parking, external works
- excluding professional fees
- good quality, medium specifications (not luxury)
- for developments in London

Efficiency of 80 % is a good value at 20 storeys.

What are sources of this knowledge?
Own experience, calculations for client, calculations of colleagues. There is no up to date literature that covers this topic. Probably because of limited numbers of projects.

What are drivers of construction costs?
Frame: strength increase with height because of wind loading. up to 80m/25 storeys conventional structures can be used. Above that, more expensive structures are necessary.
Lifts: Numbers and speed of lifts increases with height
Cladding: cost increases because of wind loading and the necessity to increase robustness with height
Services: wet risers are necessary above 20 storeys, water supply needs to be boosted for higher storeys
Construction: Complexity of construction site
Ventilation: This becomes and issue either through complicated façade elements that allow natutal ventilation or because mechanical ventilation is installed

Hamptons (Property consultant company)

Telephone interview on 7 September, 2005 with Adrian Owen, director of the London Development Team.

Relationship of sales prices to height in residential towers:

Increase in prices per storey:

up to 7 storeys	£5,000 for a 1 bedroom apartment
	£10,000 for a 2 bedroom apartment
	£15,000 for a 3 bedroom apartment

The differential comes down for higher levels with similar views. Usually the method to increase revenue is not just to sell the same apartment for more money as height increases. Instead, the units on higher levels are built to higher specifications. Typically, 1 beds and studios are placed in lower floors with unit size increasing towards the top of the building. Penthouses allow much higher sales revenues but are also built to higher specifications.

An average price level for residential towers in London is hard to establish as the prices change dramatically with the location. Also, the increase in revenue per floor depends very much on the view that is offered on a certain level and thus on the surroundings. A very early and crude revenue-model would rate the price-increase per storey in a tower as follows (without top floor and below fifth floor) .

£3,000 for a 1 bedroom apartment
£5,000 for a 2 bedroom apartment
£7,000 for a 3 bedroom apartment

Target groups of residential tower developments:
1. National and International Investors that sometimes buy off-plan.
2. Young professionals without kids, singles and couples
3. “Empty nesters”, people that used to own a house but whose kids have left for university. Their property has risen in price over the years and by downsizing to a city-apartment they can free some of the capital value and invest it somewhere else.

Market segment is middle class to luxury.

Outlook for high-rise living:
There is a great will amongst developers to build these projects. Depends very much on the development of the economy and house price levels. Smaller towers around 20 storeys are much easier to build because on higher towers the cost-revenue relationship gets worse. Planners have been rather hard on tower schemes and will control how many resi-towers we will see in the future. Another great influence will be the success of the recent and current projects. If they turn out to be successful, the model will be copied. If it becomes obvious that these projects have not made any money, other developers will shy away from the typology.

Knight Frank, Liam Bailey (Property consultant company)

Liam Bailey is head of residential research. Phone interview with Liam Bailey on 11 July, 2005.

graph with revenue per floor is indicative – not absolute!

house price increase over last five years is reason behind revival of residential towers, this has been much higher than the increase in construction cost and has opened a “window of opportunity” – but increase in building costs of tall buildings over the last two years was much stronger than increase of construction costs of medium-rise and low-rise buildings and might be closing that window: sharp rising costs of steel, rising costs of labour

no data available from Knight Frank – happy to use anything from the report if cleared with EC Harris – call Keith Brooks

Knight Frank, William Ward (Property consultant company)

William Ward is expert on valuation of residential towers at Knigh Frank. Phone interview with William Ward on 12 August, 2005.

Is there underlying research to the figure 11 (Impact of height on unit price) in the report mentioned above that can be made accessible? – not really

Are there certain thumb rules or even a formula for revenue relating to height that you use?
NO- there is no rule of thumb or wholly grale, valuers must often rely on experience and gut feeling, every building and location is different and there are intangible aspects involved, the design or the name of the architect may make a difference, the developer may have established a brand or image...

In total, residential real estate is more complicated than commercial real estate because of the importance and difference of taste

In general, values in residential towers are very low until the fifth or sixth floor, above that there is an increase of value per floor and apartment between 2,500 and 5000 Pounds with an strong increase for penthouses at the top. On the other hand there is usually a ceiling in a location that is hard to break: e.g. in Manchester, it is hard to sell a 2bed apartment w. 700sqf for more than 200, 000 to 250,000 Pounds. This gives a value of around 300 Pounds per Square foot. The ceiling for a Penthouse in Manchester would be around 500 Pounds per Sqf with penthouses around 1,000,000.

Rules of thumb for cost relating to height? Literature for this?

Similar problem. Every site is different with different obstacles e.g. for the crane position or foundations. A rough figure for build costs in Manchester would be 100 Pounds /Sqf for saleable area up to the sixth floor and 150 Pounds /Sqf for saleable area up to the 12th floor. Costing is done with comparisons from other projects rather than with general Literature like Spons.

General assessment:

Revival of resi toweres will continue for buildings between 10-20 storeys. Significantly higher buildings are only viable in prime locations. In general the softening of the market had a strong effect on the viability of such schemes.

London Borough of Islington

Telephone interview with planning officer Zayd Al-Jawad on 8 September, 2005.

The requirements for affordable housing (AH) in residential developments above 15 units in Islington are 35% of which with 25% are social rented and 10% are intermediate housing. The Borough would accept the provision of affordable housing on a nearby site as long as it is “across the street”.

A current project evaluated by the council is 259 and 281 City Road, a scheme with 314 residential units. It comprises two towers with 36 and 28 storeys. The affordable housing is provided on the other side of the canal on former council land.

Developers are reimbursed for affordable housing on the basis of TCI (Total Cost Indicator) levels. These are not adjusted for the real cost of the development. The developer that provides affordable housing in a tall and expensive building might get a slightly better percentage of TCI values but not necessarily his real costs.

London Borough of Lambeth

Telephone interview with planning officer Chris Dale on 8 September, 2005.

The requirements for affordable housing (AH) in Lambeth are 50% with subsidy and 40% without subsidy. There is a preference that AH is provided on site, but necessarily in the tower. Smaler developments that only comprise a tower would have to provide AH within this building.

The planning permission for Vauxhall tower was recently granted. It comprises a provision of 37.3% of habitable rooms to be provided as AH. The AH are all provided on site, but not in the tower.

A 17 storey tower in Vauxhall (on the corner of Salamake street and Salamake place) was recently approved with 44% AH within the tower. Chris Dale believes it is likely that this proportion is viable because of the very high density that was allowed.

London Borough of Tower Hamlets

Telephone interview with planning officer Mr Humphrey on 8 September, 2005.

The development Popular High street with a 13 storey tower and a 25 storey tower and 243 residential units has to provide approx. 35% affordable housing of which a proportion is intermediate housing. All of this is provided in the smaller building.

Cash payments in lieu of AH is not accepted any more. “The days of cash payment are over.” The preference is that AH units are provided on site, they do not need to be in a specific building. They can even be provided in another development. The further this other development is away, the more AH has to be provided

Marks Barfield (Architects)

Interview with Marks Barfield Architects on 1 July, 2005.

In the informal discussion in their office Julia Barfield and Peggy Chan explained motivation and details of their work on the Skyhouse project. Certain issues were clarified in a follow up phone interview on 2 September, 2005.

The project started in 2000. Bits and pieces were published in the following years. But the project was relaunched with much more coordinated effort in 2003.

In 2002 cabe had published research undertaken by MORI that proved that the bungalow was the most favourite housing typology. Marks Barfield found out that people interviewed for the research were shown images of beautiful detached houses but that the image representing the residential tower showed a sad 60s tower block. in 2002 Marks Barfield commissioned a second research to figure out under what conditions people do like to live in high rise accommodation.

It is likely that the combined effects on cost make it too expensive. The original proposal had 50 stories. A later proposal was adjusted to 24 stories. The social housing threshold is also a problem, because they increase the economic pressure on the scheme.

The external envelope had two layers and allowed balconies and natural ventilation up to the highest levels. Julia Barfield admits that this had probably increased cost too much. (see Ben Denton interview) In a new version of the scheme Marks Barfield would offer full height windows instead of real balconies to reduce cost. Furthermore, they would use more opaque façade elements instead of 100% glass.

Marsh, Geoff (former head of London Residential Research, consultant and professor)

The interview on 12 August 2005 took place at his office. First sign of the phenomenon of the revival of residential skyscrapers was the conversion of a former office tower (built in 1964) into the successful

“Peninsula Heights“ in 1996. It had an influence on the perception of players in the property industry as it made them aware of the opportunity to make money with high-rise residential schemes.

Revenue in relation to height is jumping between three bands:
Lower storeys without view above the surrounding buildings, higher storeys with view over the surrounding buildings and penthouses on top.

The market sector for these projects is usually medium to high.

The affordable housing provision is taken more serious now than in the late nineties and is a burden for developers.

Geoff Marsh provided crucial data on six buildings of which four could be used to generate average revenues per floor. The information also contains important explanation of planning histories. Moreover he contributed an overview of recent schemes, projects under construction and those that already have planning permission.

Pocket (Developer)

Paul Harbard is director of Pocket and former director of finance at Peabody Trust. He provided answers on several occasions over a period from July until 13 September, 2005.

Paul Harbard has commented on several issues of the model calculations.

The experience of Pocket with the recent requirements for affordable housing in London are such that the assumption of 30% affordable housing is reasonable. (allowing to reflect a higher share if intermediate housing is part of the mix)

The assumptions made for building times are reasonable. Pocket uses shorter building times but usually works with medium-rise structures and tries to use prefabricated units.

The required return relates to the risk. The typical required return for Pocket is 15%. This is for buildings between 3 and 6 storeys and does not change with height. On a current project of Pocket the required return is less than 15% because the land is provided in a joint venture and thus the fixed costs are incurred later and make up a smaller proportion of the whole investment.

St. George (Developer)

Ben Connop, responsible for planning issues at St. George, replied to questions regarding cost and revenue of tall residential buildings by email. The following text is quoted from his email dating 9 September, 2005:

“Having spoken to a number of people in the office on this matter it would seem that there is no definitive calculation on working out the increase in sales prices in relation to the storey height of the flat. …

Our rule of thumb does change depending on the type of site, for example our riverside sites, the same flat on the floor above, with river views would increase approximately 10k every floor you go up, but it would reach a ceiling height once you get above a certain level if the views don’t improve. …

So in summary we generally increase the price of our flats by 5-10k as you go up the building.

However we do look at each flat individually and assess it in terms of aspect, out look, views, size of terrace, and orientation (sunlight) all these issues are considered when determining the price of a flat.

For a tall building such as Vauxhall Tower at 50 storeys this rule will still apply but probably up to floor 30 and then the prices would remain fairly constant as the views wouldn’t really change until you got up to the penthouse flats and then they would increase dramatically.

The build cost of tall buildings is far higher than your average block of flats. The complexity of the substructure, quality of the superstructure, the carefully designed architecture in order to give it the superior quality a tall building needs to be successful, then all the internal such as additional lifts, means of escape etc... I cannot tell you a figure that it increases by per floor. …"

St. James (Developer)

Telephone interview on 8 August, 2005 with Chris Gilbert, commercial department London.

Chris Gilbert works with developments of max. 5 stories, prices for apartments increase by £5,000 - £10,000 in this range per floor if building has a lift

The Beetham Organization (Developer)

Telephone interview on 1 August, 2005 with Mary, responsible for residential sales.

Average selling prices are £260 – £300 per square foot (Liverpool, Manchester…), prices for apartments increase by £2,500 - £5,000 per floor, top floors are usually penthouses and incur a significant extra premium. Example for recent project: £235,000 per apartment on 5th floor with 813 square feet, same apartment costs £3,500 more per floor upwards in a 40 storey tower. (Did not say where)

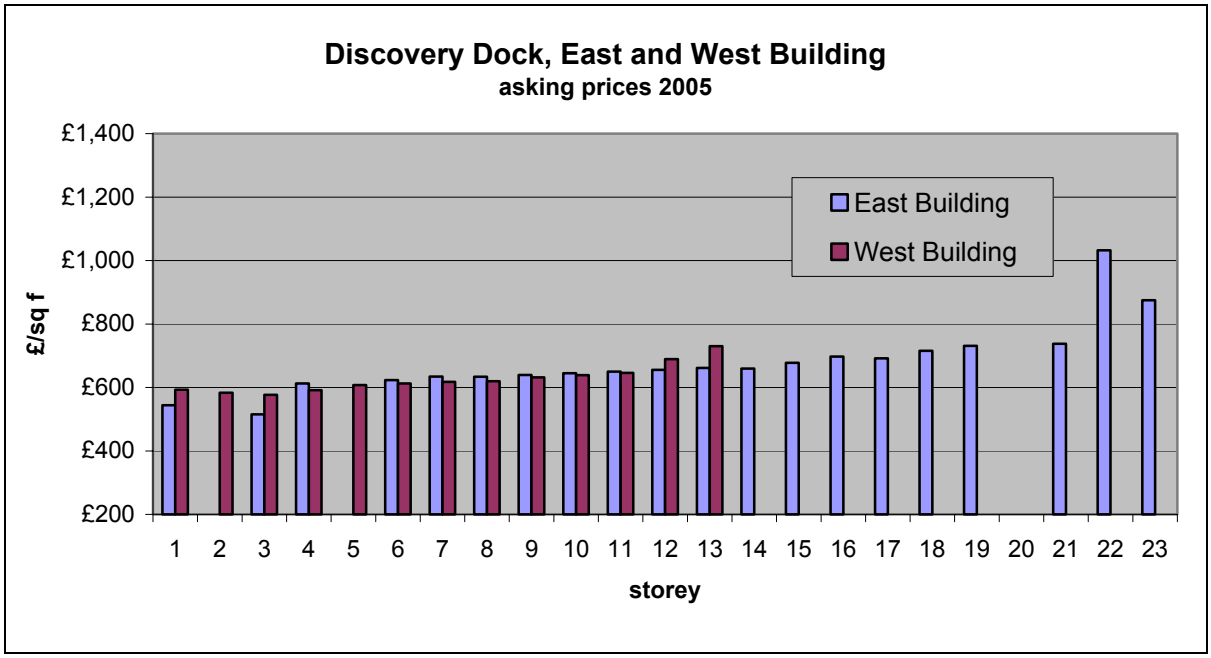
Appendix 2 – Research on revenue in relation to height

For the following case studies the data of sales prices per apartment was provided by LRR for six tall residential buildings. Two of the samples could not be used because of missing information. A further building with detailed information, the Discovery Dock, was found on the web.

The data comprises asking prices and real selling prices but only one type per building. The selling prices are from different times and this does distort the results of the analysis. An attempt was made to adjust the selling prices to the same date using house price indices for the respective periods. This did not deliver satisfying results, i.e. a rather reasonable increase per floor or range of floors. The reasons for this distortion are expected to be the different phases of disposal: Developers are willing to sell at a discount before completion and even at a larger discount at very early stages of the project. This reduces risk and subsequently allows cheaper cost of finance.

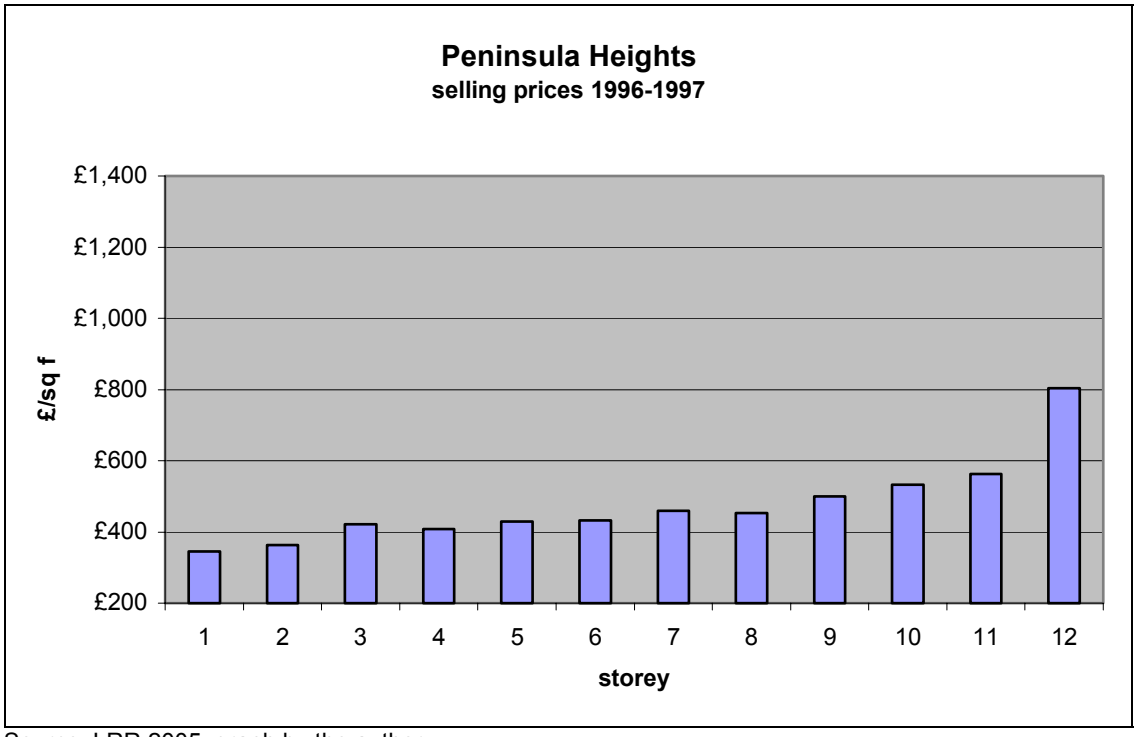
The following graphs illustrate the results of the average revenues per saleable area in £/ sq f. Missing columns are due to missing data.

Figure 15



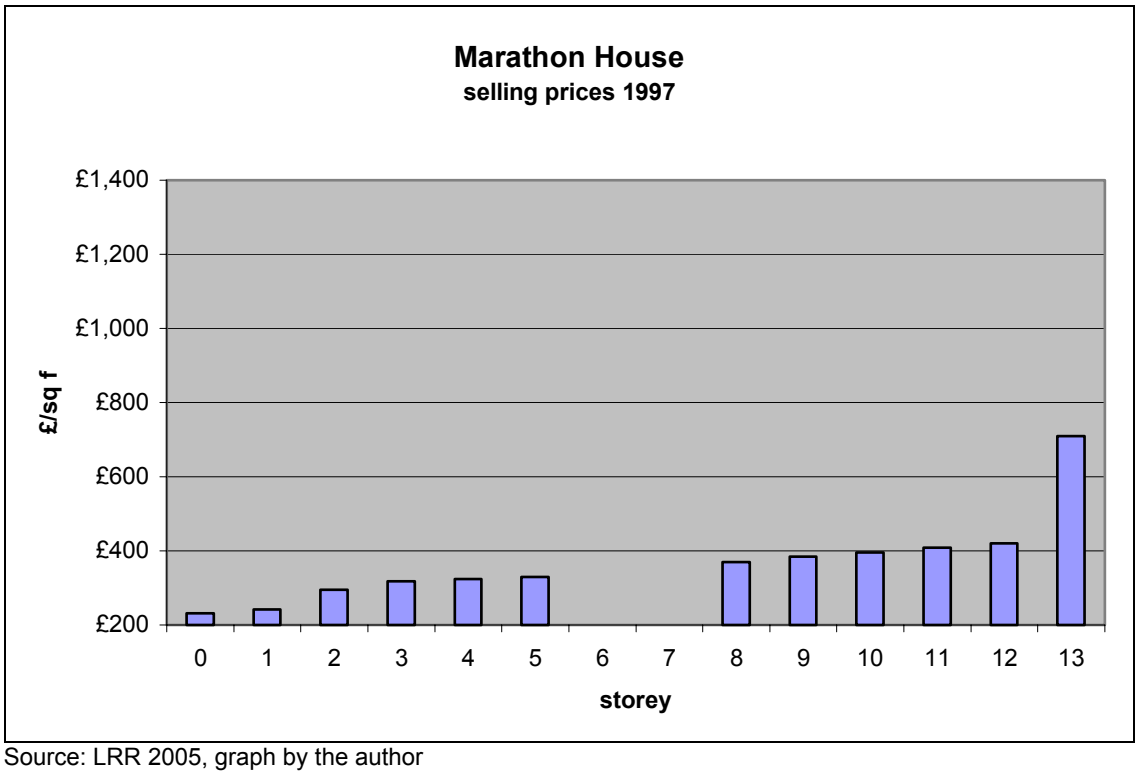
Source: www.discoverydock.com, graph by the author, the decrease of value per floor area for the top floor is probably due to the different sizes of the penthouses on the 22nd and 23rd floor. The penthouse on the lower floor is for some reason significantly smaller than the unit on top. Thus the lower penthouse it is still notably cheaper in total even with a higher price per sq f.

Figure 16



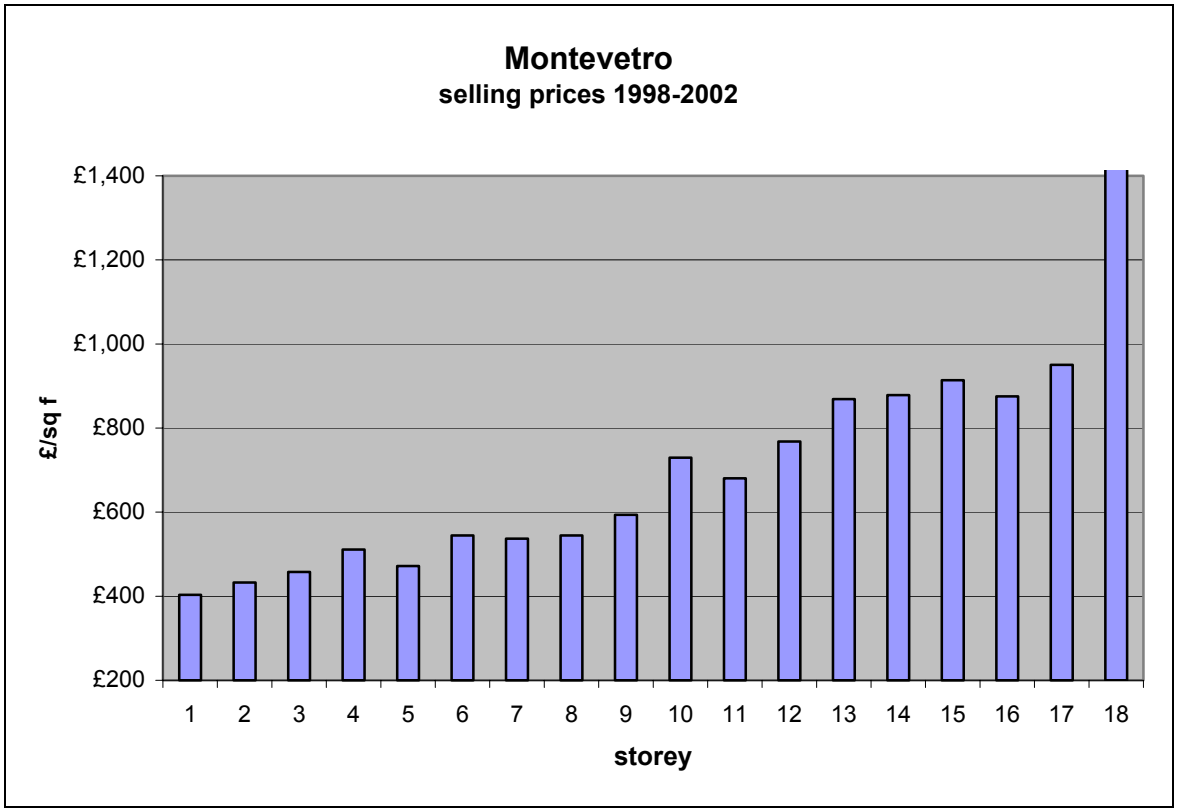
Source: LRR 2005, graph by the author

Figure 17



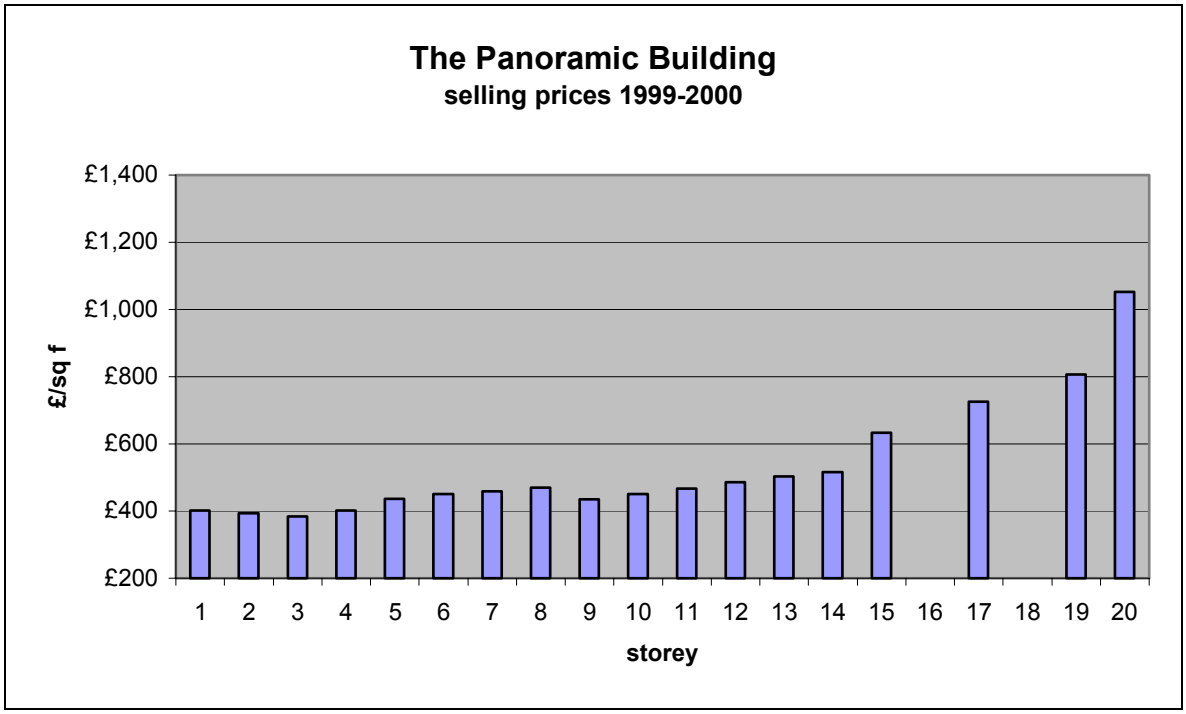
Source: LRR 2005, graph by the author

Figure 18



Source: LRR 2005, graph by the author

Figure 19



Source: LRR 2005, graph by the author

Appendix 3 – Model calculations

The calculation

The following calculations were undertaken to test the implications of the values that were established in the research for this paper. The model compares the economics of residential developments with six different heights. For each development an individual discounted cash flow (DCF) analysis is undertaken. The result of the calculations is the internal rate of return (IRR) for each height. The IRR is an indicator for the potential return in relation to the investment without considering the total amounts involved. The fact that the total volume of the six model calculations is different is not relevant.

The values that change with height are:

cost	**revenue**
building costs	price per saleable area
efficiency (net to gross)	
building time	

The model demonstrates the combined effect that the respective results of the research on costs and revenues in relation to height have when applied in one calculation. The significance of the results is in the relationships that can be found, not in any particular value. The various inputs and assumptions are manifold. Real conditions of property development projects can differ significantly and are extremely diverse.

The inputs and assumptions in detail

Density: The density level determines the necessary amount of land that is needed in proportion to the number of residential units. The higher the density, the lower the percentage of land cost in the total costs.

Building cost: The building costs rise with height and are different for each height-specific model. The values are the averages from the estimates given in different interviews as documented in Figure 10. These figures are for inner London at 2005 prices.

Efficiency: The efficiency (net area to gross area ratio) decreases with height and is different for each height-specific model. The respective values used are the averages from the results from different interviews as documented in Figure 9.

Building time: The building time increases with height. For the different models the following times were applied:

5 storey	13 months
10 storey	14 months
20 storey	16 months
30 storey	18 months
40 storey	20 months
50 storey	22 months

The values are estimates that were checked with developer First Base and developer Pocket. (Interview Denton, Interview Pocket)

Land cost: The cost for land is set at £15 million per hectare. The British government's Valuation Office Agency (www.voa.gov.uk) publishes extremely divergent land prices for sites for flats in inner London. While such land costs £8 million per hectare in Lewisham, it is valued at £18 million in Camden, respectively. It is assumed that a site that lends itself to the construction of tall buildings is rather more expensive.

Affordable housing: The requirements to provide affordable housing as part of a development often permit a share of intermediate housing next to social rented accommodations. Intermediate housing allows a limited profit for the developer while social rented apartments are handed over to a registered social landlord (RSL) and the developer is paid a sum based on the Total Cost Indicator (TCI) that is supposed to cover the development cost. (GLA, 2004b, interview Marsh, interview London Borough of Tower Hamlets, interview Pocket)

For the purpose of this calculation, a ratio of 30% affordable housing, all social rented is assumed. The assumption is made that the reimbursement covers the development costs and thus no allowance is made for construction costs for affordable housing. An additional 30% of the land cost is added to allow the provision of the affordable housing on a different plot. (see chapter: affordable housing)

This crude simplification does have a similar effect than a higher share of affordable housing with a mix of social rented and intermediate housing. It does not recognize that the increased construction costs for higher buildings is not necessarily reimbursed.

Revenue: The revenue for sold floor area increases with height. To model the relationship between height and revenue, three bands are used as suggested in several interviews. (interview Marsh, interview Denton, interview Hamptons, interview St. George, interview Knight Frank)

Table 4

storey	average revenue per floor in £/sqf in					
	5 storey buildg	10 storey buildg	20 storey buildg	30 storey buildg	40 storey buildg	50 storey buildg
1	315	315	315	315	315	315
2	360	342	342	342	342	342
3	405	369	369	369	369	369
4	428	396	396	396	396	396
5	621	414	414	414	414	414
6		432	432	432	432	432
7		450	450	450	450	450
8		536	466	459	456	455
9		621	481	467	462	459
10		747	497	476	468	464
11			512	484	474	468
12			528	493	479	473
13			543	501	485	477
14			559	510	491	482
15			574	518	497	486
16			590	527	503	491
17			605	536	509	495
18			621	544	515	500
19			623	553	521	504
20			797	561	527	509
21				570	533	513
22				578	538	518
23				587	544	522
24				595	550	527
25				604	556	531
26				612	562	536
27				621	568	540
28				648	574	545
29				747	580	549
30				846	586	554
31					592	558
32					597	563
33					603	567
34					609	572
35					615	576
36					621	581
37					673	585
38					747	590
39					821	594
40					896	599
41						603
42						608
43						612
44						617
45						621
46						698
47						759
48						821
49						883
50						945

All sales prices are calculated in relation to a price per saleable area on the 7th floor. Down to the 4th floor the revenues are decreased in steps of 4% followed by steps of 6%. Subsequently, the ground floor is valued at 70% of the seventh floor.

The range between the 8th storey and the last storey before the penthouses is rising by an average percentage that is the same for all projects. This total increase is 38% and is evenly spread over the floors. The value reflects the average increases as calculated in the case studies in Appendix 1. This is a very rough estimate as the value changes considerably between the samples. The finding is similar to the estimate of developer First Base (interview Denton) who used 15% on average -thus 30% total- for this band for his latest project.

In this model, there is one penthouse for the ten storey calculation and then one more with each additional 10 storeys. The values for the penthouses are calculated with an increase of 110% to the seventh floor for the top-penthouse on the fifty storey development. The values decrease with each floor down and with each calculation with lower height. The penthouse on the ten storey project is valued at 60% of the penthouse on the fifty storey development.

While the average revenue per floor in the middle bands is the same for all projects, the increasing prices and numbers of penthouse storeys with increasing height reflect an increasing premium for height.

The revenues for the five-story project are calculated separately. These are increased at higher rates and the top storey is valued at a price that matches the price of the floor below the penthouse of the ten storey development.

The revenues per floor are constructed using various inputs and suggestions of which most are documented in the chapter Interviews. The limited number of sources and the diversity of the situations in real life impose significant limitations on this model.

Figure 20

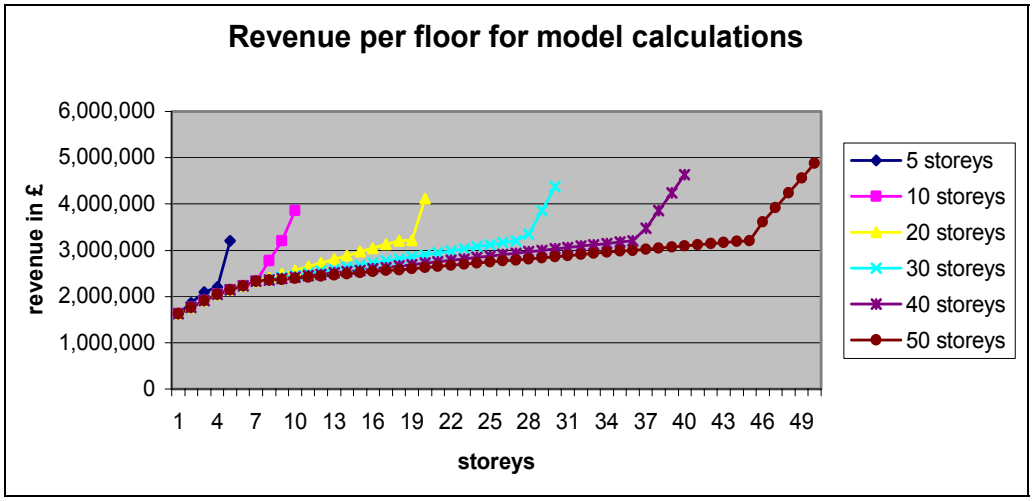


Figure 20 illustrates the results of Table 18

Discounted Cash Flow Analysis: The costs and revenues are spread over the time of the project to allow a calculation of the internal rate of return (IRR). The construction period starts in the second month and the costs are spread evenly over the construction period. The total revenue from sales is spread over six months, starting on the last month of construction. Professional fees are incorporated in the model on month two and month eight and agents fees are deducted parallel to the income stream. The IRR is calculated as a measure to compare the viability of the developments using the given input variables. (a DCF spread sheet is documented as Table 5)

Test of input variables

The assumptions made and inputs used are subject to various limitations as discussed above. To test the implications of different inputs, the model was run with changes in one variable at a time. The results are illustrated below. The main conclusion that can be drawn from this exercise is that the qualitative relationship between the different projects remains similar if any of the input variables is changed separately. However, the model seems to be most sensitive to changes in the average house price level. The doubling of this value has by far the greatest impact on the IRR.

Figure 21

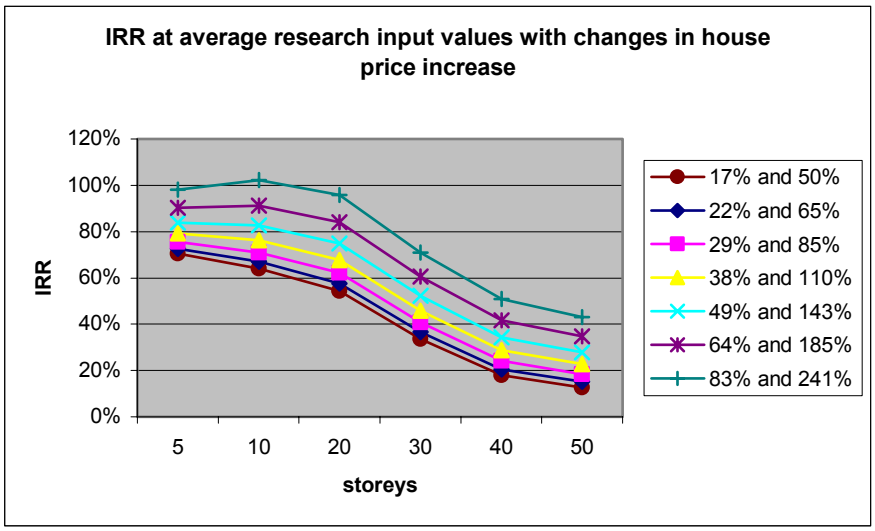


Figure 22

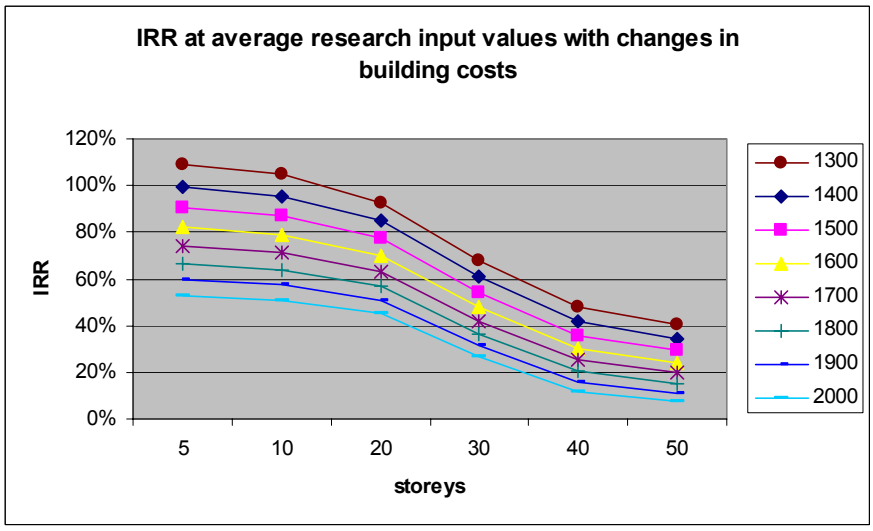


Figure 23

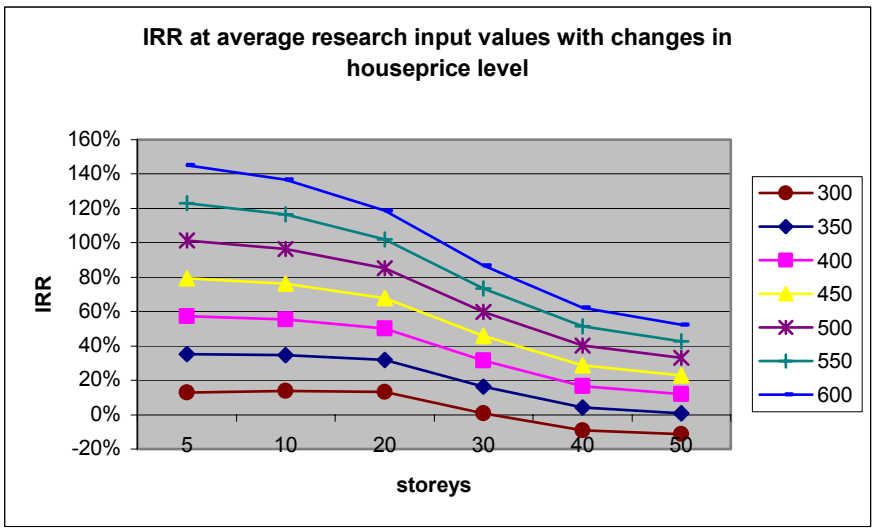


Figure 24

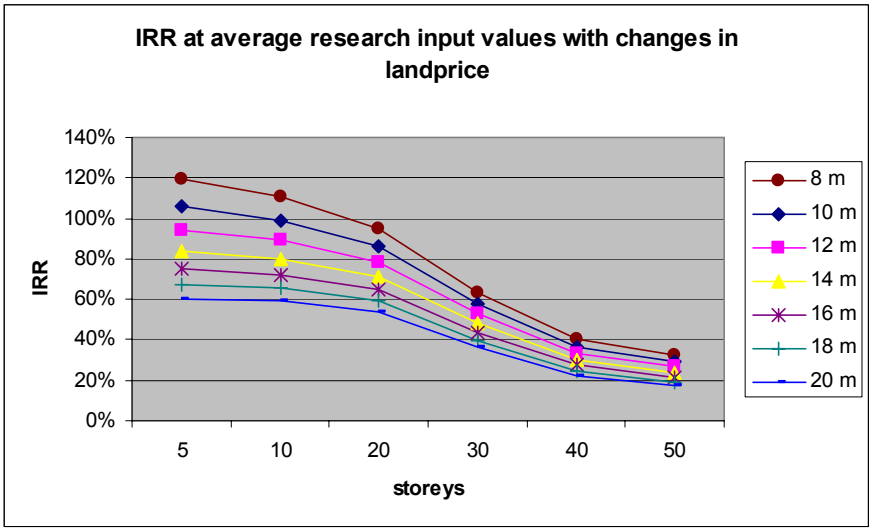


Figure 25

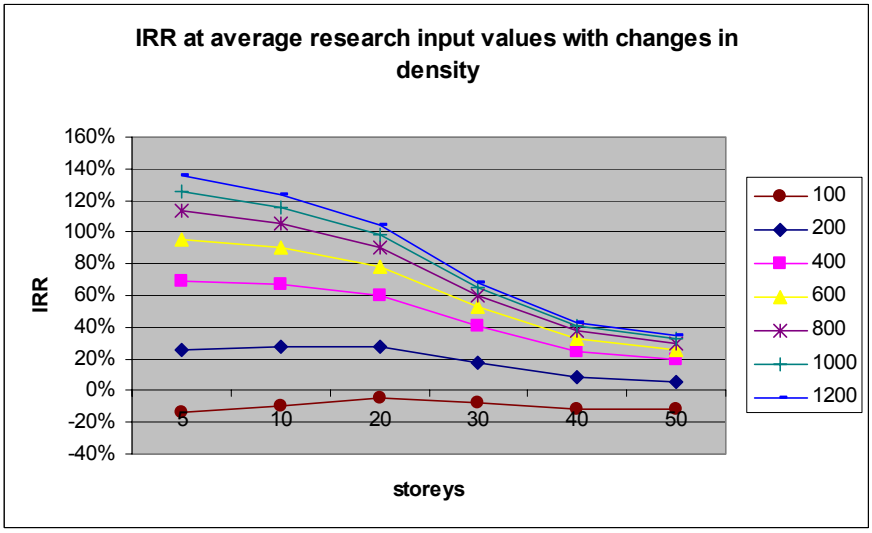


Table 5

Discounted Cashflow Analysis for development with 10 storeys

INPUTS

Build period		**14**	*months*
Build cost/month		**-£667**	*in thousands, paid one month in arrears*
Professional fees	12%	**-£1,120**	*in thousands, paid in two transactions*
total income		**£23,878**	*in thousands*
Selling period		**5.75**	*months*
Sales/month		**£4,153**	*in thousands*
Agents fees/month	2%	**-£83**	*in thousands, paid one month in arrears*
Discount rate		**1.17%**	*per month*

Discountrates	
year	month
15%	1.17%

DCF (in 000s)

	NPV	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*	*18*	*19*	*20*	*21*	*22*
land cost	-3427	-3467																					
building costs	-8462	0	-667	-667	-667	-667	-667	-667	-667	-667	-667	-667	-667	-667	-667	-667							
fees	-986	0	0	0	0	0	0	0	-560	0	0	0	0	0	-560								
Agent fees	-386	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-83	-83	-83	-83	-83	-62	
income	19508	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4153	4153	4153	4153	4153	3115		
net cash flow	**6248**	-3467	-667	-667	-667	-667	-667	-667	1226	-667	-667	-667	-667	-667	1226	3486	4070	4070	4070	4070	3031	-62	0
control value	6248																						

Net PV	£6,248,076	
IRR	**76%**	*monthly: 4.83%*