Compaction, scale and proximity: an investigation into the spatial implications of density for the design of new urban housing

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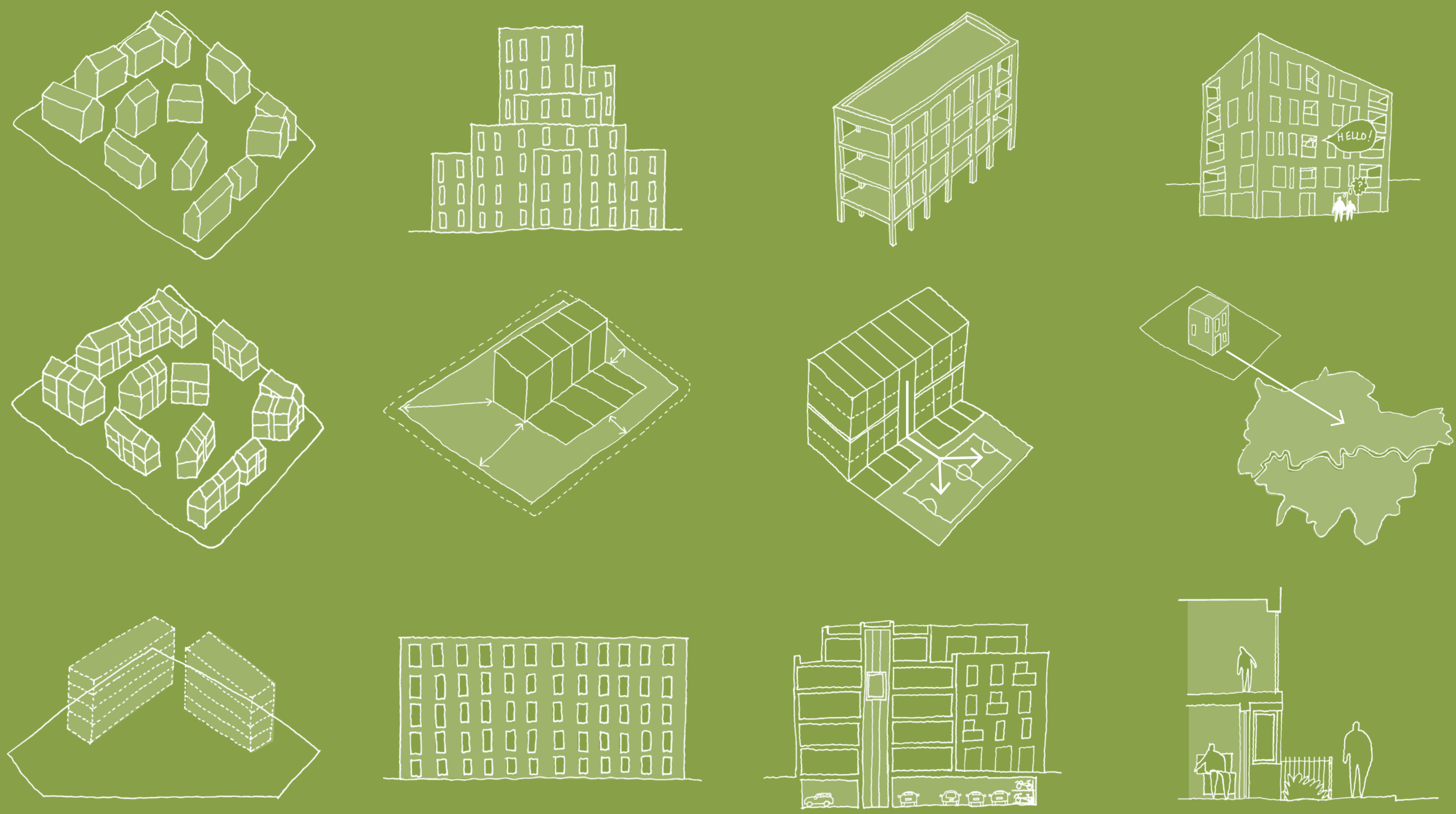

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A thesis submitted in partial fulfilment of the requirements of the University of Westminster for the degree of Doctor of Philosophy.

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Declaration

This thesis is the work of Claire Harper. All other contributors are acknowledged in the text and listed in the bibliography

signed: Claire Harper

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Abstract

This thesis investigates the implications of density for the design of new urban housing. An historical study of the notion of density in architectural and planning practice indicates that density ratios as a design mechanism were born out of a desire to control the physical conglomeration of the built mass of the city and to limit the social and hygienic consequences of proximity between people. Density ratios therefore provided a device for addressing the societal distaste for the conditions of proximity, and a professional aversion to the cohesiveness and impermeability of the industrial city. A number of studies have investigated the correlation between density ratios and built form and found density in numeric terms to be a poor descriptor of the qualities of the built environment. However, it is argued that the numerical conception of density as a ratio measure is only one way in which density can be conceptualised and excludes the qualitative aspects of proximity and cohesiveness from the debate.

The thesis presents a critique of the current definition of density as a ratio measure and sets out an alternative, spatial index of density that reintroduces the notions of proximity and cohesiveness to the conceptualisation of what density means for the design of the built environment. It proposes that the continued conception of density as a numeric index limits its veracity for describing the qualities and characteristics of the built environment, and perpetuates the need for assumptions and generalisations about the type of development associated with different density ratios. The index is proposed initially out of an historical analysis and a cross-disciplinary review used to gather together the range of research and understanding, types of measuring, applying, thinking about and writing about the subject of density in architecture and other disciplines. The proposed index is then tested against a series of typical housing schemes in East London. The index is presented finally as a reference for designers and provides a way of thinking about the social and spatial implications of proximity as a starting point for the design of new urban housing.

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Introduction

At its most basic, density is a simple ratio of matter to space. Typically, in the design and planning of the built environment the 'matter' is defined in terms of dwelling units, floor area or people. Space is measured in abstract hectares. In spite of its relatively narrow definition, however, the concept of density is implicated in a vast range of issues and attributed a range of social, economic, ecological, psychological and formal consequences.[1] The implications of urban density are investigated across a range of different disciplines: anthropologists, architects, geographers, economists, planners, developers and psychologists, variously consider the impact of density at different scales, according to different indicators and using different methods of analysis.[2] However, despite the range of investigation dedicated to the subject, the understanding of what density means for the design of the urban environment remains relatively under-explored. This thesis therefore sets out to investigate the implications of urban density for the design of the built environment and in particular the design of residential environments in the city.

This is a pertinent subject for study. Over the past decade, there has been renewed interest in the subject of urban density. The publication of the planning agenda *Towards an Urban Renaissance* in 1999 marked a turning point in the approach towards urban development in the UK. Critical to this shift was a change in attitudes towards density. The

1 Arza Churchman, 'Disentangling the Concept of Density', *Journal of Planning Literature,* 13 (1999), 389–411 (p. 390).

2 Christopher Boyko and Rachel Cooper, 'Clarifying and Re-conceptualising Density', *Progress in Planning,* 76 (2011), 1–61; Churchman.

3 Urban Task Force, *Towards an Urban Renaissance* (London: Department of the Environment, Transport and the Region, 1999).

Urban Task Force report called for a more 'compact' model of urban development intended to bring about the best qualities of the city centres of Paris, Barcelona and Berlin in UK urban centres.[3] These were taken as models of 'compact city' urbanism, characterised by mixed-use - residential, commercial and institutional buildings close together rather than segregated in to their respective zones as in the twentieth century Modern city - good public transport and public open spaces. Setting out the agenda for this new approach to urban development and planning, Richard Rogers defined the compact city as:

> *A dense and socially diverse city where economic and social activities overlap and where communities are focussed around neighbourhoods.*[4]

Urban density was a key part of this new urban agenda. Higher urban densities were attributed with a range of environmental benefits such as reduced travel distances, more effective public transport systems and reduced consumption of land for housing. There were assumed social benefits, too. The 'dense city', wrote Rogers, offered the opportunity to reconsider the "social advantages" of proximity and living in each other's company.[5] This was a significant step in the context of the suburbanisation and outward expansion of the city that had predominated for the past thirty years.

In London, the Compact City agenda was adopted swiftly with two explicit objectives: one, to reverse the population exodus from London by accommodating new population growth and new housing within the existing boundaries of Greater London, and two, to maximise the effective use of available development land within the city.[6] There was an emphasis on infill development of vacant sites within the city, and on density as an indicator of effective land use. Between 2001 and 2009, the average density of new housing built in London increased from 50 dwellings per hectare (d/ha) to 103d/ha.[7] Such a significant increase in the density of new housing generates questions, however, as to the implications of this increase for the qualities of the urban environment.

A large body of research has been dedicated to testing and exploring the implications of higher urban densities for public transport use, land use efficiency and protection of the green belt, social diversity, social sustainability more broadly as well as cognitive and experiential factors such as the experience of privacy.[8] Indeed, two significant studies, Arza Churchman's *Disentangling the Concept of Density* (published in 1999) and Boyko and Cooper's *Clarifying and Re-conceptualising Density* (published in 2011) have been dedicated solely to the task of investigating and summarising the breadth and variety of research surrounding the subject of urban density in an attempt to reach a more concise understanding of how density might be used by policy makers and planning practitioners. These studies provide a valuable resource for understanding the variety of ways that density has been thought about and the consequences that have been attributed with it. However, both studies are situated within an environmental-psychology field of study

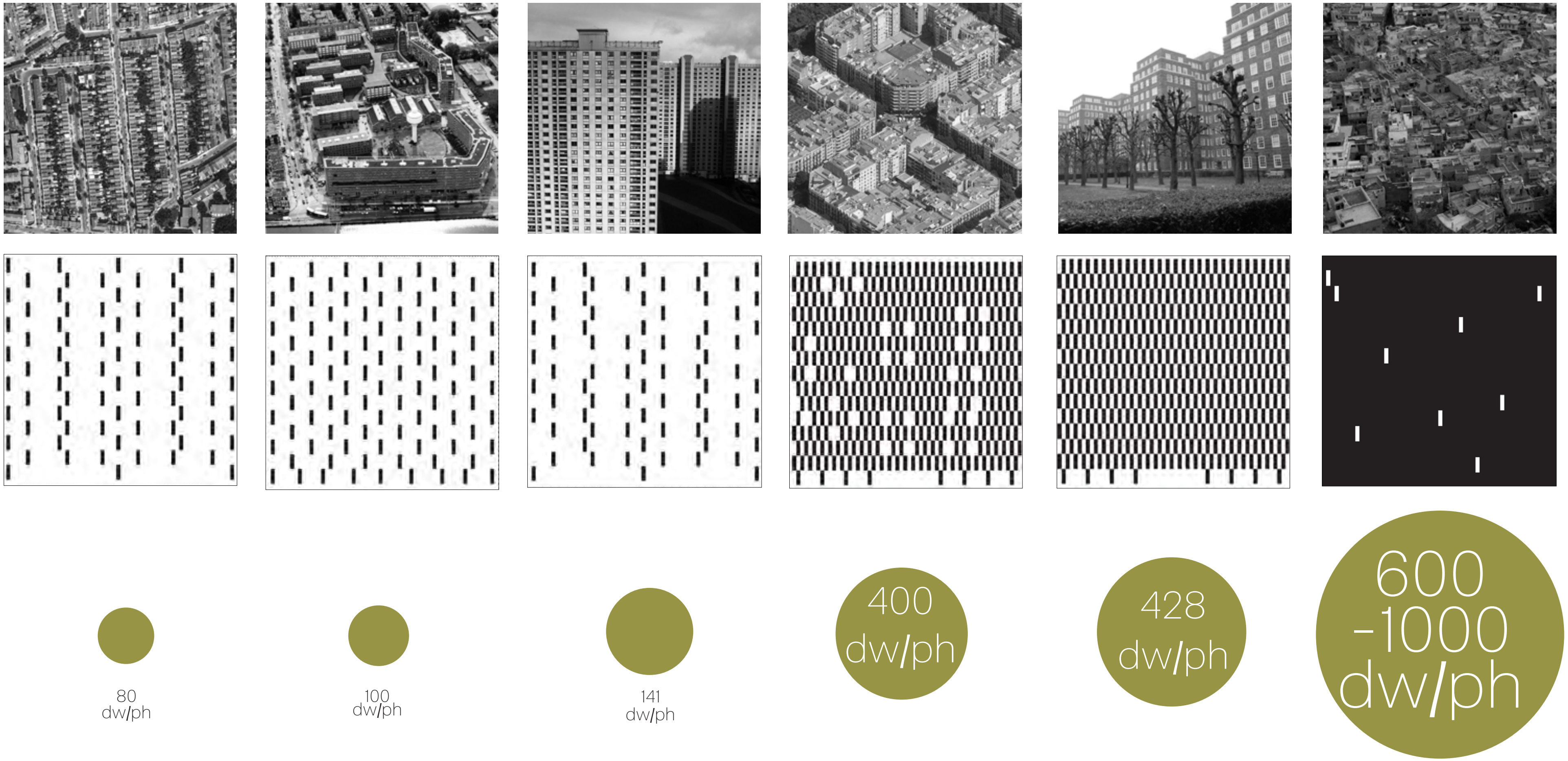
4 Lord Richard Rogers, *Cities for a Small Planet:* Reith Lectures, ed. by Philip Gumuchdijan (London: Faber and Faber, 1997), p. 33.

5 *Ibid.*

6 LSE, *'Density: a Debate About the Best Way to House a Growing Population',* 2006, p. 2. The population of Greater London as whole had been in decline since 1939 and has only, since 1991 begun to increase again. Greater London Council and Office for National Statistics, *Historic Census Population: London DataStore*, Demographics (Greater London Authority, 10 September 2010). See also Duncan Bowie, 'Density, Housing Mix and Space S*tandards of New Housing Development in London',* in *Space at Home* (presented at the RIBA Research Symposium 2008, Royal Institute of British Architects, 2008), p. 1.

7 Land Use Change Statistics and Department for Communities and Local Government, *'Land Use Change: Proportion of New Dwellings on Previously Developed Land, and Density of New Dwellings 1994-97, 2006-09'* (Department for Communities and Local Government, 2010)

8 The implications of urban density for social sustainability are considered in both Churchman, p. 389 and Glen Bramley and Sinéad Power, 'Urban Form and Social Sustainability: The Role of Density and Housing Type', *Environment*



Teraced Housing, Stoke Newington, London

Van Hallstraat, Amsterdam-West

Red Road Housing, Glasgow (demolished)

Barcelona

Dolphin Square, Pimlico, London

Jodphur, Rajasthan

Figure 1: Diagrams showing the density of these six different urban environments in terms of their numeric, density ratio. The figurative diagrams at the centre represent the amount of the site that would be covered by dwellings if each were on the ground. These are devised in relative terms, beginning with Jodphur as the densest, and calculating the coverage in the other diagrams in relation to this. Source for density figures for all except Red Road – taken from Greater London Authority, 'Housing for a Compact City' (Greater London Authority, 2003)

and therefore focus primarily on social science research that aims to test the impact of density ratios on different social and psychological conditions. They are not particularly useful for deciphering the implications of density for the design of the built environment.

There has, however, been a recent flurry of interest in the implications of higher density ratios for the design of new urban housing.[9] Research into the design implications of density has broadly focussed on two main conditions. The first of these is the relationship between density and built form. The recently published *Spacematrix* study by researchers Meta Berghauser-Pont and Per Haupt at TU Delft investigates the relationship between density as a ratio measurement and the formal characteristics of the built environment. The study begins by establishing that density ratios, in themselves, provide a poor means of describing built form and therefore sets out to expand a multi-variable model based on a series of metrics, or measurements of built form.[10] The study itself is a comprehensive and detailed investigation into the use of density within urban planning and design and will be considered in more detail in the course of the development of this thesis. It draws on, and expands the morphological studies developed by Leslie Martin and Lionel March, researchers at the Centre for Land Use and Built Form Studies at the University of Cambridge during the late 1960s and early 1970s. Through a series of form-based design experiments, Martin and March sought to demonstrate the density potential of different formal configurations.[11] Their studies were a critique on the prevalent planning doctrine at the time that high-density necessarily meant high-rise building.

These two studies clearly demonstrate that density ratios on their own provide a poor means of describing the formal characteristics of the urban environment. The diagrams in Figure 1 further illustrate their point. The density ratios give very little indication as to the formal characteristics of the spaces and the forms depicted in the photographs. Nonetheless (and as will be considered more fully in the second chapter of this thesis), there continues to be an assumption that maximum and minimum density ratios set out in planning policy can be used as a means of determining the character or type of development on a site, its formal characteristics and, to an extent, the social qualities of the environment that is created.[12]

These two detailed studies into the relationship between density and urban form have each proposed a way in which density ratios can be useful within the design process, either as a limit (Martin and March), or a useful instrument (Berghauser Pont and Haupt). However, that design process is limited purely to the manipulation of form. But design is concerned not only with physical massing and form, but with the implications that has for the social organisation and use of the spaces created, the qualities of the spaces and the experience of the built environment. Density, defined in the broadest sense, as the relationship between the amount of building or number of people, and the space that they occupy, impacts on all of these things. Indeed, as

and Planning B: Planning and Design, 36 (2009), 30-48; Social Research Institute MORI, *'Physical Capital: Liveability in 2005'*, 2005. The implications of density for the experience of privacy is considered in: Morag Lindsay, Katie Williams and Carol Dair, 'Is There Room for Privacy in the Compact City?', *Built Environment*, 36 (2010), 28–46 and Mulholland Research and Consulting, '*Perceptions of Privacy and Density in Housing'* (Design for Homes and Popular Housing Research, 2003).

9 A number of design guides and compendiums have been published over the past decade that present examples of higher density housing. The most comprehensive are: Javier Mozas and Aurora Fernandez Per, *Dbook: Density, Data, Diagrams, Dwellings* (a+t ediciones, 2007); Javier Mozas, *Density: New Collective Housing* (a+t ediciones, 2006). Two guides have also been published with specific relevance to London: Maccreanor Lavington Architects, Emily Greeves Architects and Graham Harrington Planning Advice, *'Housing Density Study'* (Greater London Authority, 2012) Design for Homes, '*Recommendations for Living at Superdensity'* (Design for Homes, 2007).

10 Meta Berghauser Pont and Per Haupt, *Spacematrix: Space, Density and Urban Form* (Rotterdam: NAI Publishers, 2010).

will hopefully become clear over the course of this thesis, density has qualitative, social, economic, political and experiential implications – all of which contribute to how density might be thought about and used in design practice.

In order to elaborate on the implications of density, it is also necessary to elaborate on how density is understood within architectural and urban disciplines. It was stated above that enquiry into the implications of density within architectural discourse predominantly focussed on two issues: one was the relationship with built form, the other, is concerned with situating density within a framework of social, economic, political and technological conditions. Koolhaas' seminal text, *Delirious New York*, (published in 1978) situates density as a product of the particular social, economic and political culture in Manhattan at the beginning of the twentieth century. In the context of fervent vertical expansion, the density of the city was part of its defining phenomenological character. Koolhaas situates the density of the city as both cause and consequence of the cramped, crowded, overshadowed, over-developed, but at the same time, exhilarating and desirable urban experience.[13] The text expands on a long history of literary, sociological and theoretical references to the experiential qualities of density as part of the urban condition, (although often expressed in other terminology, particularly 'crowding'). Walter Benjamin and Baudelaire also wrote extensively on the experience of being in the crowd.[14] Georg Simmel, in his text *The Metropolis and Mental Life* contemplated the effect of the density of the city on social interaction and the experience of proximity to others.[15] These texts, and the social and phenomenological conditions that they associate density with, suggest the need for an expansion on the conception of density beyond its simple understanding as the ratio of dwellings to the hectare.

Research Questions

Out of this initial foray into the subject of urban density, two research questions were established:

1. Expanding on the conception of density as numeric ratio, what are the spatial implications of urban density?
2. How might the concept of density be elaborated or reinterpreted in order to be a useful starting point for design, specifically in relation to new urban housing?

Research Approach

Existing studies in the field of architecture have focussed primarily on establishing correlational patterns based on density ratios. The conception of density as a numeric ratio lends itself to, and undoubtedly encourages, this type of analysis. However, these studies are premised on a Cartesian conception of space, particularly one in which building mass can be manipulated through the use of representative volumetric measurements. These models generate an abstract, and therefore limited representation of the built environment, or more specifically, the

11 Lionel March and Leslie Martin, 'Speculations', in *Urban Space and Structures* (Cambridge: Cambridge University Press, 1972), pp. 28–54.

12 See in particular the diagram cited at the beginning of Chapter Two from Michael Collins and Patrick Clarke, *'Planning Research Programme: The Use of Density in Urban Planning'* (Department of the Environment, Transport and the Region, 1998), p. 33.

13 Rem Koolhaas, *Delirious New York: A Retroactive Manifesto for Manhattan,* New Edn. 1994 (New York: Monacelli Press, 1978).

14 Walter Benjamin, *Charles Baudelaire: A Lyric Poet in the Era of High Capitalism,* trans. by Harry Zohn (London: New Left Books, 1973); Walter Benjamin and Asja Lacis, 'Naples', in *Reflections: Essays, Aphorisms, Autobiographical Writings,* ed. by Peter Demetz, trans. by Edmund Jephcott (London: Helen and Kurt Wolff, 1925), pp. 163–173.

15 Georg Simmel, 'The Metropolis and Mental Life', in *Rethinking Architecture: A reader in cultural theory*, ed. by Neil Leach (London: Routledge, 1997), pp. 69–79.

implications of density. The approach adopted in this thesis presents a critique of these studies, their models and their methods. The approach stems from the initial starting point for the study, which was an interest in the social and spatial landscape of housing. When density is added to the mix, both the physical and the social character of that fabric is altered which has implications for the experience of the urban environment and of the dwelling itself. The personal, emotional, social and cultural importance of the home and the immediate dwelling environment is omitted from much of the discourse on residential density, and in particular those morphological studies noted above.[16] From an architectural standpoint, these 'softer' social, experiential and cultural factors are of fundamental concern to the designer. There is a need therefore for a research methodology that reflects the range of issues with which designers are concerned, and expands upon the existing quasi-scientific methodologies that explore either form, or quantity of some kind.

The analysis in this thesis is based on a broader conception of the 'spatial' that draws on Lefebvre's tri-part theorisation of space. Lefebvre's proposed conceived, lived, and perceived space provides a useful starting point for expanding on the well-trodden field of study concerned with the representational conceptions of density, and suggests that the lived and perceived conceptions of density provide a useful point of departure. Following Lefebrve therefore, this thesis adopts the notion of the spatial as more than merely form, or representations of form (as in numeric density ratios). In so doing it moves away from the existing research on the subject, which focuses on either built form, or on the sociological implications. The research sets out to define the implications of density in a spatial sense: that is relevant for the social and lived experience of the urban environment.

A range of analytical methods are used, reflecting the multifarious approach often involved in the beginning of a design project. The approach adopted follows what Bruno Latour describes as an 'assembling' approach:

> *[A] multifarious inquiry launched with the tools of anthropology, philosophy, metaphysics, history, sociology to detect how many participants are gathered in a thing to make it exist and to maintain its existence.*[17]

Whilst the tools of inquiry used here vary from those cited by Latour, the intention was to gather together a range of types of measuring, applying, thinking about and writing about the subject of density. This was used to define the issues, or consequences of density that are of most concern from a designer's perspective. In the initial inquiry, the range of sources was broad and the scale and which the consequences of density were being explored spanned from the regional, to the dwelling interior. The scope was eventually narrowed to a concern with the scale of the individual development site and the context of the dwelling in its immediate residential environment. This emerged as the scale at which the qualities of density at the urban scale could be most affected by design.

16 Studies such as Bretherton and Pleace's for Joseph Rowntree Housing Trust have sought residents views on their residential environment and used these to inform and approach towards the design of new urban housing. *Residents' Views of New Forms of High-Density Affordable Living.* Joseph Rowntree Foundation, April 2008. Similarly the CABE report, *Better Neighbourhoods*, considers the design of the residential environment in some detail, but it is posited as a consequence of a stronger emphasis on density ratios as a core component of sustainable urban development.

17 Bruno Latour, 'Why Has Critique Run Out of Steam? From Matters of Fact to Matters of Concern', *Critical Inquiry*, 30 (2004), 225–248 (p. 246).

A multi-method approach was adopted in the first instance. This allowed the research, and research methods to develop iteratively, in response to conclusions drawn along the way. It also reflected the critical objective which developed over the course of the study, to posit an alternative to the application of density ratios in quasi-scientific design practice and research. The methods, and the way that they are deployed disclose my personal background as architect and designer. Comparisons and conclusions drawn along the way are treated as setting-off points for design solutions. The architect's position is also apparent in the observations that are drawn, which focus instinctively on those elements of the built environment with which architects are concerned. The analyses focus on the structure of the urban fabric, the organisation of distinct elements (housing, shops, public spaces, etc.) in relation to one another. There is also a focus on the buildings, their internal layout, their appearance, and the relationship they have with the spaces around them. This instinctive, yet conditioned approach defines a distinct methodology for the study which contributes to broadening the range of research methods used within architectural research.

Whilst the research is concerned with a broad range of elements within the built environment (described collectively as spatial conditions), it is necessary to define the limits of the research. Whilst the 'spatial' is defined to include the use of space (lived and perceived space), the study does not delve into the way that conditions of density influence residents' experiences of their dwelling and its environment. This has been addressed in a number of studies and in greater depth than would have been possible within the scope of this thesis.[18] The study is also limited in terms of urban scale. The analysis primarily focuses on the scale of the urban development: an urban block, a street, or a defined scheme. This reflects the scale with which architects are most frequently engaged. However, another thesis could be dedicated to defining the spatial implications of density at the scale of the urban district.[19]

The research began with an historical study into the subject of density within the discourse of architecture and urban planning. The objective of this initial inquiry was to contextualise the current urban planning agenda and the approach towards density represented therein, and to explore how urban density has impacted on the built environment historically. This chapter (Chapter One) is presented as a series of 'episodes', each of which expands a different notion of density and demonstrates different architectural and formal outcomes associated with it. From the initial starting point of thinking of density as a ratio of dwellings per hectare, and a component of mixed-use, compact city urbanism, the historical analysis both expanded and problematized the notion of density. The importance of scale was highlighted. Density as a device of regional planning (as in the Garden Cities for instance), has substantially different implications for design from the idea of density as a stimulus for the cross-programming and functional hybrid archetypes proposed by MVRDV and others. Chapter Two therefore sets out to unpack the

18 These studies are discussed in more detail in Chapter Three. The most detailed in probably the 'Density and Urban Neighbourhoods in London' report conducted by Ricky Burdett, Tony Travers, Darinka Czischke, Philipp Rode, and Bruno Moser. Enterprise LSE Cities, 2004.

19 Indeed , this presents scope for further research and is considered further in the conclusions to the thesis.

applications and potential implications of the use of density ratios in planning and design practice. The analysis in this chapter was essential to defining both the limits of the study, and a critical stance as a design practitioner in relation to dominant forces and modes of practice. It became clear that the spatial qualities with which designers are concerned are disregarded by prevalent measurements and practices.

Following Latour's notion of 'gathering together', Chapter Three' draws on a variety of sources, representations of, and conceptions of density to expand an alternative model of density based on its potential spatial implications. The model responds to both the field of concern defined at the beginning of the thesis - that is the residential environment within the city - and that scale at which designer's are able to operate most effectively. The model is divided into four main types, or ways of thinking about density. Within each theme, three indices are set out which are suggested as key design considerations.

Chapter Four uses urban analysis methods; design analysis, morphological analysis and field observation to test the indices set out in the previous chapter in terms of their usefulness for describing the spatial characteristics of density in the built environment.[20] A series of case study schemes – chosen to represent typical urban residential environments – are compared in terms of their spatial density characteristics.[21] The objective of this part of the study was to test the proposed 'index' of density and draws on a range of analytical methods to do this. Demographic data was used to provide an understanding of the socio-demographic context of the case study schemes. This was supplemented by technical reports such as planning statements and development briefs (available for some sites but not all) which described critical site conditions, tenure, or development constraints that affected the design. Measured site drawings were used to calculate the density ratios of the sites in order that the findings could be further considered in relation to numeric density measures. Architectural drawings, photographs and sketches were used to compare different spatial conditions, and finally, observations made on-site recorded in sketches, field notes, photographs and video recordings, were combined to provide what Geertz describes as a 'thick description' of the spatial qualities of each of the case studies.[22] The processes of design analysis and observation are inter-dependent and were carried out simultaneously, with the design analysis informing what might be looked for on-site, and the observation process informing what might be looked for in the design analysis.

The final part of the thesis (Chapter Five) is presented as a reference for designers. It draws on the analyses of the previous chapter to set out a series of key issues or factors that affect the perception of density in the built environment.

The unique contribution lies in the conceptual approach adopted for the study, the methods used to explore and test different conceptions of density, and the particular definition

20 It is important to note that the index set out in the second half of the thesis reflects the methods and skills used by architectural designers. If I was a geographer, the methods used and areas of interest would have been different. The thesis therefore contributes to a broad, existing body of knowledge in the field by nature of the designerly methods used.

21 Tactics for generating meaning from qualitative data, presented by Miles and Huberman, cited in Linda Groat and David Wang, *Architectural Research Methods* (New York: John Wiley & Sons, 2002), p. 192.

22 Clifford Geertz, cited in Groat and Wang, p. 186.

of the subject through these designerly methods of inquiry. The thesis expands on Cartesian notions of density as an abstract, numeric measurement and sets out to identify and define a spatial conception of density that draws on socio-spatial and architectural readings of the built environment. In this way it expands on the existing research on the subject of density and contributes to a broader critique on the dominance of numeric, quasi-scientific conceptions of density in built environment research.

Chapter I

Exploring historical perspectives on density as a concept for architecture and design

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Exploring historical perspectives on density as a concept for architecture and design

Introduction

The basic dilemma of density – the balance between the accumulation of population (and the resulting wealth and power) and the determination of an optimal size and expanse for the city has been at the centre of deliberations on the form and organisation of the city throughout Western history. In their earliest contemplation of the social and physical organisation of the city, Plato and Aristotle both considered the balance between population size and city expanse to be critical to matters of defence, political organisation and social hierarchy.

Plato: "the state should be allowed to grow only so far as it can increase without loss of unity".[1]

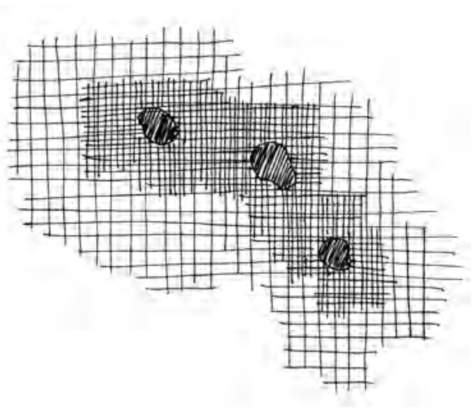
Aristotle: It [the city] should be small enough that every citizen could hear the speaker at the agora, large enough to provide as many hoplites as any neighbouring city with whom it might come into conflict.[2]

There was a belief that if the city expanded too much, it would no longer have the cohesion required for communication and social unity, yet if it became over populated, then it would also cease to function. Figures 1a,b and c illustrate three different approaches towards controlling the relationship between population growth and the expanse of the city. Figure 1a represents the unrestricted expansion of the city, expanding outwards from an historic core (or cores). London has developed in this way, expanding outwards from a number of small centres to form an expansive urban agglomeration. The density, and cohesion of the urban fabric and, by Plato's theory, the social cohesion of the city decreases as the city expands outwards in this way. Figure 1b represents the 'annexed'

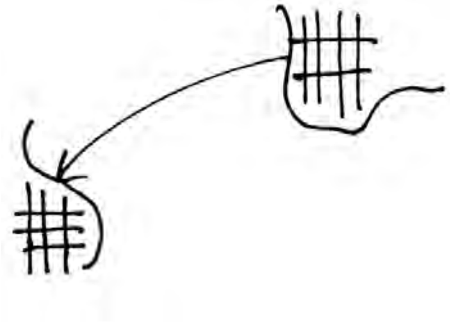
1 Plato, 'Republic', as cited in L. Hilberseimer, *Nature of Cities* (Academy Editions, 1955), 40.

2 Aristotle, 'Politics', cited in *Ibid*., 40.

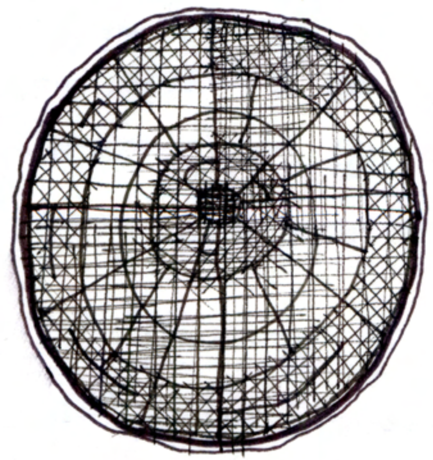
3 For detailed analysis of the simultaneous development of social and spatial organisation in Ancient Greece, see Nicholas Cahill, *Household and City Organization at Olynthus* (London: Yale University Press, 2002).



1a. Unrestricted growth from pre-existing centres



1b. Contained growth results in densification of the built fabric within the city walls



1c. Expansion of the city by colonisation: Greek model

The arrangement of the city on grid was also geometric representation of the intended equality of citizens before the law. To divide space is to establish law... all legal actions to the soil originally divided among the appropriating people and all institutions of a walled colony are determined by this "primary criterion". Schmidt, cited in Luigi Mazza, "Plan and Constitution - Aristotle's Hippodamus: Towards an 'Ostensive' Definition of Spatial Planning," *Town Planning Review* 80, no. 2 (2009): 124.

Figure 1: Containment, colonisation and expansion: three different urban strategies and their implications for the density of the built fabric

growth of the cities of the ancient Greek empire. Population growth was limited and when the city exceeded its useful limit, either in expanse, or population, new colonies were founded and citizens from the old colonies moved in and settled in the new.[3] Later, in the medieval city, the defensive wall acted as a limit to the physical expanse of the city and population growth was accommodated by building taller and packing buildings more tightly together to create an intricate fabric of narrow streets (Figure 1c). As Kevin Lynch describes:

> *The act of setting or changing densities directly influences the character and functioning of a city. In most medieval cities, fundamental changes came as the population gradually increased within static city walls. Gardens disappeared, houses were packed together and upper floors were added, leaning out over the streets. [...] Conversely the depopulation of the cities at the beginning of the Dark Ages left them disorganised and decaying.*[4]

The plan of the city of Olynthus (Figure 2) demonstrates how the strategy for controlling the optimal size and population of the city also determined the form and layout of the dwellings which defined the city's streets. The plan for the city followed Plato's proposition that the houses of the city be arranged in such a way as the whole city may all the houses form a wall - "so that the whole city [would] have the form of a single house".[5] The dense fabric of narrow streets was to aid the defence of the city against would-be assailants, but the orthogonal grid strictly defined the extent of each individual plot so that every citizen had equal space and access to land.[6] The plan manifested the idea of the urban society as a collective in which each household and each dwelling contributed to the organisation and defence of the city as a whole. In the medieval city the conditions of each individual household were not protected in the same way. The containment imposed by the perimeter wall forced expansion upwards, and the development of building types that optimised the amount of accommodation on the designated building plot.[7] The lack of space for expansion meant that population growth was largely accommodated by carving out additional dwellings within the existing building stock, or sharing accommodation between increasing numbers of people. From these typical case studies it can be seen that density, and the control thereof, is fundamental to the layout, organisation, massing, form and inhabitation of the city. It affects the dimensions of spaces between the buildings, the height and layout of the buildings themselves, the demand for resources and the expanse from which the city draws those resources, and it affects the lifestyle and living conditions of the city's inhabitants.

There is a distinction, however, between the control of population size, or urban expanse, and the control of density per se. Lynch (cited above) refers to the act of 'setting densities' to describe the effect of the containing city wall. However, 'setting densities' in terms of optimal density ratios for urban development has different implications. Historical narratives have suggested that the concept of density as a strategic instrument of design and planning

4 Kevin Lynch, 'The Form of Cities,' in *City Sense and City Design: Writings and Projects of Kevin Lynch*, ed. Tridib Banjeree and Michael Southworth, 1954, 37.

5 Cahill, *Household and City Organization at Olynthus*, 11.

6 James Connolly and Justin Steil, 'Introduction: Finding Justice in the City', in *Searching for the Just City: Debates in Urban Theory and Practice* (Abingdon: Routledge, 2009), 2.

7 Indeed Sutcliffe argues in his history of multi-storey housing, that the early breach of the city walls in England was "crucial to the non-emergence of a flat tradition in pre-industrial England". *Multi-Storey Living: The British Working-Class Experience* (London: Croom Helm, 1974), 5–6.

8 Miles Glendinning and Stefan Muthesius, *Tower Block: Modern Public Housing in England, Scotland, Wales and Northern Ireland*, 1994, 37; Meta Berghauser Pont and Per Haupt, *Spacematrix: Space, Density and Urban Form* (Rotterdam: NAI Publishers, 2010).

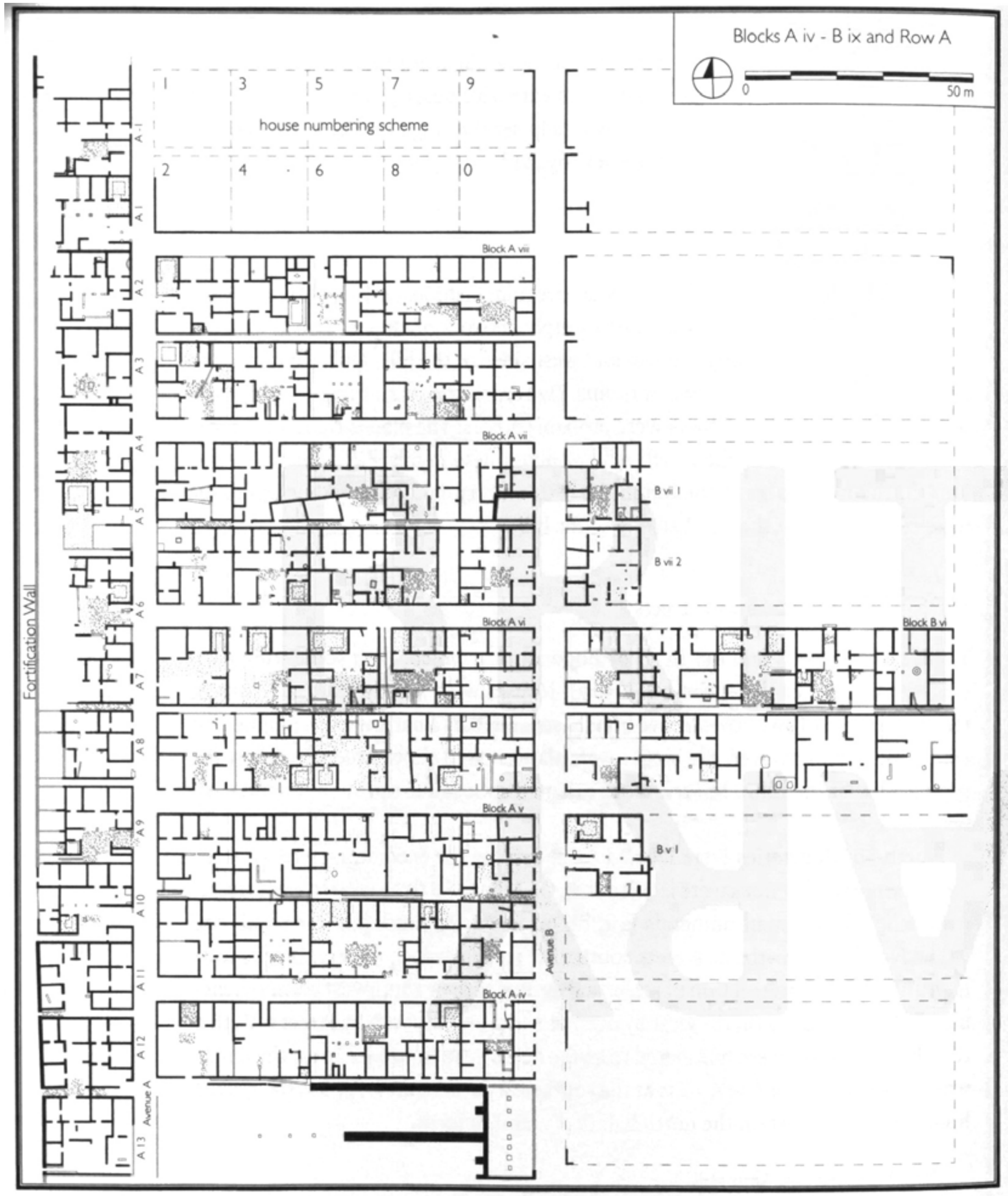


Figure 2: In the plan for the city of Olynthus, the city wall is formed of the back wall of the outermost houses. The transition from round, tribal huts to orthogonal forms that could be abutted together to form a collective mass was therefore crucial to the fortification of the city. Source: Cahill, 2002.

coincides with the emergence of town planning as a "scientific discipline".[8] Berghauser Pont and Haupt's recent *Spacematrix* study traces the concept back to the beginning of the twentieth century with the Garden City Movement in England and the early Modernists in Germany. In both of these epochs, the determination of the form and layout of the city was a reaction to the conditions of too many people, dwellings and workplaces, combined with too little air, light and open space that led to social deprivation, ill health and crime in the industrial cities of late nineteenth century Europe.[9] They suggest that the notion of density as a 'prescriptive' device of design and planning is a concept of the Modernist period and Modernist methods in design and planning practice. They write:

> *The concept of density proved useful for describing the conditions under which this occurred and prescribing alternative housing environments.*[10]

The use of density ratios as an instrument of design and planning has been explored in a number of different studies (some of which were noted in the Introduction). At the time of beginning the research into the history of urban density, only two sources presented what might be described as a history on the subject. Dempsey and Jenks' study describes the history of density framed within planning policy and statutory building standards. The other, included in Collins and Clarke's report on the application of density within urban planning, covers the units and scales at which density ratios have been recorded historically and how these measurements have been interpreted in practice.[11] Both focus on how density ratios and their units and scales of measure have changed over the past 150 years. Neither of these two studies considers the implications of 'setting densities' as Lynch describes it for the qualities of the urban or residential environment.

However, the conception of density as a measured ratio and as an instrumental device represents only one conception of density, and a fairly recent one, too. The history of density as a defining characteristic of the urban environment can be thought of as extending back as far as the earliest agglomeration of tribal dwellings into clusters for purposes of defence.[12] Yet, the qualities associated with density, the consequences of containment, compaction and proximity for the experience of living in the city have been largely overlooked in previous studies on the history of density.[13]

This chapter sets out to identify the implications of different conditions of density - both planned and incidental. A series of six historical episodes are used (Figure 3) as a means of exploring the various ways that density has been conceived of in urban planning discourse. Through the discussion a series of themes are drawn out that expand the potential implications of density beyond common associations with built form or housing type, to suggest the qualitative and experiential qualities associated with the density of the urban environment. Episode One considers the conditions of density in nineteenth century industrial London and outlines the basis for the popular conflation of density with conditions of crowding. The second episode

9 Meta Berghauser Pont and Per Haupt, "City or Sprawl? The Need for a Science of Density," *'Scape* no. 1 (April 2007): 60.

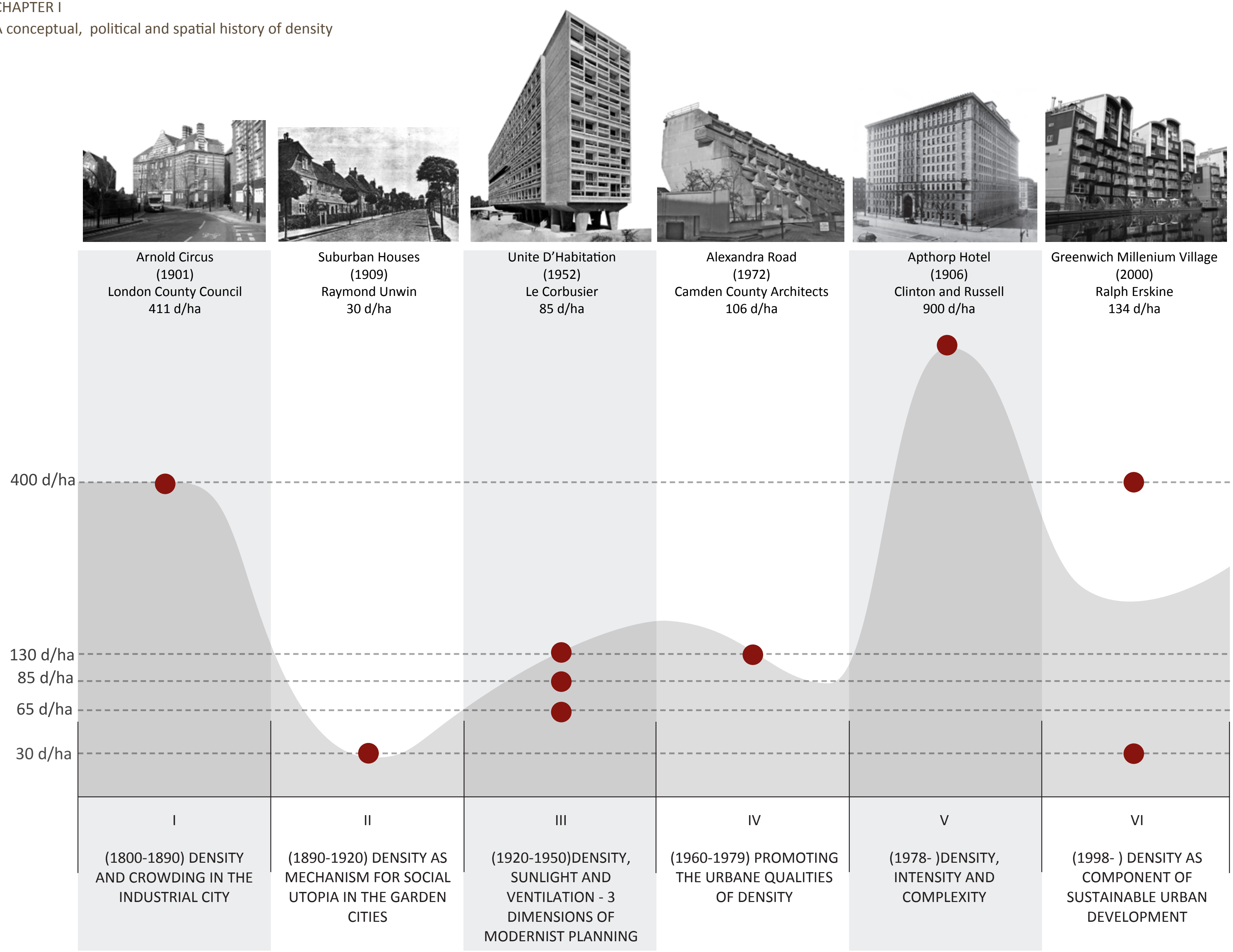
10 *Ibid*.

11 Nicola Dempsey and Mike Jenks, "The Language and Meaning of Density," in *Future Forms and Design for Sustainable Cities* (Amsterdam: Architectural Press, 2005), 287–309; Michael Collins and Patrick Clarke, 'Planning Research Programme': *The Use of Density in Urban Planning* (Department of the Environment, Transport and the Region, 1998).

12 This argument is suggested in L. Hilberseimer, *Nature of Cities* (Academy Editions, 1955).

13 Since 2010, Berghauser Pont and Haupt's *Spacematrix* study has been published and it sets out a very thorough history of how density and attitudes towards density have informed the urban development of Amsterdam. However, it does not delve into the impacts of density for the experience of dwelling in the city. In addressing these issues, the chapter makes a unique contribution to the existing research in this subject area.

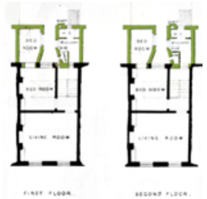
12 Tridib Banjeree and Michael Southworth, eds., *City Sense and City Design: Writings and Projects of Kevin Lynch*, n.d., 37.


Arnold Circus
(1901)
London County Council
411 d/ha
Suburban Houses
(1909)
Raymond Unwin
30 d/ha
Unite D'Habitation
(1952)
Le Corbusier
85 d/ha
Alexandra Road
(1972)
Camden County Architects
106 d/ha
Apthorp Hotel
(1906)
Clinton and Russell
900 d/ha
Greenwich Millenium Village
(2000)
Ralph Erskine
134 d/ha
400 d/ha
130 d/ha
85 d/ha
65 d/ha
30 d/ha
I
(1800-1890) DENSITY AND CROWDING IN THE INDUSTRIAL CITY
II
(1890-1920) DENSITY AS MECHANISM FOR SOCIAL UTOPIA IN THE GARDEN CITIES
III
(1920-1950)DENSITY, SUNLIGHT AND VENTILATION - 3 DIMENSIONS OF MODERNIST PLANNING
IV
(1960-1979) PROMOTING THE URBANE QUALITIES OF DENSITY
V
(1978-)DENSITY, INTENSITY AND COMPLEXITY
VI
(1998-) DENSITY AS COMPONENT OF SUSTAINABLE URBAN DEVELOPMENT

explores the first attempt to control density through defined development ratios in the Garden Cities. The third and fourth episodes explore the Modernist conception of density as an instrument of architectural form-making. The latter also introduces potential social implications associated with density and suggests ways in which they might be harnessed through design. Episode Five introduces theoretical ideas that posit density as a defining component of the physical, social and economic culture of the city. Following this, the final episode considers the compact city agenda and the qualities attributed with urban density and their significance for the 'urban renaissance' model. The aim is to expand on the predominant conception of density as a ratio measure and to begin to define the qualitative consequences and attributes of density in response to the first research question, posed above. The chapter establishes a broad range of phenomenal, social, physical and economic implications that have historically been associated with density, which provide a basis for the thematic definition that is set out in Chapter Three.

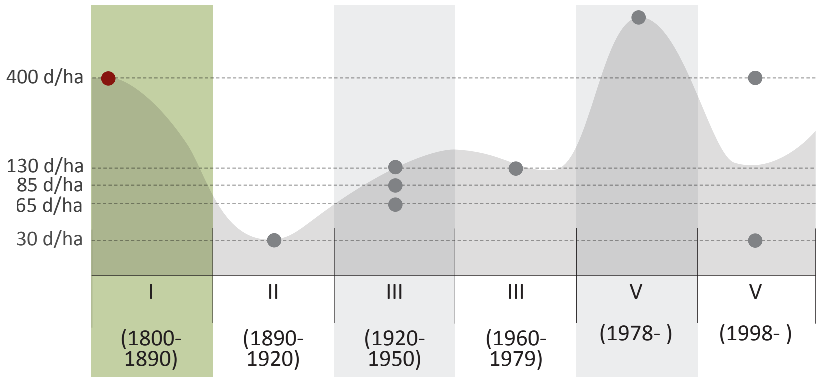
Opposite

Figure 3: Timeline showing the six episodes of density expanded in this chapter and the typical numeric densities or range of densities considered in each



Sub-divided townhouses
(1840s-1900s)
Sir Banister Fletcher
up to 250 d/ha

Arnold Circus
(1901)
London County Council
411 d/ha



Episode I: 1800-1890 - Density and Crowding in the Industrial City

The first episode investigates the relationship between population growth and crowding in nineteenth century London. Overcrowding in industrial cities was a product of concentrated population growth in areas of employment opportunity. The distance that workers were able to travel between their dwellings and the workplace was limited by lack of transport, placing pressure on available housing in certain parts of the city. The high cost of land in central locations and a building industry that tended towards more profitable ventures than housing for the working classes led to a shortage of supply of housing and exacerbated the over-occupation of the existing housing stock.

The high demand for housing and limited supply prompted all sorts of make-shift strategies to increase the number of people that could be accommodated in houses originally intended for one family. Reports of living conditions in the working class parts of the London in 1864 found that typical overcrowded 'rookeries' were often occupied at a rate of 14 persons per room.[14] Social observers reported dwellings in which every room housed a separate family (maybe more), and found dwelling conditions to be deficient not only in terms of sanitation, sunlight and ventilation, but also in terms of personal space, privacy and propriety for the dwellings' inhabitants.[15] A report on London's sanitary conditions in 1858 summarised:

> *So long as twenty, thirty, or even forty individuals are permitted to reside in houses originally built for the accommodation of a single family, or at the most two families, so long will the evils pointed out in regard of health, of ignorance, of indecency, immorality, intemperance, prostitution, and crime continue to exist unchecked.*[16]

As well as sub-letting separate rooms within the house, landlords were also incentivised (by high rental returns) to maximise the lettable space within their properties and in some case build physical extensions. The use of basements and attic spaces as dwellings (see Figure 4) was common, as noted in this report from the General Board of Health, 1850, which noted "[in Marylebone] the pressure of overcrowding had driven thousands of 'troglodytes' and 'human moles' to live in underground cellar rooms".[17]

The historian Anthony Wohl describes the urban condition of nineteenth century London as a stark indicator of the relative market value of land and workers. The reality of the overcrowded city, he argues, challenged the most basic Victorian assumptions of the benefits that would be bestowed upon all classes by a free market economy.[18]

14 George Godwin, Another Blow for Life (London: Wm. H. Allen, 1864), 33–35.

15 Ibid., 33.

16 The Strand (2nd Annual Report on Sanitary Conditions of the Strand, 1858) cited in Anthony S. Wohl, The Eternal Slum: Housing and Social Policy in Victorian London, 2002nd ed. (London: Edward Arnold Publishers, 1977), 24.

17 The Report of the General Board of Health of 1850 1850 pp xxi cited in ibid., 3.

18 Ibid., Xi and 3–4. Charles Booth's 'Descriptive Maps of London's Poverty' of 1889, identified the geographical coincidence between social status and the density of occupancy of the houses as one of the primary factors differentiating the better categories of housing from the worst. See See Robin Evans, "Rookeries and Model Dwellings: English Housing Reform and the Moralities of Private Space," in Translations from Drawing to Building and Other Essays (London: Janet Evans and Architectural Association Publications, 1978), 99.

Figure 4: Field Lane Lodging House, London, 1847. Artist: WG Mason

Each of the rooms depicts a specific evil; the flooded cellar represents a source of infectious disease, the common kitchen is the scene of daylight dissipation, drunkenness and criminal conspiracy and the dormitory, the nest of sexual promiscuity. Robin Evans, “Rookeries and Model Dwellings: English Housing Reform and the Moralities of Private Space,” in *Translations from Drawing to Building and Other Essays* (London: Janet Evans and Architectural Association Publications, 1978), 96.

Tenants were condemned to suffer crowded and deficient accommodation, whilst landlords were incentivised by demand and potential profit to maximise their rental income by raising rates and increasing the number of tenants.

Medical evidence and the introduction of statutory limits

The initiative to improve dwelling conditions in overcrowded, sub-let houses eventually came, first from the medical profession and then from the architectural one. The physiological dangers and problems associated with the overcrowding of workers' housing prompted moral concern amongst the middle classes who called for the eradication of these conditions from the city.

Attention was first brought to the subject when, in 1840, the medical practitioner William Duncan raised a successful propaganda campaign based on a revealed geographic correlation between rates of mortality and the high frequency of underground dwellings and houses shared by multiple households.[19] In 1847 Hector Gavin, forensic medicine lecturer at Charing Cross hospital compounded the mounting pressure, stating that if all the windows and doors of a typical labourer's tenement were shut tight, the maximum length of time a man could live before all the available oxygen would be consumed would be seven hours.[20] His research attributed over-occupation and shortage of breathing space with potentially fatal consequences.

The medical evidence prompted the introduction of a series of bye-laws which sought to mitigate the physiological consequences of too many people living in too little space. The Small Tenements Bill (of 1840) outlawed cellar dwellings, restricted the minimum width of courts and court entrances, and set minimum street widths. It also decreed that there should be a separate yard and privy for each house to limit the number of people sharing.[21]
In 1866, following Gavin's findings, minimum volumetric measurements were also introduced, establishing 400 cubic feet (11 cubic metres) as the minimum 'breathing room' for each adult in a room occupied both day and night, and half these measures for children under ten. Under this definition, overcrowding was deemed to exist if a family of two adults and one child occupied a room, for both sleeping and eating, of less than three metres squared and two and half metres tall.[22] These minimum volumetric requirements were established for the purposes of safety (although not yet comfort) and arguably represented the first attempt to control the relationship between the number of people and the amount of space that they occupied – i.e. density ratios. However, the space standards it set were too small to have a significant impact on the design and layout of new housing. The bye-laws that followed in 1877 set a minimum width of 36ft for streets more than 100ft long, and required them to be open at one end across their full width. These bye-laws had a significant impact on housing development producing wider, connected streets rather than courts and airier, brighter houses, each with a patch of land at the rear to accommodate an individual privy.[23]

19 Duncan measured concentrations of inhabited cellars, court dwellings, the density of dwellings, availability of adequate water supply and social habits of people. The amount of court housing, cellar dwellings and houses in multiple-occupation were revealed as major enemies of health, all of which represent high-density dwelling conditions. Note that this predates Charles Booth's mapping by half a century. Iain C. Taylor, "The Insanitary Housing Questions and Tenement Dwellings in Nineteenth-century Liverpool," in *Multi-Storey Living: The British Working-Class Experience*, by Anthony Sutcliffe, 1974, 42.

20 Cited in Wohl, *The Eternal Slum*, 3.

21 Taylor, "The Insanitary Housing Questions and Tenement Dwellings in Nineteenth-century Liverpool," 46.

22 Criteria for ventilation, daylight and comfort were introduced at a later date.

23 John Burnett, *A Social History of Housing, 1815-1985*, Revised (London: Routledge, 1993), 161.

Figure 5: Banister-Fletcher's proposals for the adaptation of a London townhouse for letting as flats

Plan A: "...the conversion of existing houses to the purpose of 'model dwellings,' is a scheme which may in many cases present advantages superior to that of the erection of an entirely new building specifically for the purpose, as where the owners of house property may desire to benefit the poorer classes without incurring any very considerable outlay, and at the same time obtain a good rate of interest on the capital invested." Source: Banister-Fletcher, *Model Houses for the Industrial Classes* (London: Longmans, Green, & Co., 1871), 22.

Figure 6: Banister-Fletcher's proposals for extension of a London townhouse for letting as flats

"It is well known to what a terrible extent the dwellings of our poorer classes are, in many cases, over-crowded. Not only among the very poor, the almost destitute,... amongst those of a rather better class, where, ... a single living-room and bedroom are made to serve for a much larger number of individuals than it is desirable they should accommodate. It is therefore to show how the extra accommodation required for such cases may be obtained in the simplest manner". Source: Ibid., 28.

New housing layouts: organised crowding

The architectural profession's response towards the conditions of overcrowding followed shortly behind the medical profession. Architects had, until then, been relatively unconcerned with the design of housing for the working classes. There was also general understanding that the dwelling was the private domain and not therefore a matter for public concern. The containment of the issue of overcrowding to the domestic interior had also concealed the matter from view and impeded the introduction of housing reform.[24] However, from the 1850s onwards, overcrowding had begun to be recognised as compromising the improvements made to public health and sanitations. Society was concerned, not only over the physiological dangers of overcrowding, but also the moral deficiencies of different families of and adults and children sharing rooms. In his essay on the history of the housing conditions of nineteenth century London, Robin Evans, writes:

> *Investigators could reveal grotesque instances of overcrowding but were as much concerned with the moral implications of flesh pressed against flesh as with the more obvious discomforts of piling too many bodies into a confined space.*[25]

Citing an illustration from Hector Gavin's 1848 study of Bethnal Green (Figure 4) Evans suggests that although no such dwelling was actually recorded in the study, the illustration itself better indicates the actual motivation for carrying out the report than the text of the report itself. The scene depicts the deficiencies of the sub-divided and sub-let dwelling houses (referred to as Common Lodgings) in terms of space, daylight, ventilation, access to sanitation, disease, and the social and moral inadequacy of the living and sleeping quarters shared by so many bodies.[26]

In 1871, Banister-Fletcher (Senior) published a report demonstrating how a typical London townhouse could be altered or extended to be let out in flats as well as plans for apartment buildings with communal stairs.[27] He intended to improve the conditions of the sub-let 'common lodgings' (as they were referred to) in regard to the major deficiencies that were resulting from their overcrowding. Banister-Fletcher's own commentary (see Figures 5 and 6) accepts sub-division of the existing houses as inevitable, arising out of extreme demand and the limited supply of housing available. However, he proposes that with the number of tenants retained, the plans ensure that there are walls for privacy between households, and shared utilities for sanitation.

Model Dwellings: density and order

Banister-Fletcher's plans for Model Dwellings, set out in the same text, shared the basic elements of his plans for the conversion of existing houses (Figures 5 and 6). His plans for the Model Dwellings (Figures 7 and 8) sought to provide small, yet separate, self-contained dwelling units for each household. The objective was to ensure adequate space per person and per household by stacking the dwellings up

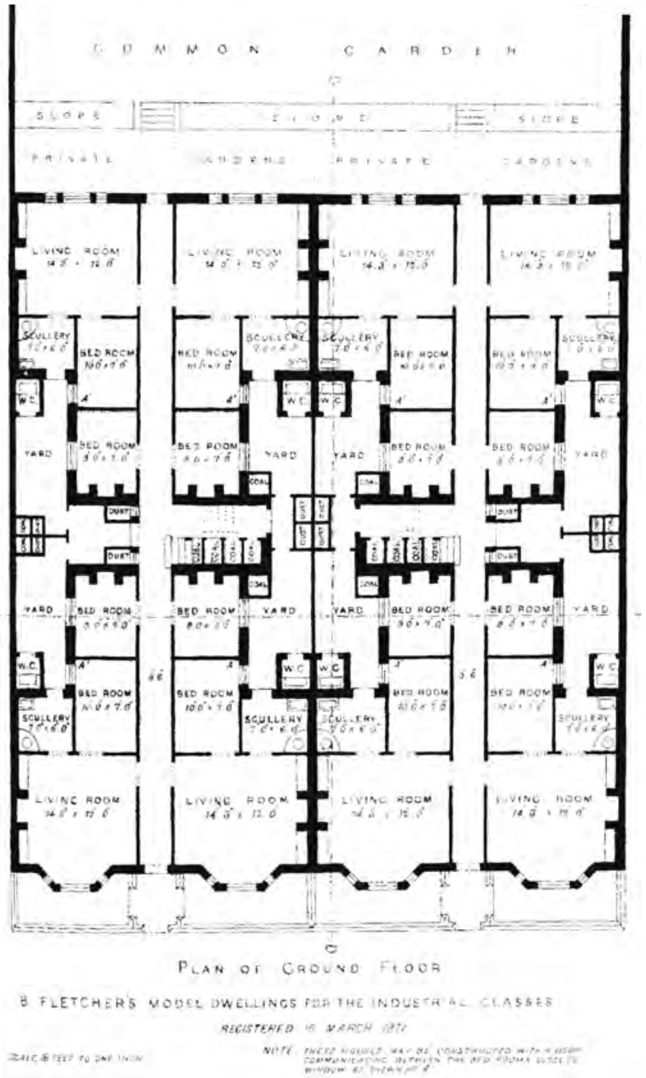
24 Wohl, *The Eternal Slum.*

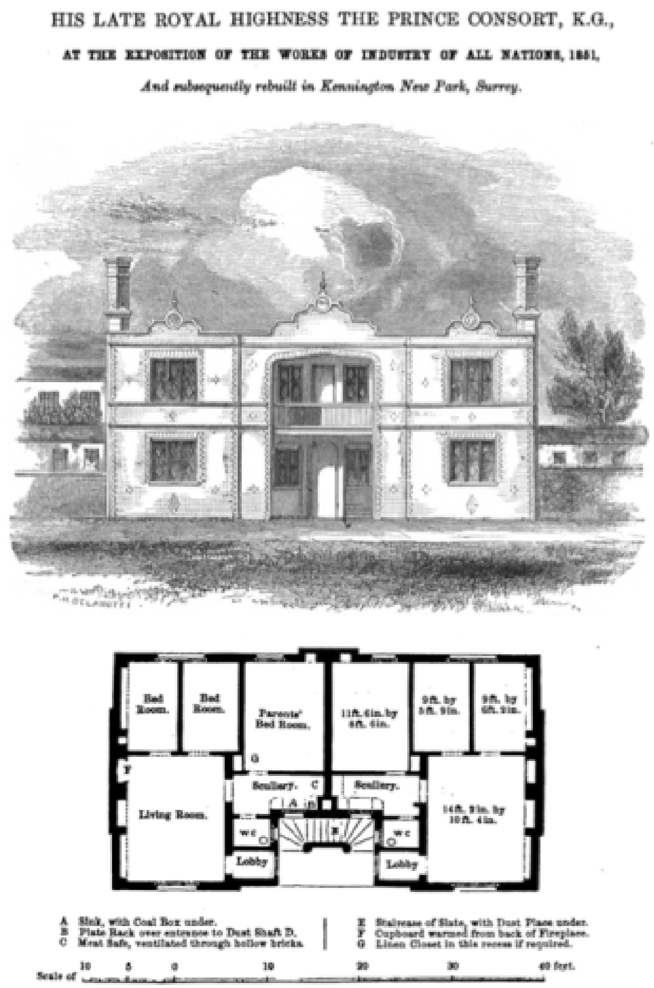
25 Evans, "Rookeries and Model Dwellings: English Housing Reform and the Moralities of Private Space," 104.

26 *Ibid*., 96.

27 Banister-Fletcher, Model Houses for the Industrial Classes (London: Longmans, Green, & Co., 1871).

28 The architectural styles and social and economic motives of the philanthropic Model Dwellings associations have been documented in various historical narratives. For a good overview see; .Burnett, A Social History of Housing, 1815-1985; Wohl, The Eternal Slum; Wightman & Co., "Philanthropy and Five Per Cent: Homes of the London Working Classes." (The National Dwellings Society Limited, 1887); J.N. Tarn, "French Flats for the English in Nineteenth-century London," in Multi-Storey Living: The British Working-Class Experience, ed. Anthony Sutcliffe (London: Croom Helm, 1974); Sutcliffe, Multi-Storey Living: The British Working-Class Experience.





Left

Figure 7: Banister-Fletcher's plans for Model Houses arranged as tenements. Source: Banister-Fletcher, *Model Houses for the Industrial Classes*.

Right

Figure 8: Model Houses for Four Families, designed by Henry Roberts, honorary architect to the Society for Improving the Condition of the Labouring Classes.

Henry Roberts' designs for model dwellings were considered an exemplar of philanthropic housing for the working classes. The dwellings are arranged two per floor, accessed from a communal stair. The plan ensures daylight and ventilation to each dwelling and provides communal utilities and external space for hanging laundry. Source: S. Martin Gaskell, *Model Housing: From the Great Exhibition to the Festival of Britain*, Studies in History, Planning and the Environment 10 (Mansell Publishing, 1986).

vertically, to create space between the buildings for sunlight and ventilation.[28] The plans for the Model Dwellings were deliberately intended to eradicate what were considered to be indecent conditions of proximity between members of different households. As with the converted town houses, the designs were centred around the provision of communal circulation and communal amenities shared between households.[29] The historian John Burnett writes:

> *The congregation of many self-contained dwelling units in a single building was an innovation in English house design, though well known of course, in Scotland and on the Continent. It was one possible solution to the problem of housing large numbers of people who needed to live near to their work in central urban areas where land values were high and the traditional method of lateral expansion was impossible.*[30]

The redevelopment of the Jago Rookery in East London developed by London County Council (LCC) was the first example of publicly-funded housing development in London and was developed according to the principles promoted by the Model Dwellings Movement. The redeveloped replaced the intricate, narrow courts of two and three storey houses that previously occupied the site with buildings six storeys high (see Figure 9). The increase in capacity generated by the development of flats as opposed to houses allowed the architects to define a communal park at the centre of the site and to provide separate buildings for industrial use, away from the residential buildings.

Maintaining the capacity of the site was essential. In the philanthropic model dwellings, rental returns for investors were calculated on a per room basis.[31] As such, the density of habitable rooms became the expedient measure for determining the financial viability of the project. However, irrespective of the fact that the density ratio was the same before and after, the qualities of the urban environment and the dwellings that were created were significantly different. The former rookery had epitomised the perceived deficiencies of tightly-packed intricate streets and courts, over-crowded houses with too many people sharing too little space between them. The redeveloped site represented a designed manipulation of the density ratio. The dwellings themselves were deliberately combined together to increase the ratio of dwelling units to site footprint, but organised such that each benefitted from communal utilities (privies, sculleries and courtyards), and a communal park at the centre of the site.

Whilst the new tenement-style flats were a great improvement on the ad hoc subdivided townhouses in terms of their functionality, their perceived institutional aesthetic was unpopular. The architectural historian Nicholas Pevsner described the era of the philanthropic Model Dwellings as “truly humanitarian in its pretensions, yet depressing in its results”.[32] Banister-Fletcher had also described the appearance of some of the early Model Dwellings as “something between a barrack and a workhouse” suggesting that these collective, multi-dwelling buildings were stigmatised from the beginning.[33] Severs,

29 The organisation of the dwellings around a communal stair was critical to this. It served as means of access, but also provided a neutral gap of uninhabitable space between the separate households. Making the stair external also entitled the dwellings to exemption from the House Tax thereby reducing the costs for the buildings inhabitants S. Martin Gaskell, Model Housing: From the Great Exhibition to the Festival of Britain, Studies in History, Planning and the Environment 10 (Mansell Publishing, 1986), 21.

30 Burnett, *A Social History of Housing, 1815-1985*, 178.

31 The report of the National Dwellings Society demonstrates how the philanthropic redevelopment of the rookeries was promoted as a financial investment. Dwellings would contain between one and three rooms, let at 2/6 for a single room up to 7s for the best, 3 room dwellings. Wightman & Co., “Philanthropy and Five Per Cent: Homes of the London Working Classes.,” 2.

32 Referring specifically to the Peabody Buildings (1862-1900) Cited in Burnett, *A Social History of Housing, 1815-1985,* 179.

33 Banister-Fletcher, *Model Houses for the Industrial Classes,* 8.

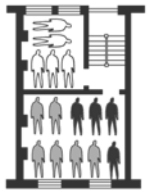
Jago Rookery (pre 1900)

639 dwellings

251 d/ha

1509 hr/ha

Site Plan



Typical Dwelling Floor Plan

Figure 9: Redevelopment of the Jago rookery: Site Plans and building floor plans.

In the new buildings, communal stairwells provided the means of access, with communal privies and washrooms shared between dwellings on each landing. The individual dwellings were reduced to the functional minimum, with sanitary and utility amenity provided communally.

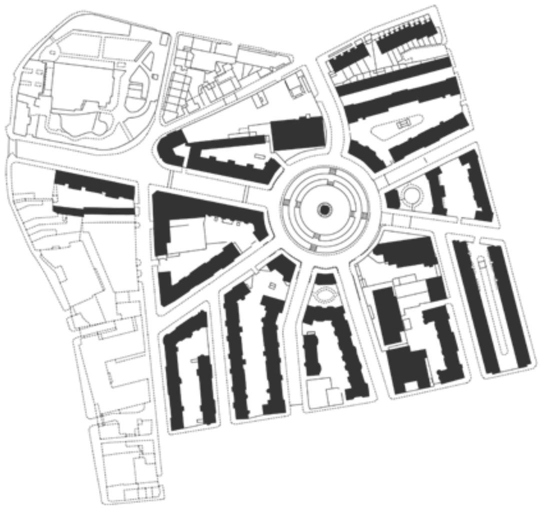
Boundary Street (1900, commonly referred to as Arnold Circus)

Owen Fleming, London County Council

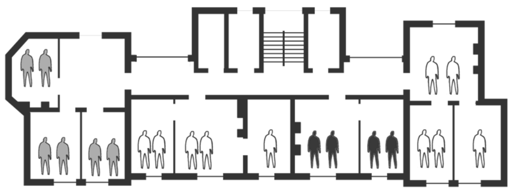
1044 dwellings

411 d/ha

1233 hr/ha



Site Plan



Typical Floor Plan of one wing, showing four separate dwelling units

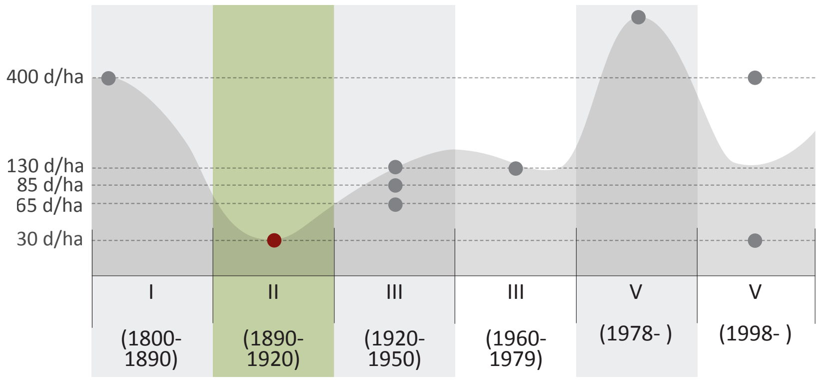
Photograph of the LCC buildings at Boundary Street in his essay on collective housing further suggests that for the particular classes for whom the dwellings were intended, the monumentality of the architecture had echoes of the "coercion of the workhouse" and loss of individual freedom.[34] These criticisms suggest that the collective dwelling forms on which these transformations were founded are associated not with perceptions of community and living collectively, but with a loss of individual identity.[35] In the episodes on Modernist attitudes towards density considered later on this chapter, the use of communal dwelling forms as a strategy for achieving density ratios is made more explicit still, and communality becomes even more intrinsic to the organisational and aesthetic qualities of density.

Tracing the emergence of the Model Dwellings and collective multi-household dwelling types in industrial, nineteenth-century London has highlighted a number of important conceptions of density. First, the over-crowded interior. The lack of privacy and personal space was a separate issue from the congestion of the built fabric itself. However, both were addressed through the design of the Model Dwellings and early public housing such as the Boundary Street estate. Architects sought to eradicate the deficiencies of the congested urban fabric with larger buildings set further apart. This had consequences for the built fabric, the width of the streets and scale of the buildings and open spaces in-between. It also affected the social organisation of households in relation to one another. In both the public and the privately-funded housing redevelopments, however, retaining the site ratio remained critical. It is interesting to note that the qualities (and deficiencies) of the built fabric and of the dwellings themselves were described in numerous different ways; congested, unhygienic, insanitary and unventilated, but were never described in terms of their density. The attribution of qualitative characteristics to the term density would come later on, and would complicate the distinction that existed at this point between the experience of density and its measurement as a ratio.

34 Dominic Severs, "Rookeries and No-go Estates: St. Giles and Broadwater Farm, or Middle Class Fear of 'Non-street' Housing," *The Journal of Architecture* 15, no. 4 (August 2010): 19.

35 In an attempt to counter these negative perceptions, Banister-Fletcher's plans for model dwelling houses (Figure 7) were designed to have the appearance of a row of townhouses (see the regular pattern of bay windows in the façade). *Model Houses for the Industrial Classes*, 8.

Garden Suburbs
(1900-1920)
Raymond Unwin and Barry Parker
30 d/ha



Episode II: 1890-1920

Garden Cities and the introduction of density ratios

In the latter part of the nineteenth century, concerns over the implications of overcrowding and the compactness of the built fabric in the industrial cities had begun to prompt changes in the layout, form and organisation of new housing being built. The transformations outlined in the previous episode can be seen as consequences of the density of people and the built fabric of the city. Density ratios were considered only as a means of calculating economic return or site capacity. This episode explores an early example (perhaps the first) of density ratios being attributed formal and social consequences and the beginning of their use as a mechanism for the design of new residential areas.

In Ebenezer Howard's *Garden Cities of To-morrow* (1898), quotas for the "proper arrangement of the individual buildings and the limitation of the amount of building in relation to an area of open space", were set out.[36] These were not only a basis for economic calculation, as in the past, but formed part of a model for setting out a new township (or Garden City). In his strict calculation of optimal population size and city expanse, Howard effectively prescribed a density ratio for his proposed Garden City that would bring about optimal conditions for the town's inhabitants.[37]

The Garden City model

Based on the famous Three Magnets diagram (Figure 10) the Garden City would provide an optimal balance between the advantages and disadvantages of the city and country. It was to be achieved by controlling the balance between population and the physical extent of the city and in this way harnessing what he considered to be the best of aspects of both city and countryside.

The ideal Garden City (as described by the academic and planner Peter Hall) was to be "small (a little larger than the City of London), dense (Islington, not Camberley) and compact."[38] It would be a town-sized city of 32,000 people and contained within a maximum of 1000 acres (405 hectares). Each town would be surrounded by a large green belt of at least 5000 acres (2023 ha) (see Figures 11 and 12).[39] In Howard's Garden City ideal, the ratio between population and the size of the city was attributed economic, social, and environmental consequences. The population

36 Control of the overall density of the town, the number of houses and people relative to the size of the town was crucial to the economic feasibility of his model.

37 Raymond Unwin, *Nothing Gained by Overcrowding!: How the Garden City Type of Development May Benefit Both Owner and Occupier,* [3d ed.] (Garden Cities and Town Planning Association, 1918), 3.

38 Peter Hall and Colin Ward, *Sociable Cities: The Legacy of Ebenezer Howard* (Chichester: John Wiley & Sons, 1999), 7. Fishman (1977). It is suggested that the 32,000 figure might have been borrowed from Dr Richardson's 1876 plan for Hygeia: a city of health, referred to in M. Jenks, Elizabeth Burton, and Kate Williams, *Compact City: A Sustainable Urban Form?* (London: Routledge, 1996), 16.

39 *Ibid.*

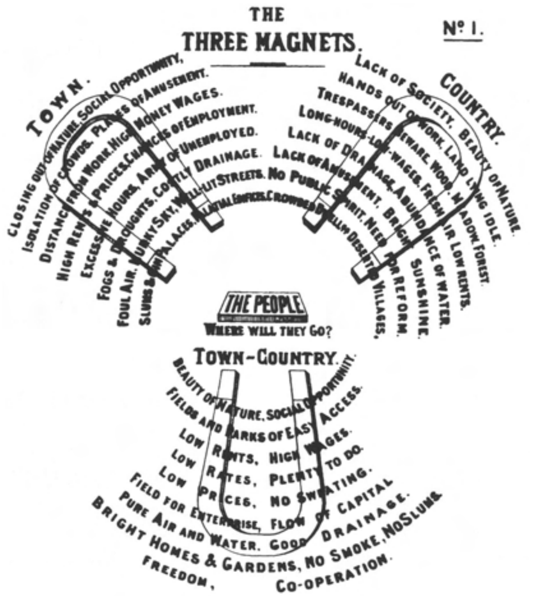


Figure 10: Ebenezer Howard: The Three Magnets.

Source: Peter Hall and Colin Ward, *Sociable Cities: The Legacy of Ebenezer Howard* (Chichester: John Wiley & Sons, 1999).

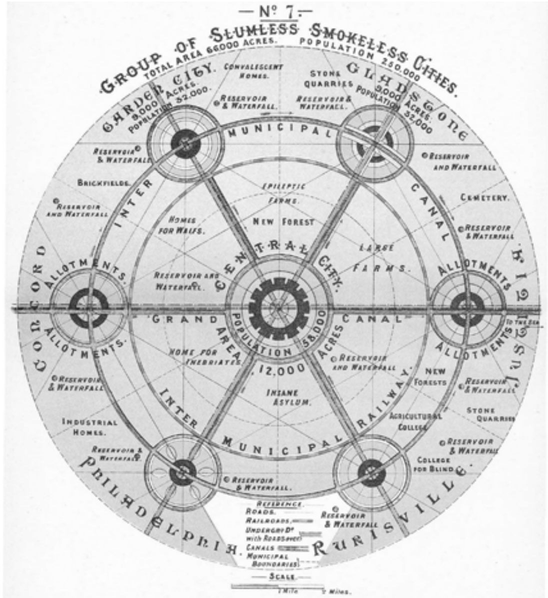


Figure 11: *Ebenezer Howard: Social City Structure.*

The ‘Social City’ diagram represents the regional plan, with six peripheral towns arranged around a central one, but each connected up to the neighbouring towns and regions.

Source: Peter Hall and Colin Ward, *Sociable Cities: The Legacy of Ebenezer Howard* (Chichester: John Wiley & Sons, 1999), 158.

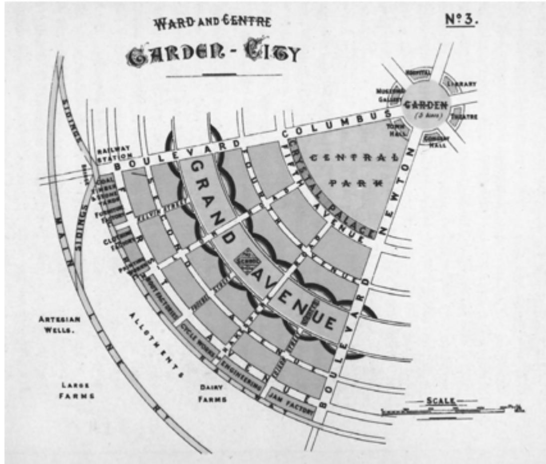


Figure 12: Ebenezer Howard: Segment of a Garden City

The concentric arrangement would ensure that the housing (located either side of the Grand Avenue) would always be in proximity to the amenities of the town centre, the park, the industrial zone on the perimeter and the countryside beyond. In this way, it would eradicate the concentration of demand in key locations that had caused concentrations of overcrowding in the industrial cities.

Source: Peter Hall and Colin Ward, *Sociable Cities: The Legacy of Ebenezer Howard* (Chichester: John Wiley & Sons, 1999), 34.

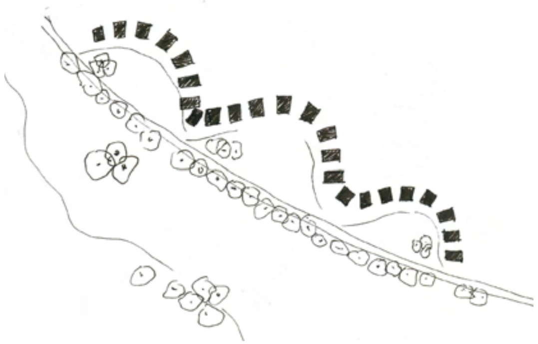


Figure 13: Sketch showing the residential layout in the Garden Cities.

Although Howard did not set densities for the residential zones within the town, Hall and Ward have calculated that, based on an average lot of 6m x 40m (240 m²) the net development density of for the residential zones would be approximately 41 dwellings per hectare. With an average five-person household this would give a population density of between 220 and 235 persons per hectare.

Source: Peter Hall and Colin Ward, *Sociable Cities: The Legacy of Ebenezer Howard* (Chichester: John Wiley & Sons, 1999), 22–23.

40 Unwin, *Nothing Gained by Overcrowding!* 11 and 13.

41 Raymond Unwin, *Town Planning in Practice* (T. Fisher Unwin, 1909), 4–5.

42 Unwin, *Nothing Gained by Overcrowding!*, 22.

of the town was to be large enough to provide the social, cultural and employment opportunities associated with the city, and small enough that all residents would be effective in the political organisation of the town. Residential and industrial zones would be separated but the concentric arrangement would ensure walkable distances between the two, and critically, expansion beyond the defined perimeter would be prohibited, thereby protecting the surrounding countryside from development.

Howard's ideal formed the basis for the early twentieth century Garden Cities. The first of these was built at Letchworth, where Raymond Unwin and Barry Parker were commissioned as architects for the new town in 1904. Unwin is credited with being one of the first to set out maximum density ratios as a means of determining the character and form of new housing. In his 1912 publication, *Nothing Gained by Overcrowding!* Unwin argued for the development of larger houses on larger lots on the basis that the higher cost of developing the house would be more than compensated for the by the higher rents that could be achieved.[40]

Howard had initially proposed that the economic gains resulting from the development of the Garden Cities be transferred to a Community Trust. Unwin, however, keen to prove the economic credentials of his lower-density proposals, demonstrated that lower densities not only required less investment from house builders for infrastructure development, but also enabled the landowners to sell off larger areas of land for housing development (a politically astute move). Aside from the financial benefits, Unwin also demonstrated that by limiting the density of development on a site, and by developing a typical site in his preferred, perimeter arrangement large areas of green space could be provided for the amenity of the surrounding dwellings (see Figure 14).

Unwin's concern to limit densities and develop housing around large areas of open space connected with major societal concerns of the day over the poor health and living environments of city dwellers. The objective, Unwin writes, is to secure more open ground, air-space and sunlight for each dwelling, make proper provision for parks and playgrounds and control the layout, orientation, width and character of the streets so they are of maximum benefit to the community.[41] On this basis he set out the following guidelines in regards to the density of development:

1. In the case of houses on ordinary sites, not more than one-sixth of the site should be covered by buildings.
2. Dwelling houses costing less than £200 should not exceed 12 to the acre, houses costing between £200 and £300 should not exceed 10 to the acre, houses costing £300 to £350 should not exceed 8 to the acre; and so forth.[42]

Consequences of a twelve to the acre standard

Through his authorship of the 'Tudor Walters' report (1918) and subsequent post as Chief Architect to the Ministry

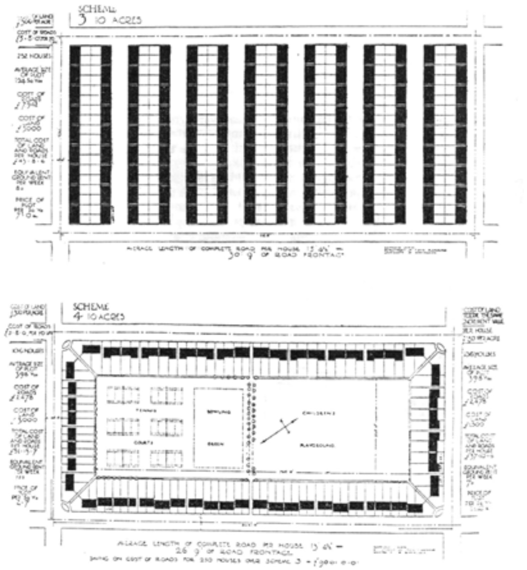


Figure 14: Comparison between a typical bye-law street layout with a density of approximately 25 dwellings per acre (62d/ha), and Unwin's proposed Garden City layout with a density of 10 dwellings per acre (25 d/ha).

"To accommodate 6,678 houses on the basis of [the bye-law scheme] he will be able to sell -

6,678 houses / 25.2 houses per acre = 265 acres of land, at £300

… If, however, having come under the influence of the Garden City Association, he should decide to limit the number of houses per acre to an average of 10.6 – that is, as in Scheme 4, the result will be as follows: He will now sell -

6,678 houses/ 10.6 houses per acre = 630 acres of land at £300."

Source: *Raymond Unwin, Nothing Gained by Overcrowding!: How the Garden City Type of Development May Benefit Both Owner and Occupier, [3d ed.] (Garden Cities and Town Planning Association, 1918), 12–13.*

Figure 15: Comparison between typical byelaw terraced housing (top) and Unwin's proposed Garden suburb layout (bottom) at approximately half the density.

The lower density of roads and services reduced the cost of the development, per square yard (or meter), and allows houses on lots three times larger to be developed for costs of around one third more per house.

Source: Raymond Unwin, Nothing Gained by Overcrowding!: How the Garden City Type of Development May Benefit Both Owner and Occupier, [3d ed.] (Garden Cities and Town Planning Association, 1918), 15.

of Health, Unwin was able to further demonstrate the societal benefits of lower housing densities. Although the Housing, Town Planning Etc. Act of 1909 had given local councils the power to exercise control over the location, height and density of new housing development, the 'Tudor Walters' report of 1918 positively encouraged lower housing densities for new development on the basis of improved public health, access to daylight and sunlight, and the provision of large gardens for domestic food growing.[43] A minimum distance of 70ft (21.3 metres) between houses was deemed necessary to allow sufficient sunlight penetration in winter, and the more varied arrangement of houses along a street which was proposed as an antidote to the monotony of long parallel rows of bye-law housing (Figure 15).

Planning historians have observed that the emphasis on numeric calculations in both Ebenezer Howard's and subsequently in Raymond Unwin's proposals, was the result of the funding mechanisms that dominated housing production at the time.[44] The facts and figures were there to convince the philanthropist business-people of the time that these utopian developments were a viable investment. In setting limits according to house size, Unwin anticipated developers' speculations about maximising ground rent by building the largest possible houses on the site. His plan for Hampstead Garden Suburb was based on even lower densities than those set out above. He proposed seven houses to the acre, or including the area that would have been allocated for industry (but was omitted from the residential suburb), the density would have been five houses to the acre (equivalent to 12 d/ha). Unwin argued that at these densities it was possible to accommodate the population of London, at the time 8 million, within a radius of 11.5 miles (compared with the then radius of 14.75 miles). Alternatively, maintaining the existing radius of the city, an additional 4 million people could be accommodated if the city were built at the proposed density of 12d/ha.[45] Not only were these densities significantly lower than the urban densities proposed in Howard's model (approximately 41 d/ha - see caption to Figure 13), but the principle of restricting the expansion of the town was diluted. In Howard's model, the concentric arrangement and higher net densities within the Garden City were critical to achieving walkable distances across town and retaining the convenience of nearby amenities. In the Garden suburbs, however, this idea was subsumed in lieu of Unwin's greater concern for the layout and appearance of the suburban idyll (Figure 15).

When financial incentives in the form of development grants were introduced for the construction of working class housing at a density of no more than 12 houses per acre (30 d/ha) for urban housing and nine per acre (23d/ha) for rural housing in 1918, the standards that Unwin had set out effectively became the density maximum for new housing, not only in the rural counties, but for the cities too.[46] Furthermore, the layout and appearance of the housing that Unwin had developed with Barry Parker were quickly

43 Michael Collins and Patrick Clarke, *Planning Research Programme: The Use of Density in Urban Planning,* (Department of the Environment, Transport and the Region, 1998), 12.

44 Professor Sir Peter Hall, *Foreword: Nothing Gained by Overcrowding! - a Centenary Celebration and Re-exploration of Raymond Unwin's Pamphlet – "How the Garden City Type of Development May Benefit Both Owner and Occupier"*, (TCPA, April 2012), 2.

45 Unwin, *Nothing Gained by Overcrowding!*, 17 and 21.

46 A circular issued by the Local Government Board in 1918. Collins and Clarke, *Planning Research Programme*, 10.

47 In a detailed history of the Town and Country Planning Association, Bassett states that these 'suburban extensions' were in essence the opposite of Howard's and the Association's plans for future town developments. Phillippa Bassett, *A List of the Historical Records of the Town and Country Planning Association,* (Centre for Urban and Regional Studies University of Birmingham and Institute of Agricultural History University of Reading, 1980), ii, NR24472.

Figure 16: Canfield Gardens , (1889): a block in West Hampstead, London, developed according to the principles of perimeter development set out by Unwin, with houses around the edge of the site enclosing a communal garden space at the centre.

Figure 17: *Becontree, Essex (1919-1938)*

Developed at Unwin's stated maximum of 30 dwellings per hectare.

adopted as the norm for new housing development in the early decades of the twentieth century.[47]

Burnett's *A Social History of Housing* provides a detailed history of state subsidised housing production during this period and an overview of the subsequent Housing Acts (1923, 1924) in which standard cottage-style house types were promoted in line with local authority subsidies for housing development. In London, housing developed by the London County Council (LCC) took on the form of flats and houses on "cottage estates".[48] These estates were laid out according to the spacing required for sunlight egress, and with a mixture of building heights to prevent monotony.[49] This was supplemented by a strategy of mass suburban development using sites outside of the administrative boundary of the city, purchased from adjoining local authorities. One of the most significant of these was Becontree in Essex (Figure 17) developed at Unwin's maximum density of 30 dwellings per hectare.[50]

Challenges to the twelve-to-the-acre norm

The pervasiveness of suburban development was such that by the 1930s reformers such as Elizabeth Denby were beginning to criticise the perceived righteousness with which the Town Planning Act (1909, revised 1923,1924) was advocating peripheral and low-density housing development. Rehousing of workers in cottages with small gardens and allotments, with all the requirements of a civilised community need not mean, she suggested:

> *That housing would sprawl at twelve cold and draughty detached or semi-detached cottages to the acre, in estates banished to the periphery of town, far from friends and work. Why not cut out the romantic sentimentalism, the pseudo-refinement of the early twentieth-century as resolutely as the materialistic wastefulness of the nineteenth?*[51]
>
> *How lazy to advocate decentralization and the creation of new satellite towns! Is there not a good case before redevelopment begins for examining the structure of each town and relating the new areas to the best traditions of the past, instead of indulging in beehive-building in the centre and chicken-coop building on the outskirts of the town...?*[52]

Denby's challenges were largely ineffective, although the arguments reappeared in the 1950s to critique the anti-urban character of the housing being built in the aftermath of World War II. (These are considered in Episode IV). However, in regards to housing development in the early decades of the twentieth century, the weight of political support for Unwin's twelve dwellings per acre maximum (30 dwellings per hectare) meant that it would become the pervasive norm for housing development and would continue to be so throughout the twentieth century.[53] It is interesting to note that the introduction of the first statutory minimum for the density for new housing development in 2000 was set at 30 dwellings per hectare, equivalent to Unwin's maximum. At the time, the Urban Task force noted that the majority of housing being built in the UK was

48 Patrick Abercrombie and John Henry Forshaw, *County of London Plan* (London: MacMillan & Co., 1943).

49 Burnett, *A Social History of Housing, 1815-1985,* 228.

50 *Ibid.*, 236–237.

51 Elizabeth Denby, *Europe Re-housed* (London: George Allen & Unwin, 1938), 264.

52 *Ibid.,* 262.

53 Hall, *Foreword: Nothing Gained by Overcrowding! - a Centenary Celebration and Re-exploration of Raymond Unwin's Pamphlet – "How the Garden City Type of Development May Benefit Both Owner and Occupier"*, 2.

CHAPTER I

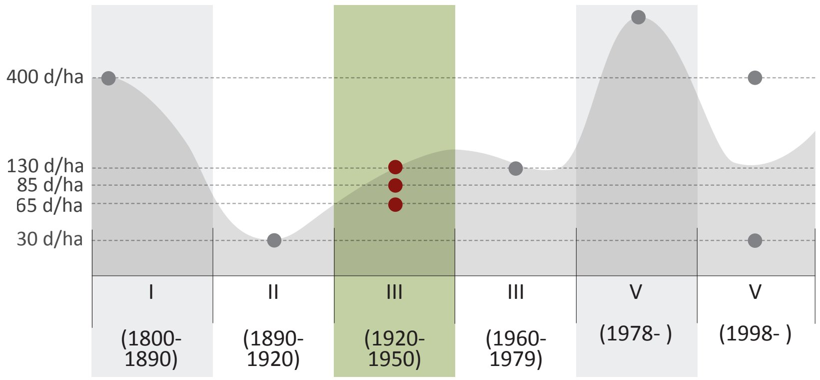
A conceptual, political and spatial history of density

developed at densities of 20 d/ha, similar to Unwin's seven per acre at Hampstead Garden Suburb.

Although Ebenezer Howard had, in effect, applied density ratios as a means (albeit theoretical) of achieving an optimal balance between people and resources in his manifesto for the Garden Cities, it was Unwin who had promoted their use as a strategic instrument for spatial planning. He demonstrated the principle of a cost ratio between the site area and amount of building as a means to calculate economic viability, and furthermore, the trade-off between the amount of housing built and area of amenity space. Twelve houses to the acre (30 d/ha) became implicitly associated with an image of the suburban idyll: with broad streets of semi-detached cottages. The emphasis on green space for pleasantness and recreation was such that all attempts to develop housing at densities greater than those set out by Unwin would be assumed to be deficient in terms of their amenity and aesthetic merits. Byelaw housing had resulted in endless rows of terraced housing that were considered monotonous, dreary and deficient in the 'amenity of life'. In attributing such consequences to specific density ratios, Unwin contributed to the creation of a more complex understanding of the potential use of density, not only as a measure of site development and economic viability, but of distinct architectural qualities.

Zeilenbau blocks
(1927)
Walter Gropius

Unite d'Habitation, Marseilles
(1952)
Le Corbusier
85 d/ha



Episode III: 1920-1950 Height, Daylight and Density

By expounding the benefits of lower densities for new housing, Unwin and the Garden City protagonists had effectively framed high-densities as socially, environmentally and aesthetically deficient. Whilst the Modernists shared many of Unwin and Howard's views on the problems of overcrowded industrial city, they saw the solution in radical transformation of the form of housing and the city at large and took a different approach to the use of density ratios to achieve this.

The period of high Modernism (1920-1950) had a significant impact on the conceptualisation of density. The manifestos set out by Le Corbusier and Walter Gropius during the 1920s presented an alternative approach to thinking about density. As opposed to the strategy of low-density suburban development proposed by Unwin, Le Corbusier argued that the density ought to even greater and organised better. He adopted an undisputedly Centrist approach towards urban planning.[54] In response to the problem of the congested industrial city he proposed to increase rather than decrease its density.[55] He wrote:

> *The density, which is too great as things are at present, of the districts affected by the "Voisin" plan would not be reduced. It would be quadrupled.*[56]

Peter Hall refers to the paradox of Le Corbusier's argument: to decongest the centres of our cities by increasing their density.[57] Aside from this apparent paradox, there are also two distinct conceptions of density being referred to here. On one hand, the density of the existing city, and on the other, the density of his proposed Plan Voisin. The former is a descriptive use of the term: density is used to describe the problem of too many people, of the intricacy of the urban fabric and the other 'deficiencies' that had been effectively attributed to the notion of density by Unwin et al. The latter, is a prescriptive density, as alluded to by Berghauser Pont and Haupt in the introduction to this chapter.[57] It is premised on the notion that density ratios per se can be used to bring about certain desired experiences or organisational strategies within the urban environment.

54 He was described as "Champion of the centrists" by Jenks, Burton, and Williams, *Compact City: A Sustainable Urban Form?*, 18.

55 Peter Hall, (1988) cited in *Ibid*. Le Corbusier's proposal for the city is based on the objective of eradicating the congested disorder of the historic city. His caption of an aerial photograph of central Paris reads: "In our walks through this maze of streets we are enraptured by their picturesqueness, so redolent of the past. But tuberculosis, demoralization, misery and shame are doing the devil's work among them." Caption to an aerial photograph of Paris, Le Corbusier, *The City of To-Morrow,* Translated from the 8 (London: John Rodker, 1929), 284.

56 Corbusier, *The City of To-Morrow*, 281.

57 Meta Berghauser Pont and Per Haupt, "City or Sprawl? The Need for a Science of Density," *'Scape* no. 1 (April 2007): 60.

57 Peter Hall, *Cities of Tomorrow: An Intellectual History of Urban Planning and Design in the Twentieth Century* (Oxford: Basil Blackwell, 1988), 207.

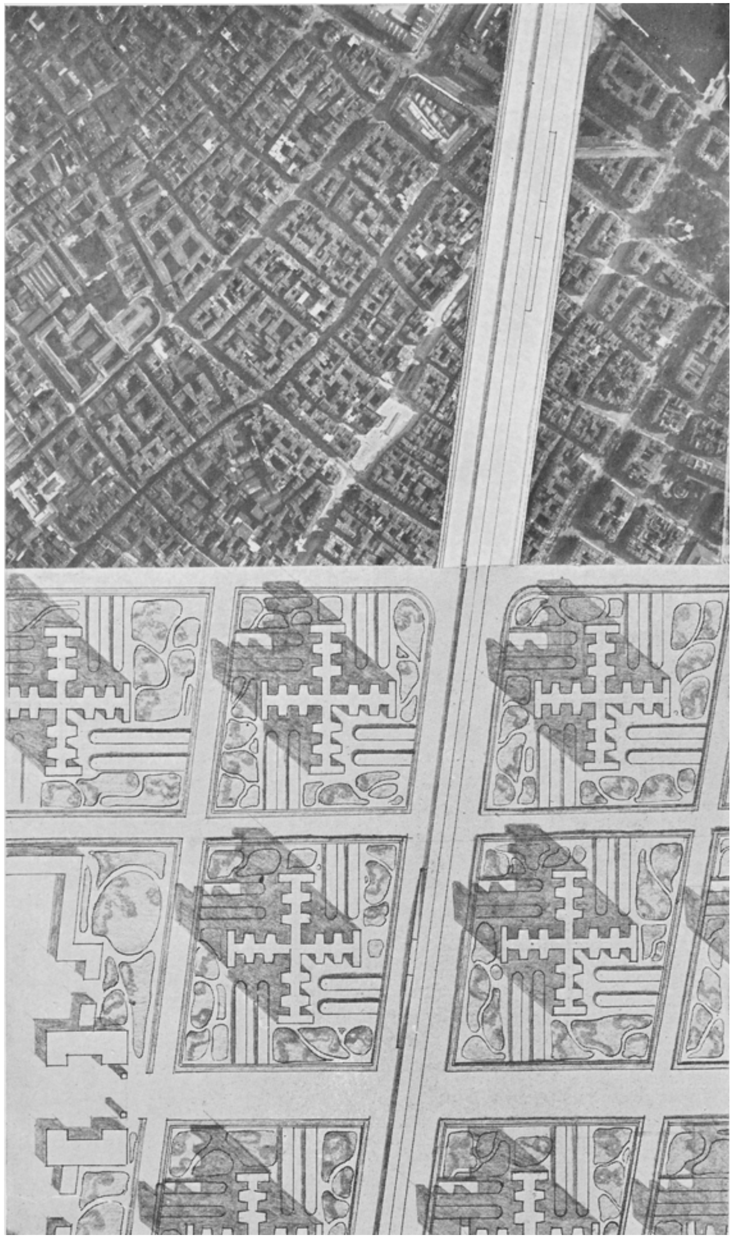
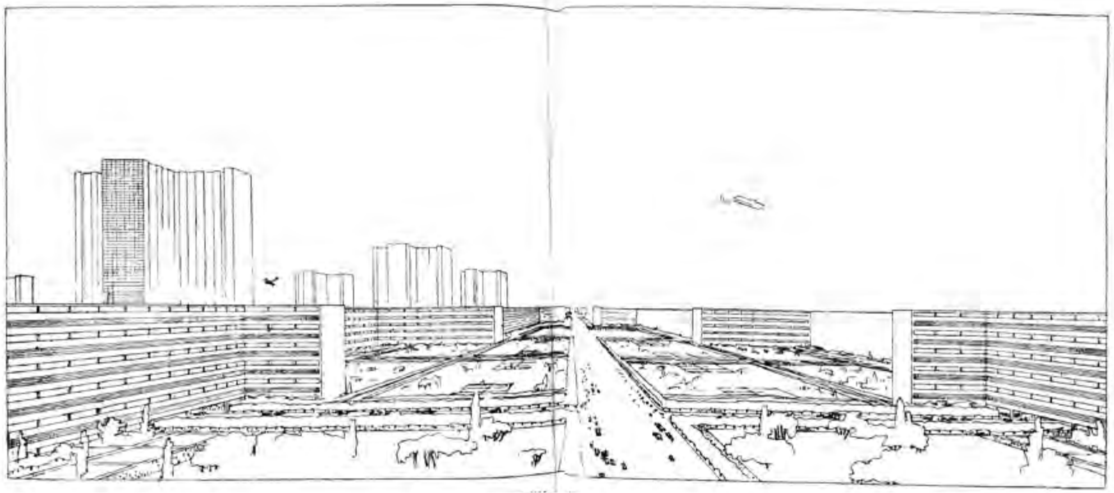


Figure 18: Le Corbusier's Plan Voisin: showing comparison between the fabric of the old and the new. Source: *Le Corbusier, The City of To-Morrow, Translated from the 8 (London: John Rodker, 1929).*

Figure 19: A Contemporary City: View showing a large housing scheme with 'set-backs'. Every window of every room looks out over open space. Source: *Ibid.*

The decongestion of the city fabric creates an open expanse - the antithesis of what has historically been considered 'urban'. "The whole city is a Park. The terraces stretch out over lawns into groves. Low buildings of a horizontal kind lead the eye on to the foliage of the trees... Here is the CITY with its crowds living in peace and pure air, where noise is smothered under the foliage of green trees. The chaos of New York is overcome. Here, bathed in light, stands the modern city." *(Ibid., 177.)*



58 Le Corbusier proposed to decongest the city centres to increase the 'means for getting about', and to increase parks and open spaces. Corbusier, *The City of To-Morrow*, 170.

59 *Ibid.*, 281.

60 *Ibid.*, 216.

61 *Ibid.*, 215.

62 Fondation Le Corbusier, *'Unité D'habitation'*, Fondation Le Corbusier.

Density and Decongestion

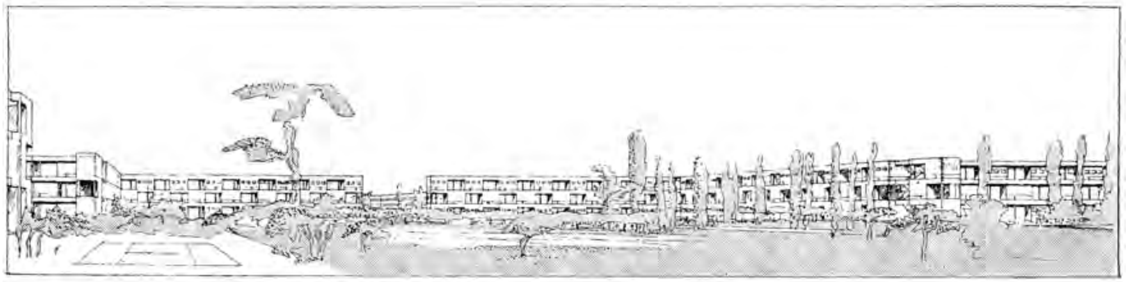
In his proposal for remodelling of the centre of Paris (the Plan Voisin, Figure 18), Le Corbusier demonstrated that by concentrating the built mass of the city at extreme densities, the ground space could be freed-up for speed of movement, recreation and leisure (see Figure 18).[58] The city would comprise of three zones: a central zone formed of 24 skyscrapers (for commercial use), a residential zone of cellular blocks, and on the outskirts, Garden Cities, whose 2,000,000 inhabitants would work in industry accommodated in the peripheral zone of the city. The densities of these zones would be 1,200 persons per acre at the centre (approximately 2960 persons per hectare), reducing to 120 persons per acre (295 persons per hecatre) in the residential zone. The aim of the Plan Voisin was, he wrote:

> *To open up in the strategic heart of Paris a splendid system of communication ...and on the vast island sites thus formed to build immense cruciform sky-scrapers, so creating a vertical city, a city which will pile up the cells which have for so long been crushed on the ground, and set them high above the earth, bathed in light and air…. Thenceforward, instead of a flattened-out and jumbled city such as the airplane reveals to us for the first time, terrifying in its confusion (…), our city rises vertical to the sky, open to light and air, clear and radiant and sparkling. The soil of whose surface 70 to 80 per cent. has till now been encumbered by closely packed houses, is built over to the extent of a mere 5 per cent. The remaining 95 per cent. is devoted to the main speedways, car parks and open spaces.*[59]

While Parisians, unlike Londoners, had an extended history of apartment living, Le Corbusier reimagined apartment structures on a much larger scale (see Figures 19 and 20). For residences close to the centre he proposed long, snaking blocks based on a 'cellular' system of two storey maisonettes, stacked up to unfetter the ground space. The dwellings would turn their backs on the street and look out over open space of nearly 10 acres (4 hectares). On the roof of the building there would be a 1000 yard running track, a gymnasium and sun parlours (sanatoria were associated with curing Tuberculosis).[60] The concentrated density of dwellings had a dual purpose. The height of the buildings freed-up large areas of green space, whilst the compact organisation created the necessary proximity between dwellings to enable communal services and amenities to be shared between residents.[61]

The principle of harnessing the constructional efficiency enabled by industrialised methods and the proximity between neighbours that was generated by these large scale structures was taken to its most complete execution in the Unité d'Habitation in Marseille (completed 1952, see Figure 21).

The Unité d'Habitation (translated from French means literally, Housing Unity) was intended to be a microcosm of the city; providing all the amenities necessary for living. 337 apartments provide accommodation for almost



A HOUSING SCHEME ON THE CELLULAR SYSTEM

A rational utilization of the ground area. An eminently architectural solution.

Figure 20: A housing scheme on a cellular system. Source : Corbusier, The City of To-Morrow.

Figure 21: Unité d'Habitation, Marseille (1952) Source: Phaidon (ed.), Le Corbusier Le Grand, New York 2008; as cited in Florian Dreher, Anette Busse, and Annelen Schmidt, 'Brutalism. Architecture of Everyday Culture, Poetry and Theory', Website for the International Symposium, Berlin, Brutalismus, 2012, http://www.brutalismus.com/e/?/concept/.

1600 residents; a population mass that validated the incorporation of two internal streets of shops and amenities, communal domestic services such as laundry and cleaning, a restaurant, hotel, nursery school, roof garden and small swimming pool.[62] It epitomises Le Corbusier's thesis on density. The density ratio of the Unité site is approximately 85d/ha, or 400 persons per hectare; higher than Unwin's proposed limits, but not compared to typical byelaw housing built in UK cities at the end of the nineteenth century.[63] The height of the building, at 18 storeys, provided the density of compaction needed to validate the range of domestic services, facilities and entertainment provided within the building, and to free up the remainder of the site to create an expansive park that provided amenity and a grand view for residents. Indeed, far from advocating a limit on the overall density, Le Corbusier had previously expounded the view that the addition of extra storeys (on top of his cellular residential block) would only increase the efficiency and viability of the elevators, parking garages and mechanical and electrical services, as well as the centralised domestic service and concierge.[64] The economic and spatial efficiency of Le Corbusier's housing models, of which the Unité became the most widely replicated, was a key factor in the adoption of these ideas, and indeed attitudes towards density as a standard in the design of urban housing, particularly in the post-war decades.

Density and Daylight

In the previous century, byelaws governed the layout of space around buildings, but from the 1930s, the promotion of 'daylight' was given explicit mention as a key planning concern and became increasingly important in governing how site density was translated into built form. In their excellent history of twentieth century housing Glendinning and Muthesius write:

> *…in the thirties, there was a profound change in thinking on this subject among architects, planners and housing reformers. Now the old regulations, with their prescriptions of maximum heights and minimum distances between buildings, aimed to prevent overshadowing, were repudiated as a kind of negatively imposed 'negative planning'. Instead there was a call for a 'positive' way of designing, in which optimal conditions would be ensured of taking into consideration, from the start, all aspects of planning the building and its surroundings. Such ideas were intimately linked with the abandonment of the traditional street and the 'street block' as the chief determinant of building layout. The provision of daylight became a 'planning matter', almost in the sense of town planning: something that went far beyond the concerns of the individual building.*[65]

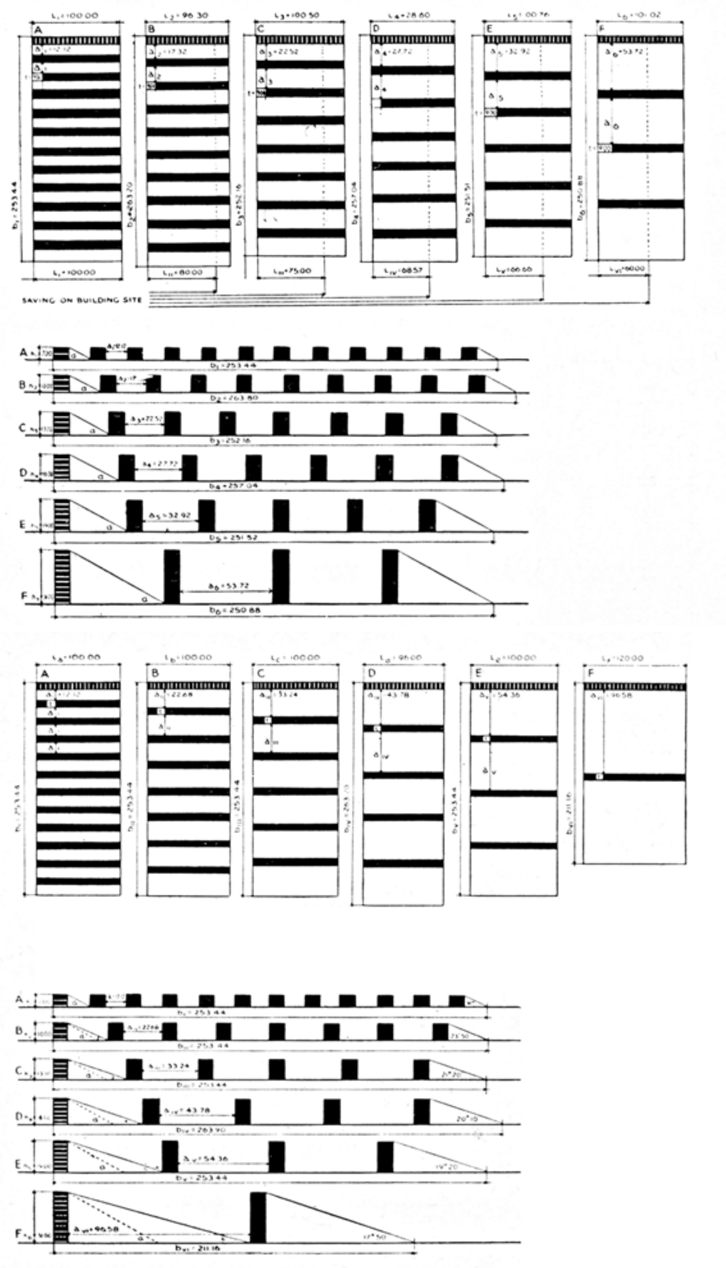
Whilst Le Corbusier had promoted the ideal of sunlight, daylight and ventilation, the relationship between density ratios and daylight and sunlight was made most explicit in Walter Gropius' text, *The New Architecture,* published in

63 Density: based on a 4 hectare site and approximately 1600 residents; density approximately 400 persons per hectare, 337 apartments gives density of approximately 85 dwellings per hectare. However it contains a variety of non-residential uses and Floor Area Ratio therefore provides the best indicator. The FAR is approximately 1.78.

Areas cited in Martin Spring, 'Welcome to the Machine: Le Corbusier's Unité d'Habitation', *Building*, 26 September 2008.

64 Corbusier, *The City of To-Morrow*, 217.

65 Glendinning and Muthesius, *Tower Block: Modern Public Housing in England, Scotland, Wales and Northern Ireland*, 36.



Left

Figure 22: Walter Gropius' diagrams. Source: Walter Gropius, *The New Architecture and the Bauhaus,* trans. P. Morton Shand (London: Faber and Faber Limited, 1935), 104.

The two diagrams on the left (top) demonstrate that, for a fixed angle of incidence for sunlight, the height of the buildings and the distance between them are inversely correlated. As building height increases, the distance required between the buildings in order to maintain the same daylight and sunlight also increased. However, increasing the height of the buildings provides an increase in site capacity disproportionate to that lost by spacing the buildings further apart therefore making more effective use of the land. There was a potential saving of about 40 per cent of the site area by increasing the building height from two storeys to 10 storeys.

The two diagrams below demonstrate that, if site capacity is fixed, by accommodating the required dwelling units in taller buildings set further apart from one another the buildings have a lower angle of incidence and therefore receive more sunlight.

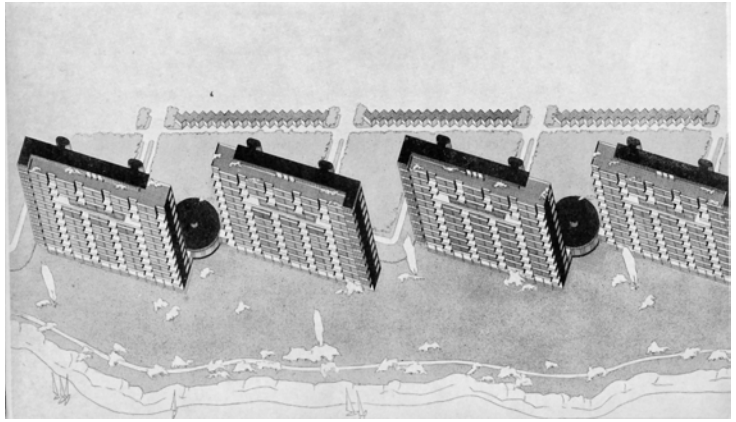


Figure 23: Gropius' proposed alignment of blocks maximised sunlight, ventilation and the open view. Source: Walter Gropius, *The New Architecture and the Bauhaus,* trans. P. Morton Shand (London: Faber and Faber Limited, 1935), 92-93.

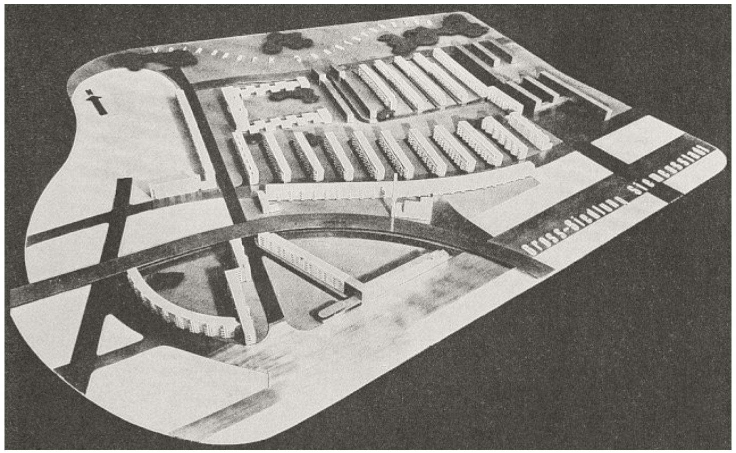


Figure 24: Model of the Siemensstadt district, near Berlin (1929) built under the direction of Hans Scharoun. The plan for the Siemensstadt district exemplified the urban model promoted by Gropius, of tall blocks, set apart from one another and aligned on the north-south axis, with the surrounding landscape predominantly green.

Source: Karl H. P. Bienek, *Siemensstadt - Großsiedlung Siemensstadt* (Großansicht 8), 2006.

66 Walter Gropius, *The New Architecture and the Bauhaus*, trans. P. Morton Shand (London: Faber and Faber Limited, 1935).

67 *Ibid,* 107.

68 *Ibid*., 110.

1935.[66] Expanding on the principles of open space, sunlight and ventilation as a basis for the design of a new typology of urban housing, Gropius developed a methodology for the application of these principles to optimise these conditions for all dwellings.

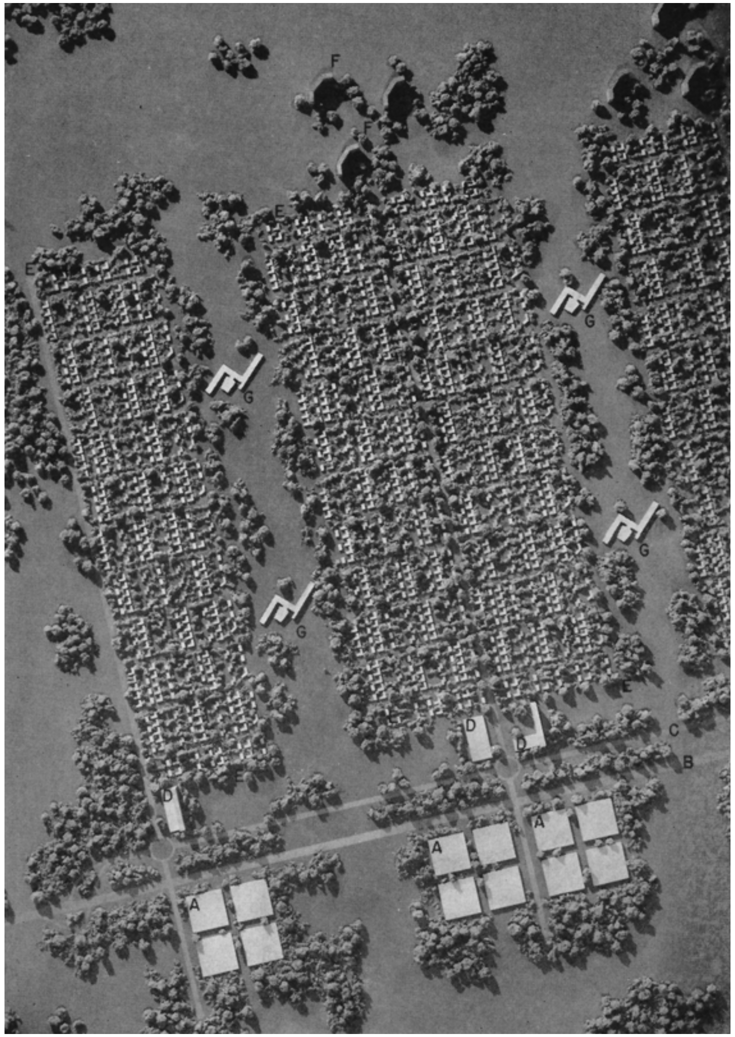
Gropius' diagrammatic studies (Figure 22) demonstrated that, for a fixed (minimum) angle of incidence for sunlight, building height could be increased in proportion to an increase in the distance between blocks. However, the increase in height would more than offset the floor area lost by increasing the distance between blocks, demonstrating that taller blocks, set further apart made more efficient use of the site and generated higher capacities. The second diagram showed that if site capacity is fixed, then taller blocks set further apart from one another received more sunlight than lower-rise housing set close together. Gropius used these diagrammatic analyses to expound his argument for the primacy of daylight and sunlight considerations in setting out the principles for urban planning. He wrote:

> *It is evident, therefore, that the height-limit imposed by regulations is an irrational restriction which has hampered evolution in design. Restriction of the number of dwellings per acre is, of course, a very necessary safeguard, but one that has nothing to do with the height of the buildings concerned. Overcrowding can be far more efficiently combated by reducing their maximum floor area or total cubic volume.*[67]

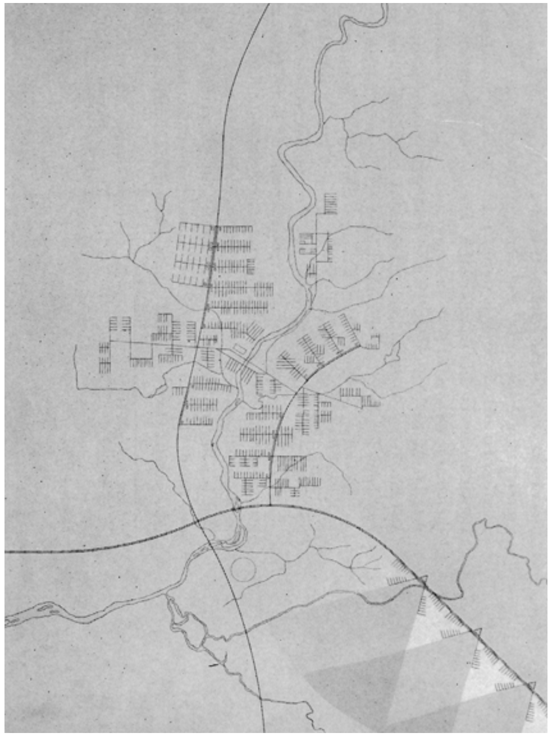
Gropius' diagrams demonstrated a direct proportionality between site capacity, building height, and the distance between buildings. His explication of a simple, rational model through which the critical components of site planning: capacity, building height, separation distances and the resulting sunlight and daylight, could be controlled, made the most crucial contribution to the establishment of density ratios as an instrument of spatial planning. Given the over-riding concern for the health-giving benefits of sunlight and ventilation, this tri-part relationship gained significant traction within planning disciplines. The systematic methodology he demonstrated became a key principle governing the redevelopment of cleared slums in many European cities in the aftermath of World War II. Figure 24 shows a development near Berlin, laid out according to Gropius' rational criteria. His numeric approach would also form the basis of the planning methods used by Abercrombie and Forshaw in their London Plan of 1943 (discussed in more detail below).

Gropius' model not only had implications for way in which density ratios would be used in planning practice. The studies demonstrated the feasibility of his wider strategy for the dissolution of what he described as the 'overcrowding' of the city. He argued for a "progressive loosening" of the city's tightly-woven tissue of streets and the alternation of rural and urban zones.[68]

This principle was expounded most rigorously by Gropius' contemporary, Ludwig Hilberseimer. Hilberseimer



A	Industry
B and C	Communication routes
D	Commerce and Institutions
E	Housing
F	Recreation Space
G	Schools (located amongst the housing zones)



Hilberseimer's 'settlement units' can be thought of as linear interpretations of Ebenezer Howard's concentric Garden Cities model, arranging the different parts of the town, including the residential areas according to convenient connections.

Left

Figure 25: Model of a complete 'settlement unit' developed on open land as proposed by Hilberseimer. Source: *L. Hilberseimer, Nature of Cities (Academy Editions, 1955).*

Right

Figure 26: Plan for Rockford showing Settlement Units repeated along the transport line. Source: Hilberseimer. Source: *L. Hilberseimer, Nature of Cities (Academy Editions, 1955).*

argued that whereas in historical walled-city, density had contributed to the defence of the city, now, in the age of the air-borne threat, concentrated cities invited their own destruction.[69] He wrote:

> *The advent of the airplane and the development of atomic weapons have made obsolete, not only the city wall, but also the concentrated city that wall required.*[70]

"The space concept of our age tends towards openness and breadth", he claimed.[71] It was an extension of the planning objectives that Le Corbusier had promoted; ventilation, open views and expanses of greenery being the guiding criteria for urban planning. However, whereas Le Corbusier had advocated the benefits in terms of efficiency of construction, and provision of amenity for residents in the large apartment complexes that he proposed, for Gropius and Hilberseimer, the effect of dissipating the congestion of the city and creating an expansive, green landscape was the overriding objective. The large apartment buildings, with their very high plot ratios but low overall site density ratios, simply provided a mechanism for freeing-up more green space.

For Hilberseimer, the dispersed city had social and economic benefits too. In the first phase of the industrial age, he argued, city and country had become separated, opposing one another. The dispersed city, on the other hand, would bring city and country back into contact, allowing for integration of agriculture and industry (an objective not very different from that of Ebenezer Howard's Garden Cities). Hilberseimer's model for the dispersed region (as it is probably more accurately described) was based on 'settlement units', each comprising zones for living, industry, culture and community (see model shown in Figure 25). These settlement units would then be distributed across the landscape – each with enough space around it to provide adequate food for the settlement (see Figure 26). The density of the settlement units themselves was to be no greater than was "consonant with good city planning".[72]

Le Corbusier and Walter Gropius had both described their proposals in terms of density ratios. Gropius also expanded a quasi-scientific understanding of how density ratios might be used as an instrument of site planning. However, it was Hilberseimer who best demonstrated how density had been translated from an index of land-use efficiency in Unwin's *Nothing Gained*..., into a means of indicating the site layout, housing typology and, by virtue of Modernist certainty, the size and type of households that would occupy the houses. To summarise, this transformation he writes:

> *Population density is both a social and hygienic problem. It is a social problem insofar as it determines the type of building erected and the life of the people who occupy those buildings. It is a hygienic problem insofar as it affects the health of people by controlling the amount of space, light and air available in each housing unit.*[73]

By the time that Abercrombie and Forshaw came to write the County of London Plan (published in 1943) the idea that a simple density ratio could be used to describe both the

69 Hilberseimer, *Nature of Cities*, 257.

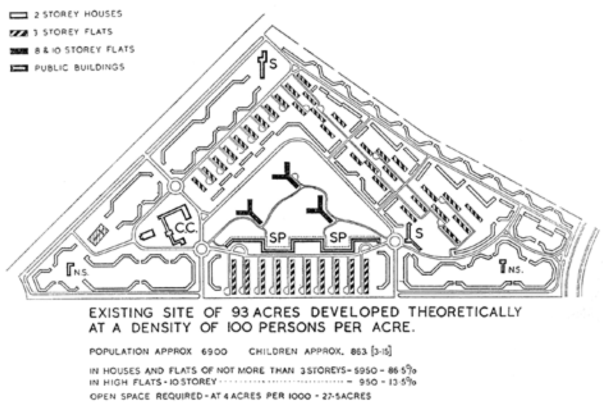
70 *Ibid*., 281.

71 Hilberseimer, *Nature of Cities*, 220

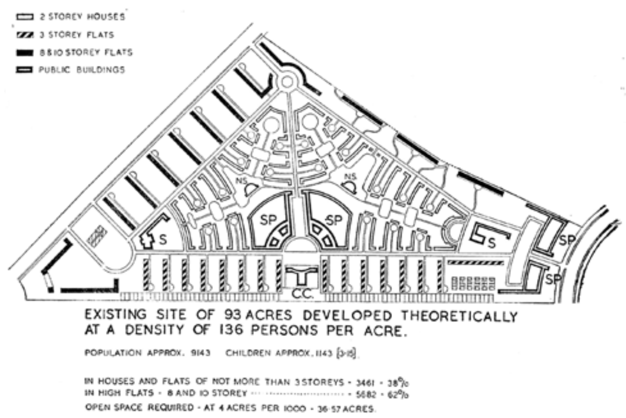
72 Hilberseimer, *Nature of Cities,* 202. Note that Hilberseimer does not specify a density, but in his design exercises in which he tests different forms, he takes 100 persons per acre (equivalent to approximately 250 ppl/ha, or 65 d/ha) as the set figure. Note that the graph shown at the beginning of this chapter and at the start of each episode charts the shifting ratios considered to be ideal in each of these different historical episodes.

73 *Ibid*.

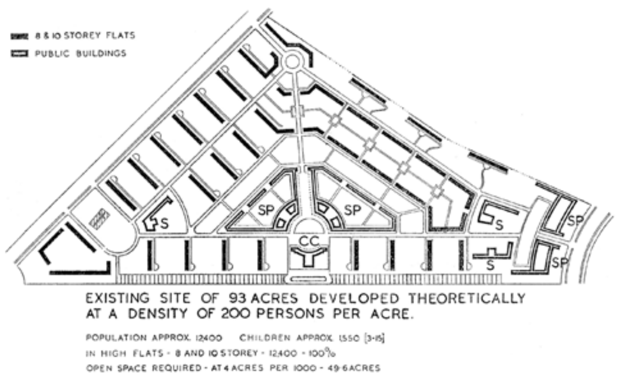
74 The Barlow Commission was remitted to consider the containment of the existing urban areas and the decentralisation of population and industry from older city areas, including central and east London, with the objective of improving living standards, environmental conditions and industrial and business performance. Crawley New Town, *Select Committee on Transport, Local Government and the Regions Appendices to the Minutes of Evidence: Supplementary Memorandum by Crawley Borough Council (NT 15, a)*, Parliament UK, 2002.



100 persons per acre | 250 ppl/ha 65 d/ha



136 persons per acre | 335 ppl/ha 85 d/ha



200 persons per acre | 500 ppl/ha 130 d/ha

Figure 27: Diagrams showing a site developed at 100, 136 and 200 persons per acre, described by the authors as "a mixture of low density housing and high density flats".

Source (quotation and image): Patrick Abercrombie and John Henry Forshaw, County of London Plan (London: MacMillan & Co., 1943), 27 and 79.

75 Abercrombie and Forshaw, *County of London Plan*, 9.

76 *Ibid.*, 77.

77 *Ibid.*, 83.

78 *Ibid.*, 77.

masterplan for the site, the heights of the buildings and the type and sizes of dwellings included, was an established methodology for planning.

Density, Daylight and Site Capacity: housing in London post WWII

The eminent early modernists had effectively demonstrated that site planning could be determined using three key dimensions; site capacity (generally in terms of population), building height and sunlight. Patrick Abercrombie's 1943 County of London Plan exemplified this principle in practice. The Plan was published following the Barlow Commission of 1940 which had come to the general conclusion that all large towns in England (or Britain) required decentralisation to a greater or lesser degree.[74] The authors of the Plan adopted the guiding principle that decentralisation of some of the population was necessary in order to improve the general conditions within the city. However, the density of the inner city areas ought to be maintained in accordance with "industrial conditions" (i.e. employment).[75] The requirements for open space (set out under the four-acre by-laws) meanwhile would have a determining influence on building height. Their central objective was to determine:

> *How the best living conditions can be provided, consistent with the related factors, and what proportion of houses to flats, of various heights, and what degree of decentralisation would result from the adoption of certain standards of density.*[76]

Three standards of density were devised; 100, 136 and 200 persons per net residential acre (247, 336 and 494 persons per hectare respectively), for rural, suburban and urban sites. Based on these predetermined site densities and areas of open space required for recreation, quantitative calculations could be used to determine the height of the proposed buildings, as well as the site layouts and mix of housing typologies for the redeveloped areas. It could be determined that, at a density of 100 persons per acre (247 persons per hectare or ppl/ha), up to 55 per cent would be in houses and 45 per cent in flats (up to three storeys). At 136 persons per acre (336 ppl/ha), 33 per cent would be houses and 67 per cent flats. At 200 persons per acre (500 ppl/ha), all would be flats, with 65-85 per cent of them between seven and ten storeys high (see Figure 27).[77] This deterministic use of density as a site planning strategy was facilitated by the use of standardised housing typologies.

> *Although the effect of building flats is to get a higher density, the increase is not directly proportional, as more open space must be provided for the higher densities, always assuming that the same ratio of open space to population is used.*[78]

The result was a spacing-out of the fabric of the city and greater distances between buildings in the areas with the tallest buildings. Critics described the approach as anti-urban. The criticisms were framed primarily as an objection to the densities set out in the 1943 London Plan, deemed to be too low. Architecture critic Ian Nairn opened up the

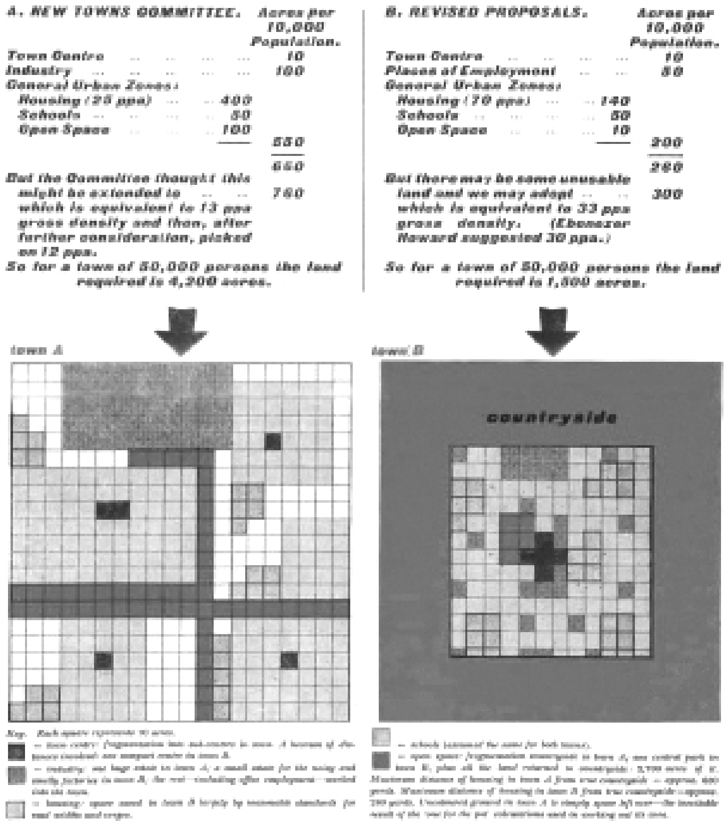


Figure 28: Manthorpe's proposal for the reallocation of outdoor amenity space

He suggests that the interjection of the city fabric with large expanses of open space decreases the efficiency of land use and dissects the fabric of the town. Allocating open space provision on the edge of the town, would allow for larger and better open spaces, and by increasing the density of urban development from 60 ppl/ha (as in the New Towns) to 175 ppl/ha, the area required for building the town would be reduced and every household would live in closer proximity to the countryside.

Source: *Walter Manthorpe, 'The Machinery of Sprawl', in Outrage, by Ian Nairn (London: The Architectural Press, 1955), 411.*

debate in a special edition of the Architectural Review, published in 1955. It was called *Outrage* and in it, a series of contributors argued for preserving the physical separation and architectural distinction between town and country development. They criticised the expansion of the city at universally low-densities which Nairn himself analogised to a gaseous pink marshmallow.[79]

> *The city to-day is not so much a growing as a spreading thing, fanning out over the land surface in the shape of suburban sprawl.*[80]

The decentralisation strategies adopted as planning policy in the aftermath of the Second World War, not only in the county of London Plan but nationally too, had promoted the de-densification of the city through suburban development and building of the new towns. However, it was argued that even the strategies for the redevelopment within the city were too low-density to adequately maintain the vitality of the urban experience.

> *From the civic design point of view, therefore, density control alone, even in terms of rooms per acre, is quite ineffective in achieving a foreseeable type of building, except that excessively low densities simply deprive the architect of the raw material from which cities are made – building bulk.*[81]

It was argued that the space that was left between the buildings – that had been conceived of as a green and luscious landscape giving every resident a view over open countryside – lacked the structure and surveillance inherent in the city street. It also lacked purpose. Front and back gardens were replaced by "mindless expanses" of open lawn, the responsibility and pride of no-one wrote the critic Nicholas Taylor.[82] The systematic generation of so-called "dead ground" was deemed to be a direct consequence of legislation of density ratios, building heights and open space requirements.[83] Figure 28 shows a proposed alternative - it advocates a rationalisation of the recreation space requirements so that open space does not dilute the continuity and coherence of the urban fabric, and importantly, an increase in density.

Jane Jacobs argued that the preoccupation with numbers (density ratios) was a reaction to the perceived failings of the 'old', industrial cities, but that the planning-by-numbers approach had failed to resurrect, or even recognise the 'successful' aspects of cities. It was merely concerned with eradicating what had been identified as the spatial deficiencies of the overcrowded slum.[84] Fundamentally, the 'anti-street' urbanism of 'set-backs' and disconnected slab blocks that had resulted from the decentrist policies of post-war planning were, she argued, "city-destroying ideas".[85] Streets, she argued, provided a density of activity that was inimical with the safety of the street and of the city, and with good design, the density of overlooking of a city street could enable it to be self-policing.[86] Taylor also contributed to the bid for a return to an urbanism based on streets:

79 Ian Nairn, *Outrage* (London: The Architectural Press, 1955), 365. The publication of 'Outrage' gave publicity to the dissenting voices that challenged the rectitude of decentralisation and the destruction of the city fabric with strictly controlled densities and fragmented urban planning (buildings in the park urbanism).

80 *Ibid.*, 365.

81 Walter Manthorpe, 'The Machinery of Sprawl', in *Outrage*, by Ian Nairn (London: The Architectural Press, 1955), 410.

82 Nicholas Taylor, *Village in the City*, published in Association with New Society (London: Maurice Temple Smith Ltd, 1973), 80.

83 Manthorpe, 'The Machinery of Sprawl', 411.

84 Jacobs, *Death and Life of Great American Cities*, 20. Mixing of residential with commercial and industrial land uses, little open space (evidenced by children playing in the street; referred to as Abercrombie as the '...evil'), high density of streets; and finally, high residential density are cited as factors by the Boston planner is securing the demolition of the North End.

85 Cited in Jenks, Burton, and Williams, *Compact City: A Sustainable Urban Form?*, 18.

86 Jacobs, *Death and Life of Great American Cities,* 29.

87 Taylor, *Village in the City*, 83.

88 Jacobs, in *Death and Life of Great American Cities* referred to the discipline of town planning as 'quasi-scientific'.

89 Manthorpe, 'The Machinery of Sprawl', 409–410.

90 Glendinning and Muthesius, *Tower Block: Modern Public Housing in England, Scotland, Wales and Northern Ireland*, 38.

91 *Ibid*., 38.

92 *Ibid*., 38.

The main advantages that residents find in the street are more positive than mere security and mush less esoteric than the "clattery hothouse Naples-in-the-suburbs for which Jane Jacobs and her Hampstead acolytes have such a romantic affection". It is the "quieter human relationships which are the humdrum necessities of life in the suburbs.[87]

Jacobs argued that the 'quasi-scientific' method by which density was used to determine built form was neither adequately rational, nor appropriate as a means of affecting the experiential and qualitative aspects of the urban environment.[88] Density had been attributed a deterministic authority as a primary principle of town and country planning, the rationalism of which had seduced practitioners into acceptance of the formal and typological consequences that resulted. Writing in Nairn's *Outrage* in 1995, the critic Walter Manthorpe wrote:

Creative experiment is, in most parts of the country, effectively barred to any architect who wishes to demonstrate the qualities of efficiency, compactness, and urbanity in that fundamental unit, the ordinary residential area. Rules of thumb, planning controls, byelaws and general prejudice have now so combined that it is practically impossible to build towns; only garden suburbs are permitted… There is also the problem of density being quoted within the framework of a preconceived picture of the town.[89]

Manthorpe criticised the fallacy of using density as a neutral, objective instrument of planning. 'Density', he proposed, is of little significance either as a determinant of architectural form or as a measure of 'overcrowding, but is exercised as the instrument of a 'value' system. In their analysis of the institutional, social and ideological factors affecting the development of housing over the course of the twentieth century, Glendinning and Muthesius highlight the perpetual difficulty in distinguishing between scientific procedures, and "the values or ideas that direct the selection of results and help formulate the conclusions".[90] By the 1950s, they argue, density was a mechanism through which to pursue a value-driven enthusiasm for high-rise and other formal and aesthetic considerations.[91]

'Density', like the 'Daylight Factor' was first of all a scientific way of measuring, but 'High Density' was a value, a particular desire, favoured by reformers and designers in those [post-war] decades- analogous with the way in which low density, as such, had seemed desirable for Unwin in the earlier decades of the century. [92]

Implications of the Modernists' ideas about density

In the previous episode, Unwin's proposals for a low-denstiy form of suburban development, determined through maximum density ratios contributed to the spreading out of the city. In the period of high-Modernism, the use of density ratios assumed a new level of scientific authority.

The dominant figureheads of Modernism expanded the perceived implications of density ratios for architecture and planning. Le Corbusier's proposed densification imbued the

93 "By attaining order we arrive at liberty", he had written, suggesting that the provision of domestic services, hitherto the privilege of the wealthy, would liberate housewives from enslavement to domestic service. *The City of To-Morrow*, 216–217. His social theories have come in for much criticism subsequently. Jane Jacobs described his vision of "maximum individual liberty" as "not liberty to do anything much, but liberty from ordinary responsibility". Jane Jacobs, *Death and Life of Great American Cities* (London: Jonathan Cape, 1961), 20.

94 Glendinning and Muthesius, *Tower Block: Modern Public Housing in England, Scotland, Wales and Northern Ireland,* 38.

95 *Ibid.*, 37.

concept of density with new potentialities, different from those conceived of by Unwin and the Garden City Movement in the decades previous. Where Unwin had promoted low density as a route to individual liberty and increased amenity and pleasure, Le Corbusier proposed almost the exact opposite. He proposed that the proximity generated by higher-density housing typologies be harnessed to create a sort of community, and provide an economy of scale for the provision of services and facilities freeing residents to enjoy the liberties of city life.[93]

Gropius and Le Corbusier also contributed to changing perceptions about the aesthetic and formal qualities associated with density. The Garden City protagonists had attributed higher densities with negative connotations of monotony and repetition. However, the Modernists' appropriation of industrialised construction methods and promotion of the virtues of efficient production, recast modularity and repetition as desirable qualities, or at worst, necessary by-products of a more egalitarian strategy for housing production. Concerns over repetitiveness, efficiency, even anonymity amongst vast modernist housing schemes were secondary in importance to the potential that higher densities offered in terms of the amenity of the dwellings themselves and the reconfiguration of the urban fabric. Priority was given to the qualities of sunlight, ventilation and the open view, as well as the social benefits afforded by the concentrated densities of the multi-dwelling structures. When it was demonstrated that industrialised slab and point block housing could facilitate rapid and large scale construction, higher density was also imbued with qualities of efficiency and productivity.

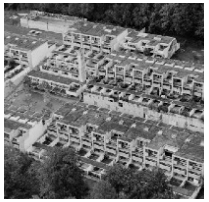
Following Gropius' studies, density ratios were deemed to provide the intrinsic (and seductive) link between housing design and the new 'science of town planning'. As such they were seized upon by practitioners.[94] The most significant legacy of these manifestos for the subject of urban density was how density was conceived of in an instrumental capacity, almost as a *tool* for planning and design.

The second factor that had changed in between Unwin's Garden Suburbs and the County of London Plan was to do with the politics and economics of housing production. Whereas Unwin had been eager to prove the financial viability of his proposals to investors, by the mid-twentieth century much housing production, in the UK at least, was publicly funded. This brought with it the possibility for large scale redevelopment and the opportunity for strategies towards density to be promoted at a regional scale. It also brought an emphasis on the collective good. The arguments that had been promoted by Le Corbusier therefore, about the potential benefits of higher density housing types, in terms of amenity and community infrastructure were appealing and persuasive. In this social and economic context, setting limits on the density of new development was posited as a collective good, better for all. Furthermore, the use of density ratios as an instrument for setting out redevelopment plans had the weight of scientific reason and was seen as more egalitarian. However, the emphasis

placed on density ratios, and the assumed correlation between density and building form was such that by the early 1960s, as Glendinning and Muthesius explain, the term 'density' was no longer simply a ratio measure as it had been for Unwin, or a term used to describe the compactness of the urban fabric as it had been for Le Corbusier. It had become a "value, a particular desire" with formal, environmental, social and political consequences. [96]

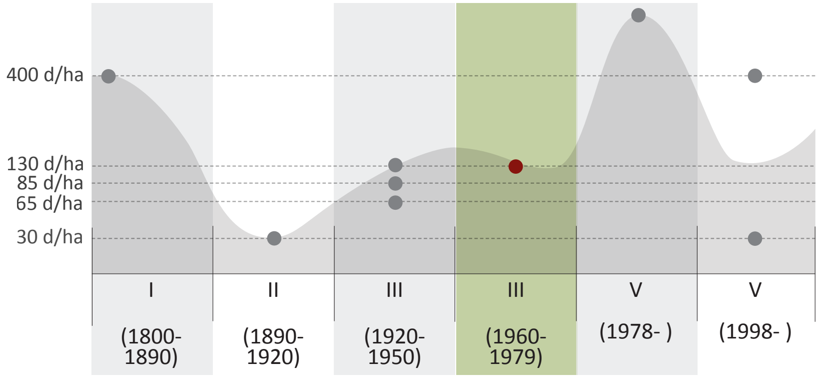
96 *Ibid.*, 38.

Siedlung Halen, Bern
(1955-1961)
Atelier 5



Alexandra Road
(1972)
Camden County Architects
106 d/ha

Odham's Walk
(1979)
Camden County Architects
154 d/ha



Episode IV: 1960-1979

Social cohesion and density

The older Modern notion of space, in the sense of the large open and public space, was now widely denounced: Large open areas were now held to be liable to abuse. Designers now spoke of a special 'sense of enclosure'.... All this was linked a new set of socio-psychological values, such as 'belonging', 'place', 'identity' or 'territoriality'... The preferred forms or values of those years were intimacy and intricacy; they now provide the key to the understanding of privacy and community, as they could be applied to both.[97]

By the 1960s, ideas about the instrumentality of density as a design tool were shifting. Other factors, such as the popular denigration of high-rise development for housing (particularly relevant after the collapse of Ronan Point in 1967) and the growing aversion towards high-rise (and flats in general) for accommodating families affected the debate about high-density as a solution to the continued deficit of housing.[98] These shifting attitudes stimulated a period of experimentation with density and form.

Leslie Martin and Lionel March presented the most rigorous critique of the prevalent use of density ratios to determine the form and typology of housing architecture. They argued that the land-use 'efficiency' argument which had been used to underpin the need for high-rise building in the inner-cities was motivated more by stylistic impetus than rationalist calculation.[99] As stated at the end of the previous episode, density ratios had been attributed autonomy, effectively subsuming the opportunity for design within the authority of the scientific ratio measure.

Martin and March sought to challenge the inevitability of high-rise forms (promoted as the most efficient use of land).[100]

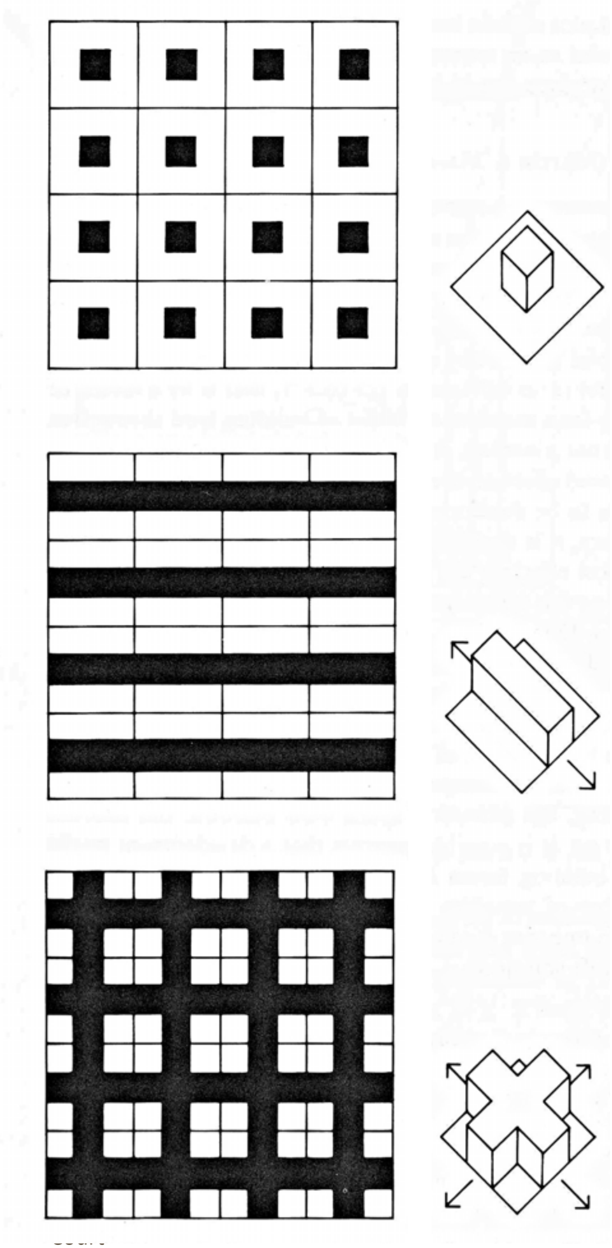
The present housing yardstick implicitly assumes that as densities increase houses decrease in favour of flats, and low buildings give way to high. This is only true because of the professional separation of land use planning from its architectural implications. With favourable land use planning, semi-detached houses can be built at 200 persons to the acre. Three storey terraces under more normal circumstances can be built at 265 persons per acre. These are facts.[101]

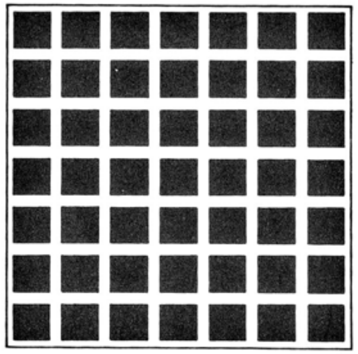
Through a series of figurative experiments, they demonstrated the fallibility of the prevalent 'efficiency' case for building 'high-rise', and presented a thorough analysis of the different physical parameters that influence the density ratio along with building height. These included the

97 *Ibid.*, 144. During this period a new strand of socio-architectural research began to explore the relationship between the spatial environment and cognitive and behavioural traits. The built environment therefore suddenly acquired a socio-psychological aspect that designers increasingly sought to acknowledge and mediate. A number of environment-behaviour studies were directed towards the experience of density and crowding. Their findings are discussed in more detail in Chapter Two.

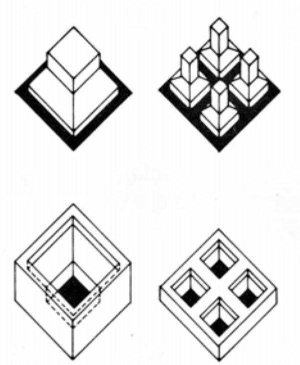
98 This deficit was both quantitative and qualitative - Peter Tábori; architect of Highgate New Town suggests that there was a pursuit of higher densities in order to satisfy the demand for new housing, noting that it would be impossible to alleviate the slum conditions of inner city housing at the low densities that were permitted at the time (85d/ha for urban sites). Peter Tabori, 'Cook's Camden', 30 October 2010.

99 Lionel March and Leslie Martin, 'Speculations', in *Urban Space and Structures* (Cambridge: Cambridge University Press, 1972).

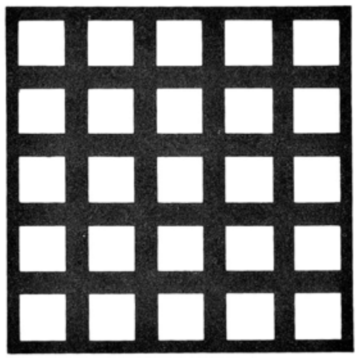




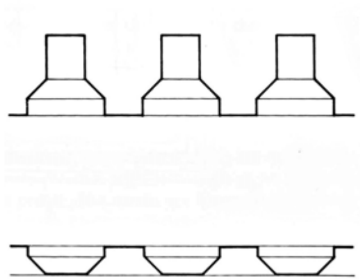
Pavilions



Pavilion (top), low podium with tower. Court (bottom) perimeter building with open space at centre.



Court form (anti-form)



The low, court formation has the same building plan depth as the pavilion, therefore the same proportion of 'dark space' at the centre of the plan.

Left

Figure 29: Three urban formations: the pavilion form (top), street (middle) and court (bottom) used by Leslie Martin and Lionel March to test the potential for increasing site density through different typologies of built form. Source: *Lionel March and Leslie Martin, 'Speculations', in Urban Space and Structures (Cambridge: Cambridge University Press, 1972), 28–54.*

Right

Figure 30: The pavilion (top) and its anti-form (bottom).

Taking the typical high-density pavilion form of a low podium surmounted by a tower (a typical New York block), the same amount of floor area can be accommodated in the 'anti-form', a court arrangement occupying the 'negative space' of the city grid at approximately one third the height of the pavilion. Furthermore, in the anti-form, the whole network of social and pedestrian space is reversed. The narrow street, 'directional' and 'restrictive' is replaced by a series of open courts out of which an alternative 'grid of movement' would develop. Source: March and Martin, 'Speculations', *21 and 37–38.*

proportion of the site that is developed, and how buildings adjoin (thereby limiting the need for a distance of separation to two aspects rather than four). Using diagrammatic representations they analysed three basic urban forms; the pavilion, the street (or slab) and the courtyard (or crucifix) to determine the potential density ratios that could be achieved with each (Figures 29 and 30). They demonstrated three key principles that were of particular significance for housing design.

1. Plot ratio is a reasonable measurement of how effectively land is development. However, contrary to the prevalent post-war argument, building height and form are not necessarily determined by plot ratio.

2. For each of the three basic urban typologies, an increase in height has a different effect on the increase in density. For the pavilion (the form of most high-rise blocks), an increase in height has the least impact on plot ratio because the building footprint is small. For the court form which has the largest site footprint, the same increase in height generates a much greater increase in plot ratio.

3. Due to their larger footprint, the same amount of accommodation that comprises a 15 storey tower could be accommodated in a court formation approximately one third of its height, indicating that lower-rise buildings with a larger footprint have a greater potential to generate high density ratios than high-rise 'pavilions'. Figure 30 demonstrates this principle applied to a typical New York block.

Two further observations were also made about the effectiveness of different built forms for achieving higher densities:

4. If the proportion of the building footprint that has outlook as opposed to no outlook is constant, then different built forms have different optimal site dimensions: attempting to reduce these dimensions results in a larger proportion of the floor area having no outlook.[102]

5. The demand for open space restricts the amount of housing that can be developed on a site. If a school shared the recreational facilities of the community, for instance, this would provide a workable solution to the problem that had previously restricted the available area of land for housing development.[103]

In terms of expanding the understanding of density ratios, the experiments published by Martin and March were transformative. In debunking the myths about high-rise being inherently more efficient they had problematised the simple correlation between density and building height that had come to preclude the scope for design in relation to housing. They demonstrated that the density ratio was determined by a composite of various dimensions of built form including, site coverage, the dimensions between buildings and the depth of the building plan.[104] This expansion of density as a measure of the 'built potential',

100 Glendinning and Muthesius also argued that the motivation for higher densities was motivated by aesthetic as well as social and economic factors. *Tower Block: Modern Public Housing in England, Scotland, Wales and Northern Ireland.*

101 'Speculation 9' in Lionel March and Leslie Martin, 'Speculations', in *Urban Space and Structures* , 51.

102 'Speculation 5' in *Ibid*.

103 This 'Speculation' draws on a model developed by Bullock, Dickens and Steadman which explored function and use in relation to time. Speculations 6 and 7 in *Ibid*, 28-54.

104 *Ibid.*

105 *Ibid.*, 2.

106 A lengthy and theoretical argument for the virtues of the grid as the basis for city planning was set out. The rectangular grid, admits change in the form and style of its buildings, enables growth by intensification of land use or by extension and allows for "those overlapping patterns of human activity which caused [Christopher] Alexander to describe New York as an organic city". *Ibid., 2, 8 and 13.*

107 Neave Brown, 'The Form of Housing', *Architectural Design* (September 1967): 433.

108 Sam Webb speaking at the 'Cook's Camden' symposium (2010) refers to the pressure of the Rent Riots in Camden in 1960. Camden Council proposed to increase rents in order to make up the shortfall in housing finances in the borough, leading to riots. Webb suggests that these rent riots provided the incentive to investigate the possibilities for increasing the density of new housing, without high-rise. Sam Webb, *'Cook's Camden: London's Great Experiment in Urban Housing'* (New London Architecture, The Building Centre, London, 30 October 2010)

109 Dempsey and Jenks, *The Language and Meaning of Density*, 299; Collins and Clarke, *Planning Research Programme*, 14.

or productive use of the site, has been continued in other subsequent studies, most notably the recent Spacematrix study.

The other significant influence that Martin and March's *Speculations* made was in the theoretical approach that they set out towards the practice of city planning. They argued that planning should not be concerned with visual image, or an attempt to predict future outcomes or outline desirable goals. Instead, the object should be to understand the relationships that exist in the physical structure of the city with the view to creating a greater choice and wider opportunity for different forms to develop.[105] The notion that the city might evolve, extend, become denser in form and activity after the intervention of the architect or planner had been completed, was in contrast to the determinist approach taken towards housing design in the previous decades. [106] Their thesis still propounded the emphasis on form and structure, however, the essential components of density, and their Speculations maintained the use of density ratios as a staple of planning practice.

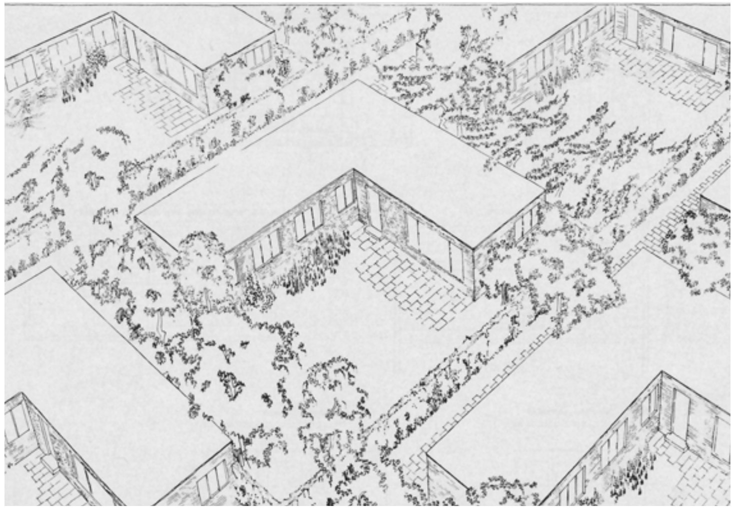
An increase in site capacity: providing the bulk to build with

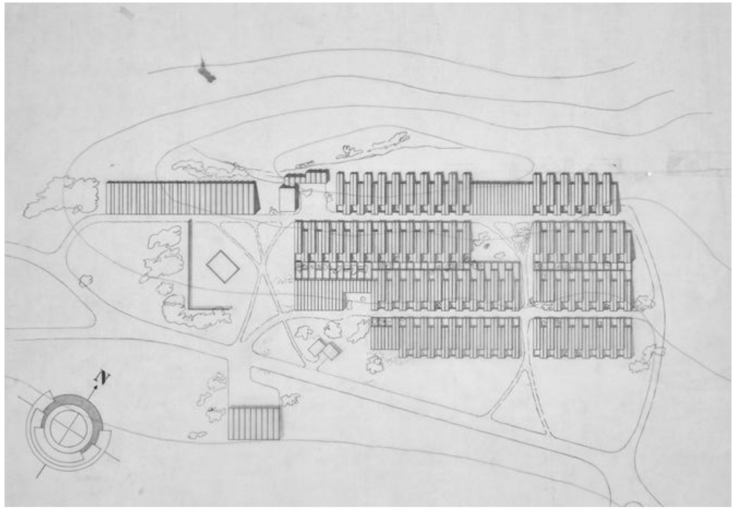
Their expanded conception of plot ratios as a composite of different dimensions of built form paved the way for further experimentation with the manipulation of density ratios and built form. Density ratios provided the framework - the standard or guide, within which form could be manipulated. The anti-forms that they had depicted as a counter to the high-rise 'pavilion' presented a new type of urban form and are credited with influencing a number of low-rise high-density housing schemes developed, particularly in London, during the late 1960s and 1970s. Neave Brown, architect of a number of the schemes developed in the London Borough of Camden under these principles described the spatial characteristics of this transformation:

> *...to build low, to fill the site, to geometrically define open space, to integrate. And at the same time to return to housing the traditional quality of continuous background stuff, anonymous, cellular, repetitive, that has always been its virtue.*[107]

The density ratio, as a measure of site capacity was still a primary concern. However, as opposed to the strategy of decentralisation pursued in the immediate aftermath of the Second World War, during the 1960s a number of financial incentives were introduced to encourage inner-city authorities to maintain higher urban densities. Local authorities were advised of the need to raise urban densities to ensure that the fullest use was made of development opportunities and to secure revenue and subsidy for housing development.[108] Guidance published in 1962 promoted higher densities for new urban housing (in the region of 100 d/ha) as a means of preserving agricultural land, preventing urban sprawl and protecting the countryside.[109]

The challenge of accommodating these densities in low-rise forms (in view of the unpopularity of high-rise housing), stimulated a series of experiments with form.





Left

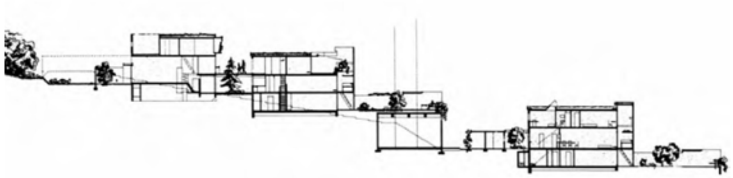
Figure 31: L-Shaped houses, Ludwig Hilberseimer. The houses are oriented around and have their main outlook over a private garden or courtyard, enabling close distances between the houses.

Source: *L. Hilberseimer, Nature of Cities (Academy Editions, 1955), 23.*

Right

Figure 32: Le Corbusier's plan for La Sainte-Baume, France (1948).

Source: *Fondation Le Corbusier, 'Urbanisme, Marseille-Sud, France, 1946', Fondation Le Corbusier.*



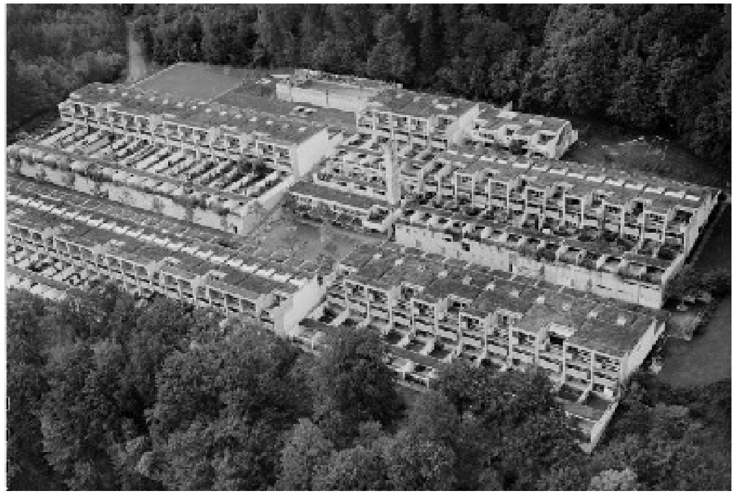


Figure 33: Section drawing and photograph: Siedlung Halen, Germany by Atelier 5 (1955-1961).

(It has not been possible to calculate the site density because the extent of the site area is unknown).

Photograph
Source: *Unknown, Siedlung Halen, Bern, Photograph, September 1963, ETH-Bibliothek Bildarchiv online.*

Section drawing
Source: Atelier Five, 'Siedlung Halen: Project Information' (Atelier Five, 1961), Practice website.

Ludwig Hilberseimer and Walter Segal had both previously experimented with 'court' or 'patio' dwellings and had demonstrated that relatively high densities of around 120 persons per acre (80d/ha) could be achieved, even with single-storey dwellings (see Figure 31).[110] The L-shaped plan was arranged around an enclosed patio onto which the main living areas of the house look out. The internal aspect allowed the dwellings to be situated close together - potentially even adjacent on three sides - creating a dense carpet of building punctuated by open courtyards.[111] Le Corbusier also contributed to the development of this type of housing. His holiday residences at St Baume shown in Figure 32 demonstrated the staggered section, tightly-packed terraced form and pedestrian and vehicular segregation that would come to typify the 'carpet' schemes of the period. The Siedlung Halen project near Bern in Switzerland (Figure 33) is probably one of the best examples of this type of housing and borrowed extensively from Le Corbusier's scheme.[112]

The Siedlung Halen scheme was conceived of as a model for a *cité*, which in French connotes both "a self-contained residential development and expectations of a city-like urbanity."[113] There were three elements to this 'city-like urbanity' that became defining characteristics of this type of housing.

i) The compaction of the scheme

ii) The focus of the site plan around a central street

The site for the Siedlung Halen was set in a clearing in the forest. However, as opposed to dissipating the houses amongst the greenery, the plan for the scheme sought to bring the houses together as tightly as possible, preserving the open space around the site and reinforcing the idea of the Siedlung Halen as a self-contained community rather than a scattering of individuals. The reintroduction of the street as a device for site planning and organisation was a clear indicator that a shift had taken place. In his text *City of Tomorrow*, Le Corbusier had reviled the 'corridor street' as he described it.[114] It had been taken to signify everything that was wrong with the historical city and everything that the Modern city should avoid. However, the protagonists of the low-rise approach reclaimed the street. Neave Brown wrote of it:

> *"Even at its worst it produced a certain immediacy of relationship between house and neighbourhood, and if haphazard and deficient in public and private amenity, the virtues of contact between house and street, neighbour and neighbour, pubs, shops and backyard industry, generated cohesive street society".*[115]

Proximity therefore, was attributed social benefits. At Siedlung Halen all 79 dwellings are served from one central pedestrian street. It is too narrow for cars, however, which are left at the entrance to the site.[116] Separation of pedestrian and vehicular traffic became a common feature of the low-rise high-density schemes. It allowed for a more intricate network of streets dissecting the site,

110 Glendinning and Muthesius, *Tower Block: Modern Public Housing in England, Scotland, Wales and Northern Ireland*, 146.

111 This type of low-rise housing comprising a dense network of court houses was commonly referred to during the 1960s and 1970s as 'carpet' or 'mesh' development. *Ibid*.

112 In his critique of the scheme, Neave Brown suggests that if it were in fact a fragment of the city of Bern, as opposed to an isolated resort outside of the city, it would have a number of progressive implications. "The plan is just one step away from that of the Permanent City of the St. Baume project." Neave Brown, 'Siedlung Halen and the Eclectic Predicament', *Architectural Design* (February 1963): 63.

113 Irénée Scalbert, 'Siedlung Halen', *Architectural Research Quarterly* 2, no. 1 (Autumn 1996): 16.

114 Le Corbusier, *The City of To-Morrow*, Translated from the 8th edn. (London: John Rodker, 1929), 167.

115 Brown, 'The Form of Housing', 432.

116 Alfredo Pini, one of the architects of the scheme stated strongly that cars should not be allowed to dictate the size or form of the town. Cited in Scalbert, 'Siedlung Halen', 17.

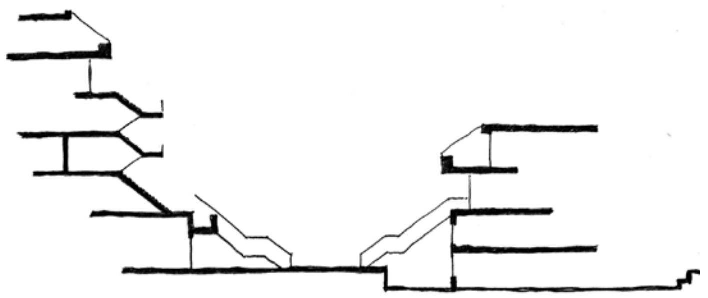


Figure 34: Sketch section and photograph showing the central street at the Alexandra and Ainsworth estate.

Neave Brown and Camden Council Architects' Department, (1968-72).

106d/ha

At Siedlung Halen and at the Alexandra and Ainsworth estate, each of the access routes to each of the dwellings feeds off the central street, creating a focus for community, activity and sociability.

Source: *author*

as opposed to the broad streets necessitated by transport and utility requirements that had been so heavily criticised by Manthorpe et al.[117] At the Alexandra and Ainsworth estate in Camden, designed by Neave Brown between 1968 and 1972, cars are directed around the outside of the site, allowing the central public thoroughfare to be scaled to the optimal proportions for human interaction, sociability and privacy rather than traffic movement (see photograph in Figure 34). The central street also provided a means of connexion between the house and the community.[118] The street was taken as a device for harnessing the social opportunity afforded by proximity between neighbours and to the city itself. Glendinning and Muthesius write of the first deck access blocks at Park Hill in Sheffield, they "were said to offer both a maximum of privacy and a maximum of contacts."[119]

The design of thresholds, entrances, terraces and gardens became the features with which designers were engaged. The Team X architects began to use new metaphors and images that created links between built form and social and psychological values. Terms such as 'cluster', 'community core', 'node', 'grain' or 'texture' began to be used to describe the layout, or 'environment' of new housing schemes.[120] There was also concern for the way that density was perceived. It reflected an emerging interest in the perception of the built environment in the field of environmental psychology (considered in more detail in Chapter Three).

Density was critical to this on two counts: one, it provided the physical bulk with which to form these clusters and nodes, and two, the necessity of proximity between dwellings. Neave Brown described the approach towards density as follows:

> *"It is this attempt to achieve a better relationship between the house and its environment which explains the changing attitudes towards housing, and the use of low-rise medium-density solutions that are now projected".*[121]

Neave Brown refers to the schemes as 'medium-density', but in terms of numbers the low-rise 'carpet' schemes and the deck-accessed, streets-in-the-sky schemes of this period had higher densities than the high-rise and mixed-development schemes that had been built during the 1950s and first half of the 1960s. The density ratios of the 'low-rise' developments varied widely, from about 170 to 500 persons per hectare (60 to 150d/ha).[122] Many exceeded density policy at the time which was set at 200, or 335 persons per hectare (depending upon the site location).

Despite the socially and community-oriented objectives of the low-rise protagonists, the schemes came in for criticism for a number of reasons. They were considered by some to be too complicated and ostentatious.[123] Lionel Esher suggested that the community oriented ideals of the architects had backfired, creating anti-social spaces. His criticisms implied a connection between density and social behaviour:

117 It is apparently cheaper to set buildings back from the street than to construct foundations in such a way as to avoid risk of damage to sewers and drains beneath. Manthorpe, 'The Machinery of Sprawl', 416.

118 Glendinning and Muthesius cite this as one of the primary concerns of architects at the time. *Tower Block: Modern Public Housing in England, Scotland, Wales and Northern Ireland,* 133.

119 *Ibid.*, 133.

120 *Ibid.*, 134.

121 Brown, 'The Form of Housing', 33.

122 Glendinning and Muthesius, *Tower Block: Modern Public Housing in England, Scotland, Wales and Northern Ireland*, 146.

123 *Ibid.*, 149–150.

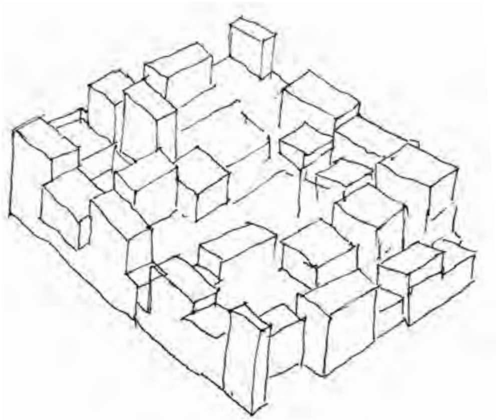


Figure 35: Sketch showing site massing and photograph of site interior: Odham's Walk, London Borough of Camden (1979).

154d/ha

The scheme is arranged around a series of intricate courtyards at the centre that are secluded from the main throughfare around the perimeter of the site.

Source: *Honorate Grzesikowska, Odham Walk, Covent Garden, London, Photograph, 2010*

High-density low-rise in practice meant mobs of children in echoing bricky courtyards, the mobs meant vandalism... They became 'hard-to-let', i.e. lettable only to the poorest and most disorderly families, who seldom had cars to occupy the now mandatory basement garages...[124]

The last of these type of developments to be permitted in London (at a density of 154 d/ha) was Odham's Walk in Covent Garden, completed in 1979 (Figure 41). Planning guidance set out in 1976 (to be the last explicit guidance on residential development densities in London until the Density Location and Parking Matrix was published in 1998) stated that;

From this time onwards, local planning authorities were expected to adopt a more flexible approach to residential density standards because they were not a reliable guide as to either the amount of accommodation that was likely to be provided on the site or its form, character and environmental quality.[125]

It marked the culmination of a progressive shift away from the Modernist application of density as an instrument of design and planning, but also a move away from the conception of density as having positive attributes for the qualities and character of residential environments. The policy set maximum densities for family houses with gardens at 210 habitable rooms per hectare (hr/ha) and 250 hr/ha for mixed development (this equates to a range of 50d/ha to 70 d/ha). There were some exceptions for sites in central London which it was deemed may be suitable for households without children. For these sites, densities up to 350 hr/ha would be allowed, provided there was a low proportion of family housing and that any family accommodation would be provided in low-rise houses rather than flats or maisonettes.[126]

The policy was intended to address the pattern of declining population in the central London boroughs – a trend that was predicted to continue. Conversely, it sought to do this through the redevelopment of some of the most densely developed parts of the city at lower densities to reduce the "overcrowding" of inner city areas that were deemed to be unpopular and a motivation for the trend of out-migration from the city.[127] A policy of general redistribution was promoted, with redevelopment of inner city areas "so that excessive overall densities can be reduced in congested parts while more dwellings are built at the best modern standards of environment allow, particularly in Outer London."[128]

Density as the basis for proximity and continuity

In the previous episode it became apparent that density was not only a means of measuring the amount of development, but that density ratios had become an instrument for bringing about a particular set of objectives in regards to the form and organisation of housing. In this episode too, although the particular forms associated with higher and lower density ratios had shifted, the ratios themselves continued to be a determining criteria in the type and layout of development on a site. There were two main

124 Esher (1981) cited in Hall, *Cities of Tomorrow: An Intellectual History of Urban Planning and Design in the Twentieth Century*, 226.

125 Taken from DoE (1976) *Residential Density in Development Briefs*. Development Advice Note 2, London, HMSO, cited in Collins and Clarke, '*Planning Research Programme*', 15.

126 *Ibid*.

127 London experienced consistent population decline from the 1930s until the 2000s. Only recently has this trend started to reverse. Greater London Council and Office for National Statistics, Historic Census Population - *London DataStore, Demographics* (Greater London Authority, 10 September 2010).

128 Greater London Council, *'Greater London Development Plan'* (Greater London Council, 9 July 1976), para. 3.13.

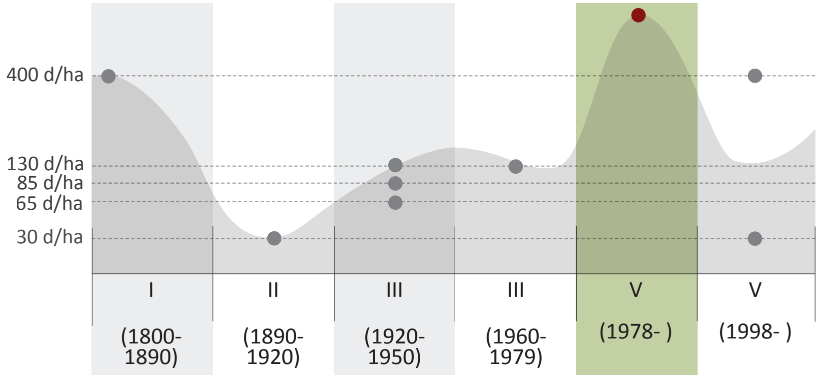
changes, however. First the numbers went up. The density of the Alexandra and Ainsworth estate in Camden at 106 d/ha or 500 persons per hectare was more than double the maximum standard set in the 1943 County of London Plan. It was, nonetheless described at the time as 'medium-density' as a means of distinguishing it from the 'high-density flats and low-density housing' development of the previous decades.[129]

The main shift, however, was in the spatial qualities of the housing that was built during this period. The criticism that had been waged against the housing built in the post-war decades - the destruction of the fabric of the city and the loss of immediacy between buildings and the street - these ideas were taken on board and provided the guiding principle for architects in their use of density, both as a concept and a measure. Whilst the numbers were important – they provided the physical bulk of building for architects to manipulate – the conception of density had also shifted. The notion of density as a generator of proximity, between people and between buildings and the idea that this might have implications for the urban environment marked a turning point. Ever since the introduction of density ratios to planning discourse at the beginning of the twentieth century, their use had been motivated by an aversion to the congested city and the notion of too many people. The conception of proximity as a potentially positive quality of the urban environment, and the attempt to develop site layouts that harnessed this potential through the creation of community spaces and threshold spaces between the dwelling and the surrounding neighbourhood represented a dramatic departure from previous conceptions of density. However, it was relatively short-lived and by the end of the 1970s the pervasive notion of density and proximity as contributing towards anti-social behaviour had re-established and would inform a general policy of low-density and decentralisation in UK planning over the course of the next two decades.

129 Neave Brown described the type of housing as medium-density low-rise. 'The Form of Housing'. Abercrombie and Forshaw used the phrase 'high density flats and low-density houses'. *County of London Plan* (1943).

Anthorp Hotel, New York
(1906)
Clinton and Russell
900 d/ha

Kowloon Walled City, Hong Kong
(1800s-1993)
14,000 ppl/ha



Episode V: 1978-

Density, proximity and complexity

This episode is a slight departure from the previous ones in that it focuses primarily on two theoretical studies. The first is Rem Koolhaas' seminal *Delirious New York*. Published in 1978, *Delirious New York* is a conceptual treatise to the potentiality of density.[130] The retrospective manifesto for the growth of New York builds up an analogy of a 'culture of congestion' that characterises not only the built mass of the city, but the social and economic experience of it. The second study is MVRDV's FARMAX from 1998, which presents a series of design-based explorations on the subject of maximising density.[131] Whilst MVRDV's studies represent only a sample of the design-based studies that have explored the potential of density as a catalyst for design, the studies are of particular interest because of the way that ideas from them have informed built projects by the practice and therefore begin to demonstrate how their theoretical ideas about density have played out and what their design implications have been or might be.

Density and Delirium

Taking the historical development of Manhattan as the starting point, Koolhaas proposes that in the Capital of Commercial Culture (Manhattan), density is a product of speculation and potentiality. The Manhattan skyscraper, Koolhaas writes, is born out of the convergence of three 'urbanistic break throughs': the reproduction of the World, the separation (annexation) of the tower from the rest of the block and finally, the designation of the block itself.[132] The convergence of the elevator and the steel frame provided the technological potential to 'reproduce the World' an infinite number of times. It was the starting point for a foray into taller and bigger buildings and dramatic increases in density. The Globe Tower that Koolhaas describes (Figure 36) is the essence of the idea of the skyscraper. Mathematically, the Globe is the form capable of enclosing the maximum interior volume with least external skin and which multiplies its footprint the most times. Assuming its site footprint to be the area of the eight socles on which it stands, the Globe tower reproduces its site 5,000 times (Figure 37).[133]

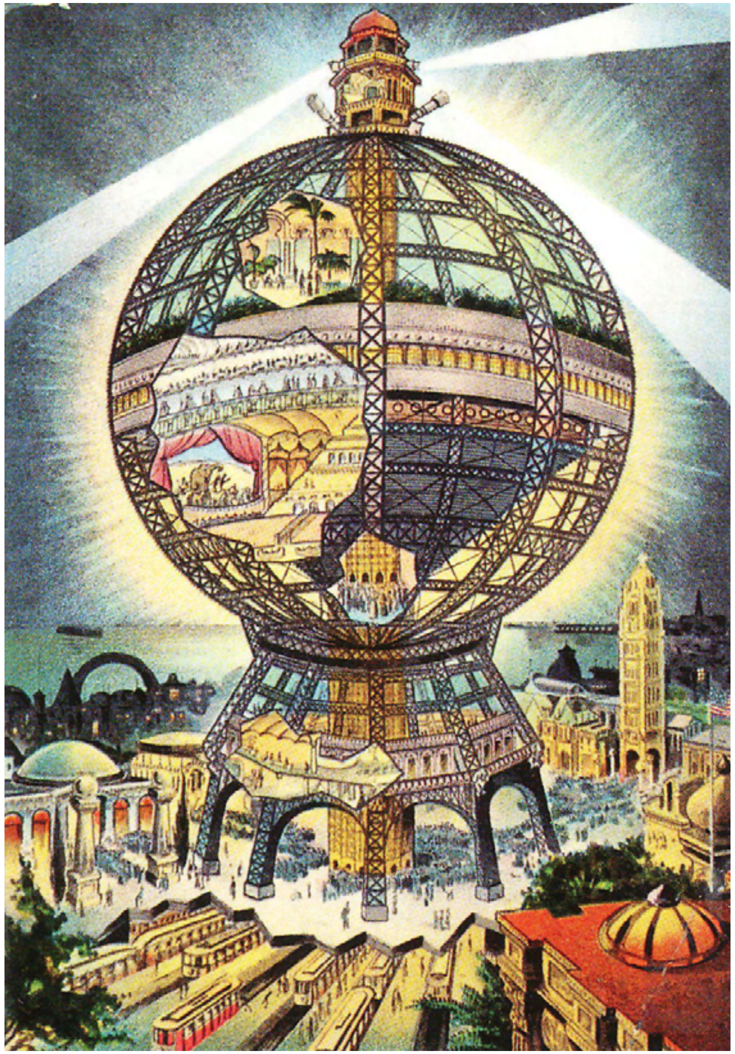
Whereas Le Corbusier and Gropius had expounded the virtues of building tall as part of their agenda towards controlling the density of the city overall, the culture of congestion in Manhattan exploited building height in a different way. Koolhaas describes the simple extrusion of the site that characterises Manhattan's early skyscrapers:

130 Rem Koolhaas, *Delirious New York: A Retroactive Manifesto for Manhattan*, New Edn. 1994 (New York: Monacelli Press, 1978).

131 *FARMAX - Excursions on Density*, ed. Winy Maas, Jacob van Rijs, and Richard Koek, 3rd ed. (Rotterdam: 010 Uitgeverij, 1998), 153 – 174.

132 Koolhaas, *Delirious New York*, 82.

133 *Ibid.*, 72–74.



Friede's quantum leap:

1. Assuming Globe Tower has diameter 500 ft
2. Assuming that floors are 15 ft apart

Formula for total sq footage:

$$\pi h^2 \sum_{k=0}^{n} k(n-k)$$

$$h = height\ 15'$$
$$n = no.floors + 1$$

= 5,000 000 sq feet

Assuming the area consumed by the 8 socles (supports) as 1000 sq ft

$$\frac{\text{Artificial surface} = 5000000}{\text{Area of the site} \quad 1000}$$

The Globe Tower can reproduce its site 5000 times!

Left

Figure 36: The Globe Tower (second version) with exploded interior showing Roof Gardens at the top, theatres, revolving restaurant, ballroom and circus. It would be the world's "first single building to claim the status of resort."

Source: Rem Koolhaas, *Delirious New York: A Retroactive Manifesto for Manhattan,* New Edn. 1994 (New York: Monacelli Press, 1978), 72 (image) and 74.

Right

Figure 37: Friede's Quantum Leap describes the theory of maximum volume to surface area ratio – the essential principle for the Globe as building form. The Globe Tower can reproduce its site 5000 times!

Source: Rem Koolhaas, *Delirious New York: A Retroactive Manifesto for Manhattan,* New Edn. 1994 (New York: Monacelli Press, 1978), 74.

134 *Ibid.*, 107.

135 *Ibid.*

136 *Ibid.* citing Hugh Ferriss (1929) The Metropolis of Tomorrow.

137 Le Corbusier, *The City of To-Morrow*, Translated from the 8 (London: John Rodker, 1929), 177.

138 *Ibid.*, 144.

The process of reproduction loses its credibility through the grim deterioration – both financial and environmental – it inflicts on its surroundings. Its shadow alone reduces rents in a vast area of adjoining properties, whilst the vacuum of its interior is filled at the expense of its neighbours.[134]

The allure of the building's awesome scale became the driver of density.[135] In contrast to the regulatory approach advocated by Le Corbusier, early twentieth century Manhattan was characterised by a laissez-faire approach towards dwelling conditions and towards density. The increase in building height, without the increase in the distance between the blocks (as in the Modernist city) impacts on the urban environment to the extent that it eventually becomes a concern, not only for the individual land owner, but the city as a whole. The Zoning Laws of 1916 imposed limits on building mass in order to protect the interests of the city.[136] The rendering shown in Figure 39 represents the maximum dimensions of built form permitted by the 1916 Law.

The essential difference between Le Corbusier's Plan Voisin and the Manhattan grid is a matter of density. They manifest fundamentally different attitudes towards the social, economic and experiential possibilities associated with density. Le Corbusier argued for the economic benefits and efficiency of higher density construction but ardently refuted that the experience of the 'congested' city was something to be embraced.[137] The exercise of control over the density of the urban fabric has a decisive impact and characterises the difference between the two urban types. Le Corbusier's proposal for the decongestion of the city in concentrated, high density building typologies (concentrated decongestion is a reasonable description), was proposed as a means of ensuring the qualities of sunlight, ventilation and adequate space were available to all of the city's inhabitants.

The introduction of the Zoning Laws to limit the impact of overshadowing and the negative effects of tall building on the spaces around them was a recognition of the impact that density could have in the qualities of the urban environment. However, density was also an economic mechanism and there was therefore no attempt at all to limit density ratios. Towers, occupying up to one quarter of the building plot, could be extruded to infinite heights as long as the technology existed to build it and there were financiers willing to fund it. In contrast to the regulated density policies common across European cities during the twentieth century, in Manhattan, the economic potential afforded by ever higher densities was prioritised over the potential implications on residents' access to adequate space, sunlight and ventilation.

Perhaps the most explicit illustration of the relationship between wealth and the qualities and comfort of the residential experience in New York is the residential hotel or the closely related apartment hotel. Koolhaas describes the residential hotel as Manhattan's definitive 'unit of habitation'.[138] The organisation of the Residential Hotel as a collective structure comprising multiple, individual dwelling

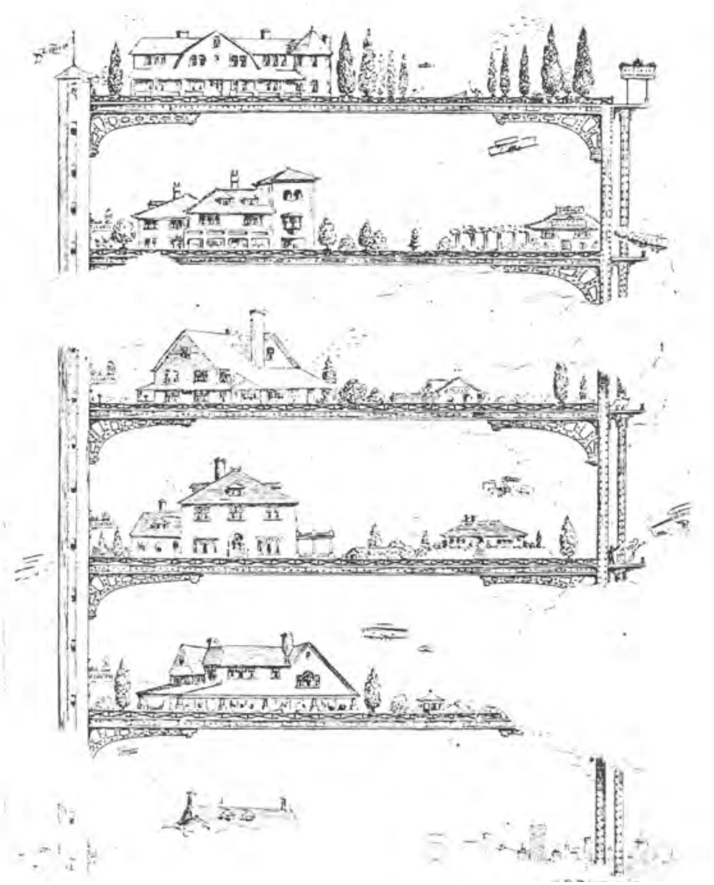


Figure 38: "1909 Theorem: the Skyscraper as utopian device for the production of unlimited numbers of virgin sites on a single metropolitan location". Source: *Rem Koolhaas, Delirious New York: A Retroactive Manifesto for Manhattan, New Edn. 1994 (New York: Monacelli Press, 1978), 83.*

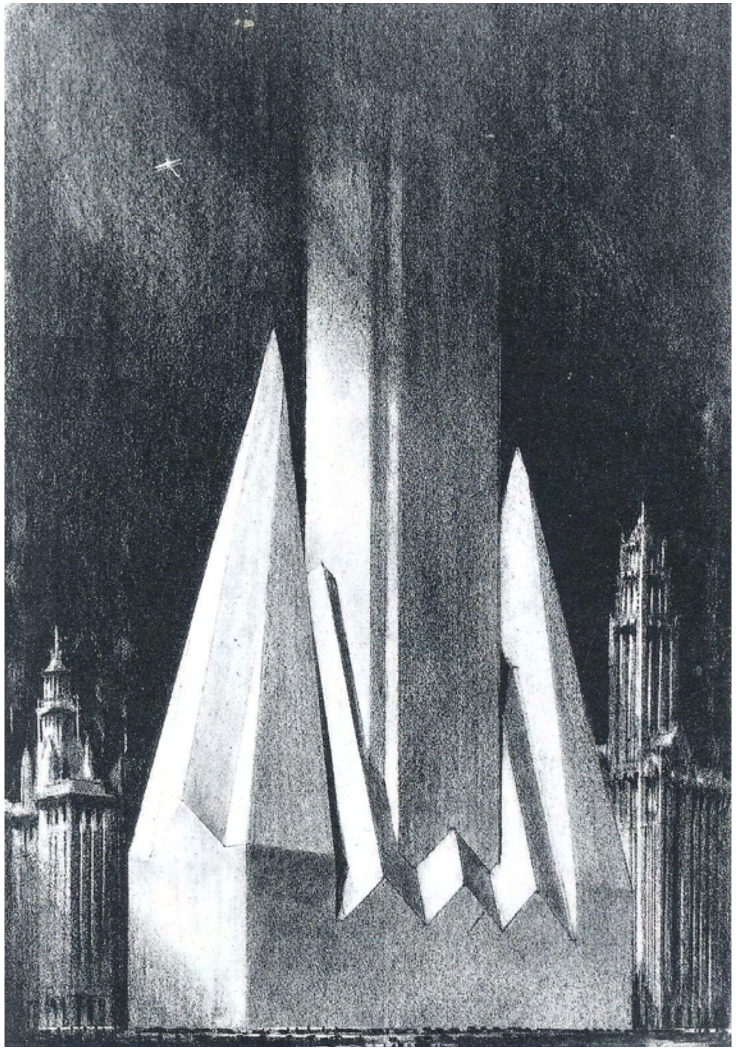


Figure 39: Theoretical envelope described by the 1916 Zoning Law. The site can be multiplied a certain number of times, then the building mass must step back and a tower, 25 per cent of the site area, can continue to unspecified heights. Rendering by Hugh Ferriss. Source: *Rem Koolhaas, Delirious New York: A Retroactive Manifesto for Manhattan, New Edn. 1994 (New York: Monacelli Press, 1978), 109.*

units enabled an expansion of the scale of the building to fill the extent of the block in a way that could not be achieved with individual dwelling houses. (Figure 41 shows the floor plan of a typical Apartment Hotel.) These perimeter-type buildings reached around 12 storeys in height, and generated density ratios of up to 900 dwellings per hectare. The density of residents on site (and the prices that would paid for a central location) enabled the provision of a vast array of services and function spaces. Shared between a large cohort of hotel residents, a range and quality of amenity spaces could be provided that were simply unfeasible in the single-family house.[139]

There was a stark difference however between the provisions of the upper class Apartment hotels such as the Apthorpe (Figure 40), and lower class hotels of the time. In the lower class hotels the demand for beds, limited supply (not to mention the lack of enforced standards) prompted the emergence of cubicle hotels (as in Figures 42 and 43). Bedspace was rented by the hour.

For the wealthy, the Residential Hotel offered residents the prestige of a good address, a central location, unctuous service and architectural grandeur. It also offered flexibility which was a distinct asset in the speculative fervour of early twentieth century Manhattan. Groth writes:

> *For wealthy hotel residents, a month or a season's lease is the longest financial commitment and tie to their home. They rent their furniture, dishes and all other aspects of shelter.*[140]

Koolhaas describes the Residential Hotel as an "instrument that liberates its occupants for total involvement in the rituals of metropolitan life."[141] In comparison with the freedom afforded to residents of the upper class hotels, however, residents of cubicle and single-room occupancy hotels found that their daily routine was determined by the rules of the institution. There were rules about what time beds were to be vacated by, what time residents could return, and a lack of security to enable residents to leave their possessions. The pressure of demand, high cost of floor space and general overcrowding, rendered the lower class hotels deficient in terms of privacy, security and the basic physiological requirements of daylight and ventilation.[142] There are many similarities between the insecure and inadequate conditions of the lower class residential hotels and the sub-divided and sub-let town houses considered in Episode One.[143] Indeed, both demonstrate the consequences that the pressures of demand that encourage higher densities can have on dwelling conditions when left at the mercy of private commercial interests.

At both ends of the economic scale, the Residential Hotel can be thought of as a vernacular of Manhattan's 'culture of congestion' as Koolhaas describes it. Its scale, organisation and flexibility correspond to the speculative economic culture and unbridled enthusiasm for the technological possibility of building bigger and taller. It also raises questions over the potential implications of the drive towards higher densities when it is unregulated. The impact

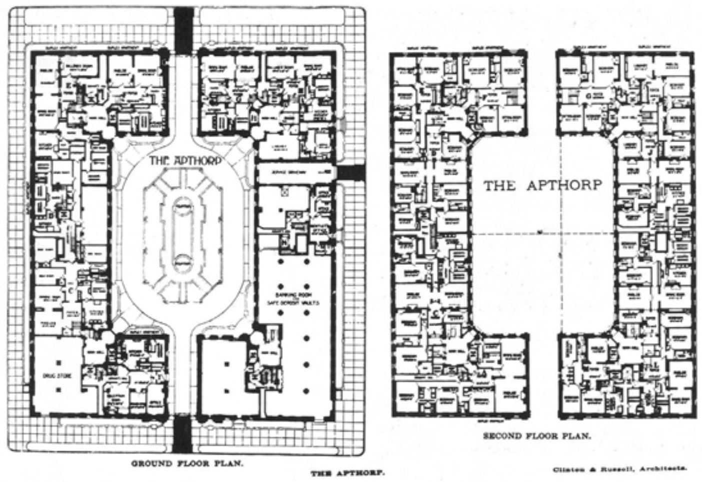
139 Paul Groth, *Living Downtown: The History of Residential Hotels in the United States* (London: University of California Press, 1994); Richard Plunz, *A History of Housing in New York City* (Oxford: Columbia University Press, 1990).

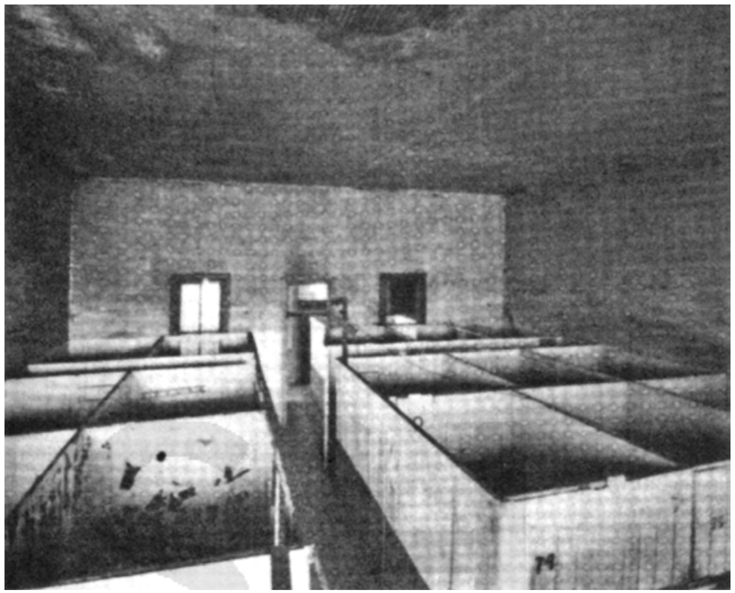
140 Groth, *Living Downtown: The History of Residential Hotels in the United States*, 8.

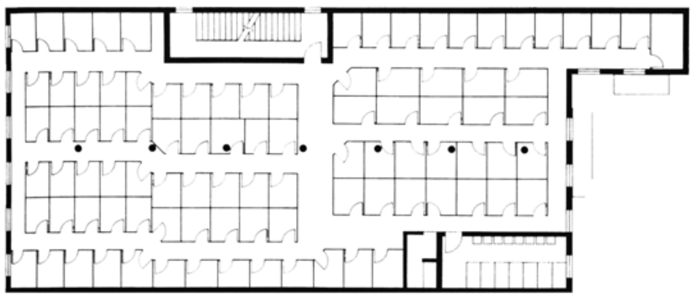
141 Koolhaas, *Delirious New York*, 144.

142 Despite these deficiencies the lower class residential hotels made an important contribution to housing supply in many North American cities during the late nineteenth and early twentieth century. Groth, *Living Downtown*.

143 In the crowded conditions of nineteenth century London the pressures of demand and increasing land values pushed up the cost of rent out of the reach of many and resulted in sub-divisions, sub-letting and box-and-cox style sharing of living space where families could not afford a dwelling, or even a whole room of their own. Wohl, *The Eternal Slum*.







Top left

Figure 40: Apthorpe Apartment Hotel designed by Clinton and Russell for William Waldorf Astor (1906-1908). Source: *Irving Underhill.*

Top Right

Figure 41: Ground Floor and Typical Floor plan of the Apthorpe 'Apartment Hotel'. The range of functions provided in these early Apartment Hotels were vast and extravagant. Reports have noted the inclusion of a private dairy in the Ansonia Building, swimming pools, barber shops, service and repair garages (despite the very recent introduction of cars to the streets of New York) and laundry services. Source: *Richard Plunz, A History of Housing in New York City (Oxford: Columbia University Press, 1990), 80.*

Bottom left

Figure 42: Cubicles in a high-ceilinged loft space, c.1923. Source: *Paul Groth, Living Downtown: The History of Residential Hotels in the United States (London: University of California Press, 1994), 143.*

Bottom right

Figure 43: Typical floor plan with cubicles c. 1900. Taken from the Kenton Hotel on the Bowery in New York City. Source: *Paul Groth, Living Downtown: The History of Residential Hotels in the United States, 145.*

of overshadowing is noted and acknowledged, but there is also an impact in terms of the increasing cost of space, sunlight and ventilation. Freedom from the burdens of housekeeping and domestic work was one of the benefits of collective dwelling structures harnessed by Le Corbusier in his Unité d'Habitation project. But, whereas Le Corbusier had intended liberty for all, the Residential Hotel provided liberty only for those that could afford it. Whilst the Zoning Laws adopted in Manhattan sought to limit the impact of the building's mass on the city streets, they did not attempt to limit the permitted density ratio. As Koolhaas writes:

> *Manhattanism is the one urbanistic ideology that has fed, from its conception, on the splendours and miseries of the metropolitan condition – hyper-density – without once losing faith in it as the basis for a desirable modern culture.*[144]

The introduction of regulatory controls in London and other European cities governing maximum densities can be viewed therefore, not only in the context of the social and hygienic factors that they sought to address, but also the essential impact of these controls on density ratios, economics and conditions of social equity. The proposals for controlled density set out by Ebenezer Howard, Raymond Unwin and later by Le Corbusier, were all premised on the objective of creating a healthy environment, motivated by a concern for the collective well-being of the city's population. Indeed Howard also made a point of acknowledging the increase in land values that would result from the increase in density brought about by the establishment of the Garden City and suggested that it be held in a community trust for use for the benefit of the community. By comparison, the lack of control over maximum densities in Manhattan allows for continued increase in land values, continued increase in the cost of space and, by virtue of the increased scale of the buildings, an increasing premium on access to sunlight and daylight.

Experiments with density, programme and form

MVRDV's studies raise two important points about density and its use as a concept within design. They posit that density is defined by activity and use. They also suggest that built mass is essential for generating the opportunity for activity. Before going any further in introducing MVRDV's FARMAX study, another important source of theory on the subject of density should be considered briefly. The documentation of Kowloon Walled City in Hong Kong, which emerged in the early 1990s (an essay on which is included in FARMAX) fuelled interest in the potentiality of density.

The study of Kowloon Walled City makes an important contribution to the notion of density as a complexity of programme and use. The documentation of Kowloon Walled City that was published in the early 1990s revealed an enthralling picture of density at its most extreme.[145] Occupying two and half hectares of land, the city held a capacity of approximately 35,000 inhabitants, at an average density of 14,000 people per hectare making it the most densely populated settlement in the world (see Figure 44).[146]

144 Koolhaas, *Delirious New York*, 10.

145 Greg Girard and Ian Lambot, *City of Darkness: Life in Kowloon Walled City,* ed. Ian Lambot (Chiddingfold: Watermark Publications (UK), 1993).

146 Liauw, "KWC FAR 12: Kowloon Walled City Density Study", in *FARMAX - Excursions on Density*, edited by Winy Maas, Jacob van Rijs, and Richard Koek, 3rd ed., 153 – 174. Rotterdam: 010 Uitgeverij, 1998, 154.

These figures can be compared to peak densities for Shanghai cited as 962 ppl/ha, 172 ppl/ha for London. Taken from Ricky Burdett and Deyan Sudjic, *The Endless City* (London: Phaidon Press Ltd, 2007), 252.

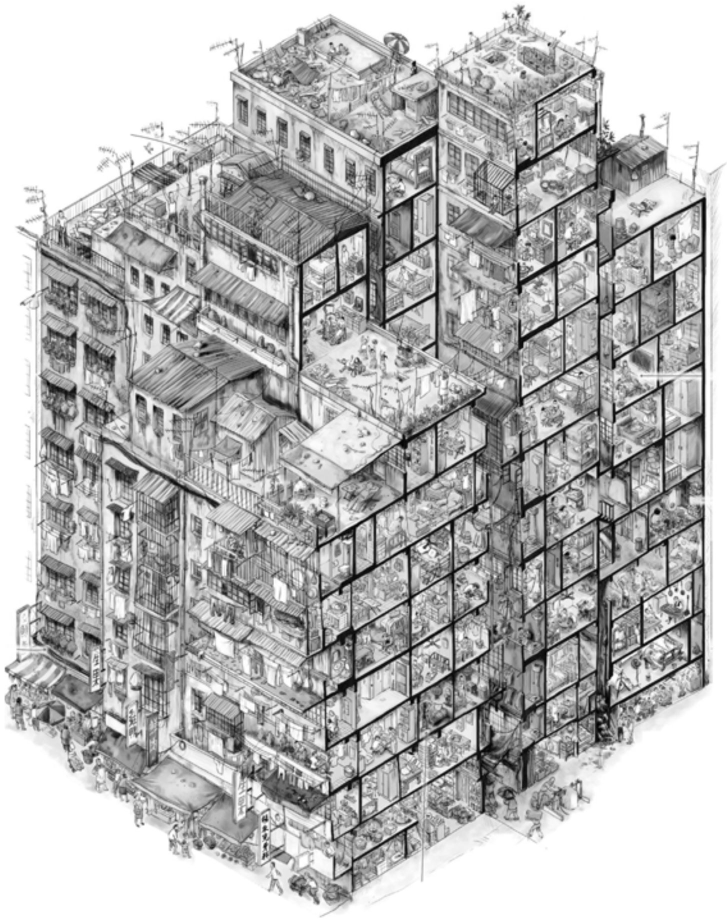


Figure 44: Life Inside The Kowloon Walled City. Source: Adolfo Arranz, Infographic: Life Inside The Kowloon Walled City, April 18, 2013, South China Morning Post,

A mix of people and programmes that, under Modernist planning dogma would be categorised and zoned into separate parts of the city, were found co-existing within a single urban block. These blocks, and the city that they formed - "essentially a single lump of building"[147] - had an urban logic that was entirely distinct from the Modern city, or any city model that had been subject to planning and organisation over the past 500 years. There were no thoroughfares, for instance, only alley ways, in some cases less than a metre wide. The critic Liauw writes: in the fabric of the two-and-a-half hectare walled city, the "normal scales – of the block, street, room, courtyard, open spaces, light incidence, staircase – collapsed."[148] The classical and modern planning laws, and regulations that determine expected minimum and maximum dimensions of buildings and the spaces in between in the Western city, were irrelevant in the context of such an intensely built-up urban fabric. The critical shortage of space also prompted the emergence of hybrid typologies and the blurring of conventional definitions and distinctions between types of spaces, and indeed types of buildings and urban zones. Liauw writes:

A cafeteria would transform into a mah-jong parlour at certain hours, while a plastic toy factory doubled as an illegal drugs den… a sweatshop and a social club would occupy the same space… non-domestic units (NDU) were often incorporated into residential quarters [...implying...] a typological blurring of KWC [Kowloon Walled City] in section (as well as plan) where levels no longer typify the programme.[149]

The Kowloon Walled City epitomised the idea of use rather than typology being the primary determining factor in designing the urban fabric of the city. In his essay in FARMAX, Liauw notes that the super-deep plan that cast the city into darkness most of the time, freed Kowloon's city programme from the "constraints of 'natural biorhythms'" and enabled the city's 24-hour programme to propagate.[150] The fabric of the Walled City exemplified the notion of a flexible urbanism, able to accommodate a seemingly infinite combination of uses and generating a distinct programme of activity. Of course, living conditions were insanitary, services and infrastructure were ad-hoc and dangerous, and the majority of apartments and workplaces had no natural light or ventilation. Nonetheless, the documentation of Kowloon and Koolhaas Delirious New York had begun to alter the perception of density as inherently negative and to associate it with the possibility for generating new urban typologies. Koolhaas' Delirious New York and MVRDV's studies share in common the notion that density - specifically the physical mass of the city - is inherently about programme. Koolhaas describes Manhattan as a collection of colossal houses:

An ultra-modern Mega-Village enlarged to the scale of a Metropolis, … where traditional and mutant lifestyles are simultaneously provoked and sustained by the most fantastic infrastructure ever devised.[151]

147 Girard and Lambot, *City of Darkness: Life in Kowloon Walled City,* 13.

148 Liauw, "KWC FAR 12: Kowloon Walled City Density Study," 154.

149 *Ibid.*, 155.

150 *Ibid.*, 154.

151 Koolhaas, *Delirious New York*, 257.

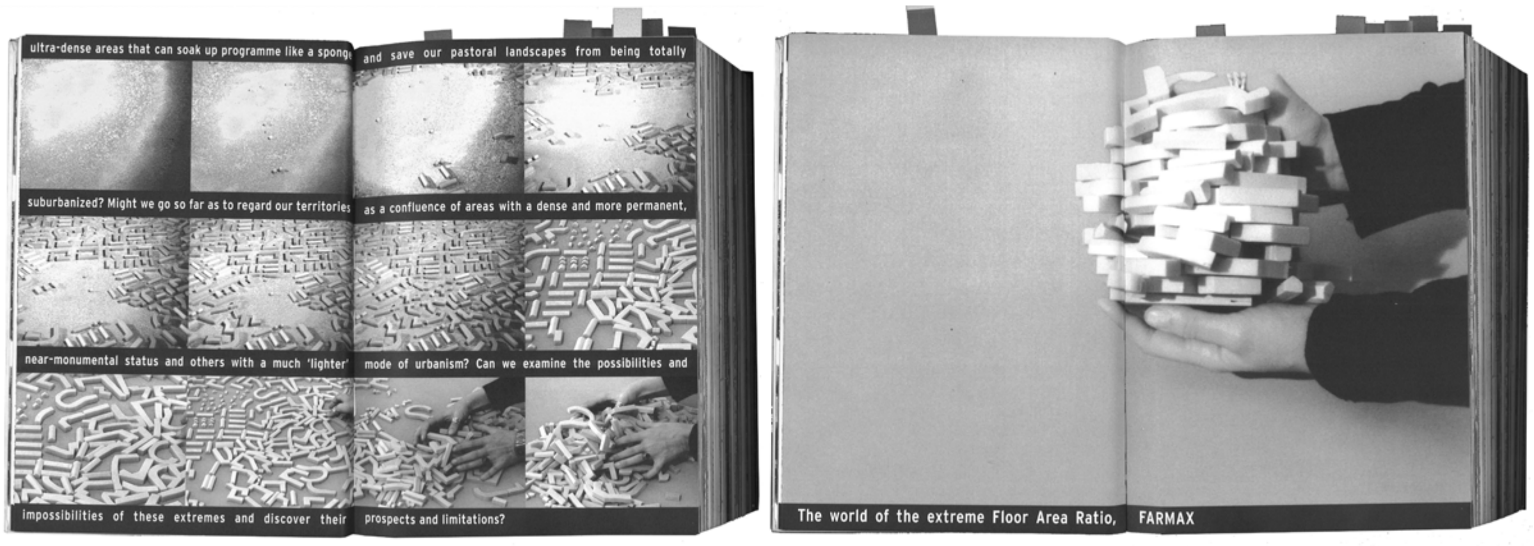
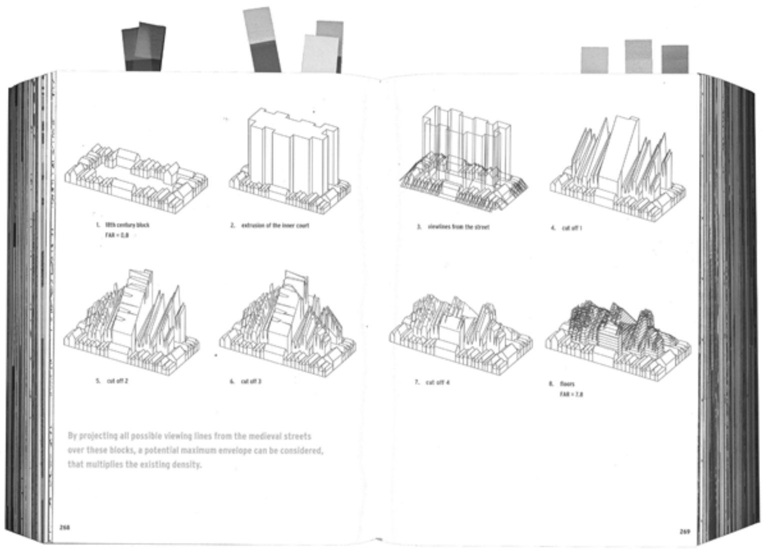
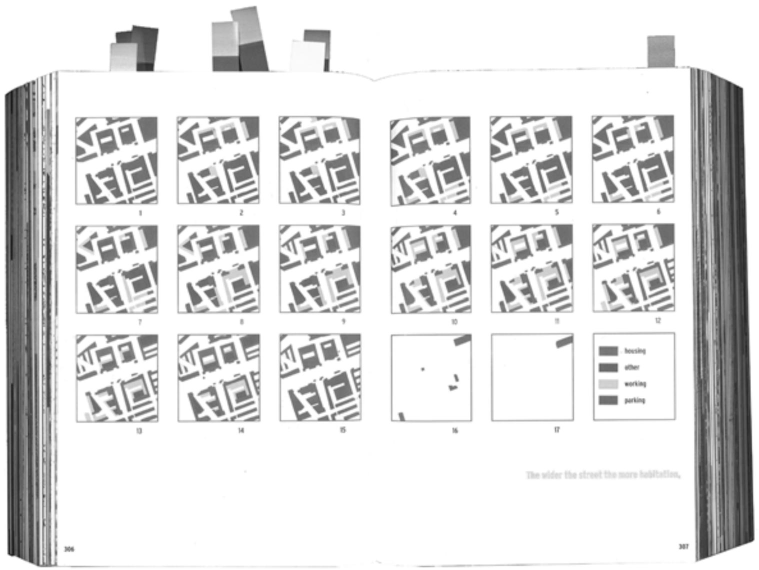


Figure 45: Experiments with 'ultra-dense' urbanism that can "soak up programme like a sponge'. Images from the prelude to FARMAX. Source: *MVRDV, FARMAX - Excursions on Density, ed. Winy Maas, Jacob van Rijs, and Richard Koek, 3rd ed. (Rotterdam: 010 Uitgeverij, 1998)*





Left

Figure 46: Gothics: Design Study for the densification of Amsterdam, the Netherlands - MVRDV (1996). Exploring the potential for accommodating 'giant programmes' in the inner courts of old European towns. Keeping the ancient facades is part of the successful marketing strategy, "as masks for modernity". Source:Source: *MVRDV, FARMAX - Excursions on Density, ed. Winy Maas, Jacob van Rijs, and Richard Koek, 3rd ed. (Rotterdam: 010 Uitgeverij, 1998), 267–269.*

Right

Figure 47: Trojan Extrusion: Densification study for Rotterdam centre, The Netherlands - Mark Verheijen (1995). Source: *Ibid., 304–305.*

The vast scale of the skyscraper ‘houses’ is sustained by new and hybrid typologies that fill their volumous interiors.[152] MVRDV suggest that housing alone is insufficient to sustain an urban fabric that comprises such deep buildings and renders such a high proportion of the floor area without natural light. They write:

> *Stronger means than just housing are required to produce a truly compact city with a density comparable to that of New York or Hong Kong. Dutch legislation restricts housing to comparatively low densities. To build more densely requires implementing more light-insensitive functions. Hence the concept of mix is essential alongside those of densification and modernisation to make an attractive compact city.*[153]

Urbanism is about programme, it is about events, they suggest.[154] The ‘sciences’ of urbanism, sociology and psychology have trained us to see the city as a functional system of relations and links – as a holistic mass that can be programmed and within which the individual is placed. Whereas, if the city is conceived of as a composite of the activities and events that take place between subjects (“soft bodies whose form changes depending on the gravitational field they occupy and the information they receive”) then the “model of a continuous and contained city” is of little use. In this context, the rules that urbanism prescribes will need to allow for the maximum freedom of urban operations, particularly those of private enterprise.[155] The static notion of density is also redundant. Instead of urbanism being intent on determining built form and prescribing density in terms of the plot ratios and mass of building, the definition of urbanism as an index of programme and events, situates density as a transient and temporal phenomenon, essentially defined as a concentration of activity. They write:

> *Urban density, then, is more than simply upping the Floor Area Ratio. It also entails densifying and stacking functional, social and economic systems and levels in the city.*[156]

In the design explorations that illustrate and extend the hypotheses proposed in FARMAX, social and economic programme is taken as the starting point.[157] However, in almost all, this is taken as a catalyst for generating higher density ratios on the chosen, or hypothetical, site (Figures 45 and 46 show examples). FARMAX documents a number of experiments with combining programmes within a block. The ‘Trojan Extrusion’ project (Figure 47), proposes extending the existing mass of the city to a new and consistent height, creating plateau at roof level. Within these blocks, the area that could accommodate housing (on the basis of available light) is indicated in the diagrams. The remaining space would be occupied by other types of programme. This idea can be traced in the practice’s recent *China Hills* project for the Future China exhibition in Beijing in 2009 (Figure 48). The concept is based on an extrusion of the maximum plot ratio for the city to form a continuous landscape of building. The rooftops form a green landscape. Housing is arranged long the contours of the ‘hills’ and looks

152 *Ibid*.

153 MVRDV, *FARMAX - Excursions on Density*, ed. Winy Maas, Jacob van Rijs, and Richard Koek, 3rd ed. (Rotterdam: 010 Uitgeverij, 1998), 304-305.

154 *Ibid.*, 101.

155 *Ibid.*

156 *Ibid.*, 126.

157 *Ibid.*, 122–123.

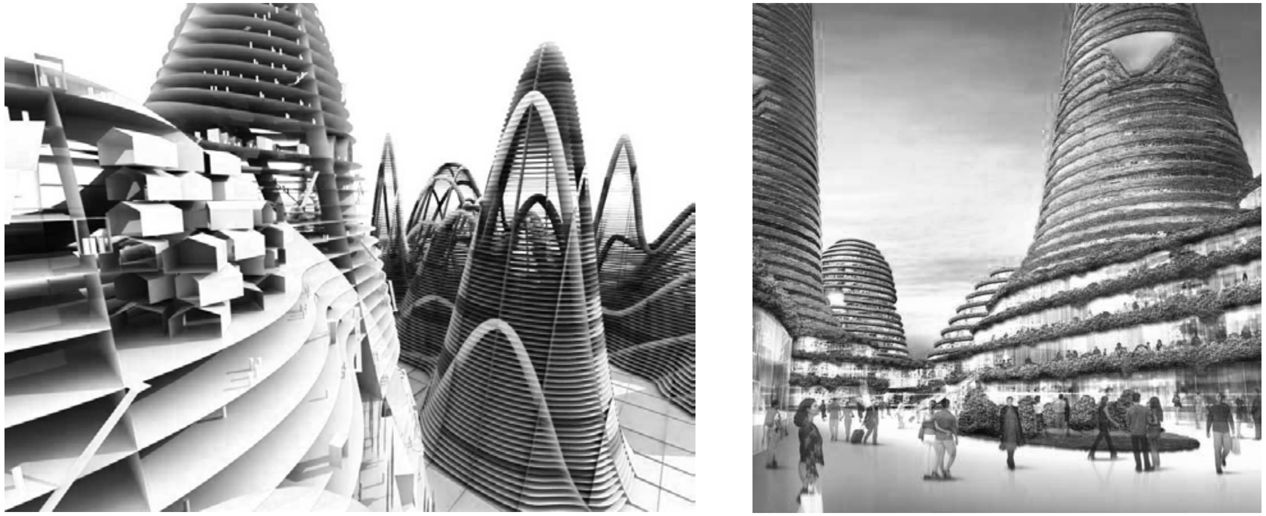


Figure 48: China Hills conceptual proposal by MVRDV working with Paolo Soleri as part of the 3D City: Future China exhibition at the Beijing Centre for the Arts. It proposed constructing an undulating mountainous landscape out of the fabric of the city; the upper surface would provide an agricultural landscape. Source: MVRDV, *"Exhibition: China Hills,"* MVRDV: Projects, November 2009

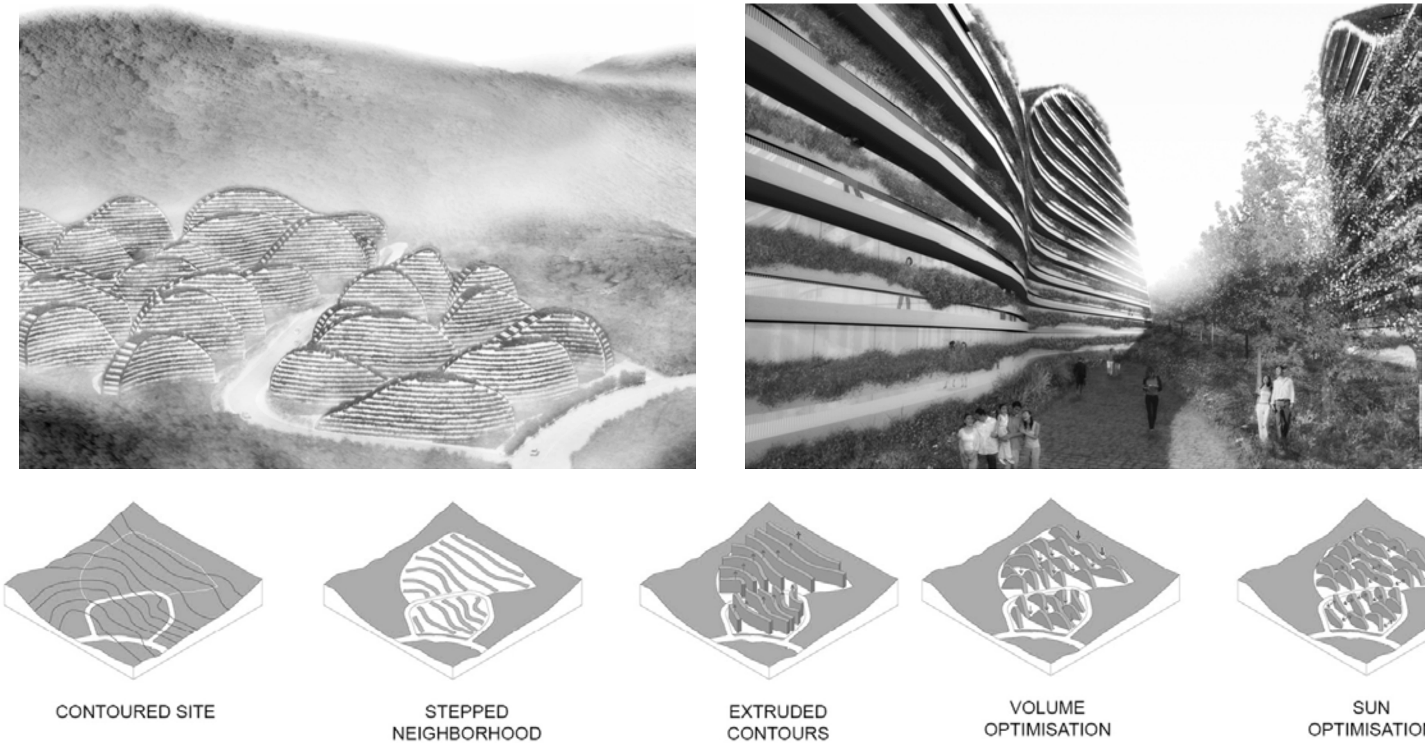


Figure 49: Gangnam Hills project, Seoul, South Korea - MVRDV (2010) the project reflects the conceptual idea of the built fabric as a topography. Source: MVRDV, *"Gangnam Hills, Seoul, South Korea,"* Practice's website, MVRDV, 2010

out. Meanwhile the interior is filled up with all of the other commerce, institutions and infrastructure that constitute the city.

There have been precedents to these experiments. Dantzig and Saaty's, *Compact city: a plan for a liveable urban environment,* published in 1973 was to be a multi-layered city in a pyramid formation. Housing would be stacked, as tiers on a cake, with the dark space at the centre used for roads and infrastructure. Horizontal and vertical travel distances would be very low minimising energy consumption and the multiplication of floors was a response to the perceived scarcity of land.[158] The core ideas of Dantzig and Saaty's model, the notion of stacking programmes on top of one another to make efficient use of land and the eradication of urban zoning policies in order to reduce distances between work and home have informed the current compact city planning agenda considered in the next, and final, episode. However, it is MVRDV's China Hills project and Gangnam Hills (Figures 48 and 49) that really exploit and explore the possibility for these extreme density ratios to generate different combinations of programme and typologies of urban space.

Delirious New York and MVRDV's design experiments in FARMAX mark an important departure in terms of how density is conceptualised within the fields of architecture and urbanism. In the previous episodes the density of housing development has been thought of as distinct from the density of the rest of the city. However, in presenting housing as part of a complex urban programme, a shift is required in terms of how density is measured, the physical form of housing, and also how the residential component is situated within the urban fabric.

MVRDV's proposals point towards a more integrated relationship between residential uses and other programmes. Responding to the statutory controls that affect development in European cities, their design propositions suggest new urban typologies based on a combination of programmes that exploit the requirements of each in terms of access, daylight and connectivity.

The critical shift between the previous episode and this, is in thinking about density not only in terms of form (although form and mass are important), but in terms of a density of activity. Density is posited as a transient and temporal phenomenon, defined by a concentration of events. This has a fundamental impact on how the concept of density is used in design terms. Furthermore, housing is considered as part of the urban complex. The experience of the city becomes an important aspect of designing for density in a way that has not been reflected in the any of the previous episodes. The residential hotel is the only example considered so far that draws on the bustle of the city around it as a defining factor in its layout and organisational logic. However, immersion in the city also raises questions about the experience (the phenomenology) of the residential environment.[159] It draws in question the implications of density for the privacy of the dwelling, individuality (in

158 George Dantzig B. and Thomas Saaty, *Compact City : a Plan for a Liveable Urban Environment*, 1973.

159 The urban experience has been the subject of much theoretical, sociological and psychological study a selection of which is considered in Chapter Three, in the discussion on the phenomenology of density.

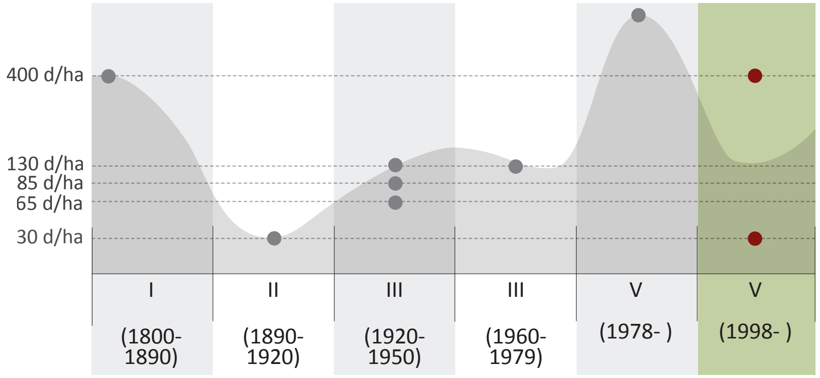
CHAPTER I
A conceptual, political and spatial history of density

view of the colossal scale of the residential hotel model, for instance). These issues will be considered in more detail in Chapter Three. The next and final episode moves on chronologically from the last and returns to the more modest density context of London.

Greenwich Millennium Village, London
(2000)
Erskine Tovatt
134 d/ha

Adelaide Wharf, London
(2005)
Alford Hall Monaghan Morris
332 d/ha

Tottenham Hale Village, London
(2006-)
BDP, KSS
252 d/ha



Episode VI: 1998-

Density and Compaction

During the 1970s and 1980s density was given relatively little significance in local authority development plans.[160] Ideas about density as a catalyst for the generation of new urban typologies were being developed and largely contained within architectural discourse. Meanwhile, housing production was dominated by individualist aspirations for a detached private house with front and rear garden and driveway for the car. Population densities in the inner London boroughs declined, while the outer boroughs expanded (Figure 50). The prelude to the Urban Task Force report published in 1999 read:

> *Our urban areas have suffered neglect and decline with an exodus from inner cities, driven by a lack of confidence in schools, fear of crime, an unhealthy environment, and poor housing.*[161]

In contrast to MVRDV and Rem Koolhaas' enthusiasm for the city and the concept of high density, planners, and the public at large, were less convinced. The publication of the Urban Task Force report set about changing popular perceptions of the city and advocated a revival of the city as a place that people wanted to live.

The 1987 Brundtland Committee definition of 'sustainable development', had also restored interest in the subject of urban density. It emphasised the need for responsible and limited use of resources, including land, and reduction in emissions and waste.[162] The density of urban development was an important factor. It potentially provided a means of limiting the consumption of land - particularly for housing - and reducing travel distances by limiting the outward spread of the city. As was set out in the introduction to this thesis, as the issue of sustainability has gained political credence, the concept of a 'compact city' has gradually become the core strategy for spatial planning.[163]

The link between high-density, compact forms of development and resource consumption was not a new idea, however. Indeed, Ebenezer Howard had made the case for compact development in his proposal for the Garden Cities in 1898. In 1955, Walter Manthorpe had argued that a more compact form of urban development would preserve the surrounding countryside for amenity and recreation. Most recently, in 1966 Rolf Jensen, called for land preservation for agriculture through higher density, concentrated development and highlighted the

160 The Planning Policy Guidance Note (PPG) series, introduced in 1988 gave little attention to the strategic role of density for spatial planning. Dempsey and Jenks, *"The Language and Meaning of Density,"* 295; Collins and Clarke, *"Planning Research Programme,"* 15.

161 Urban Task Force, *Towards an Urban Renaissance* (London: Department of the Environment, Transport and the Region, 1999), Preface.

162 Cited in Paola Sassi, *Strategies for Sustainable Architecture,* 1st ed. (London: Taylor & Francis, 2006), 2.

163 Glen Bramley and Sinéad Power, 'Urban Form and Social Sustainability: The Role of Density and Housing Type,' *Environment and Planning B: Planning and Design* 36, no. 1 (2009): 30.

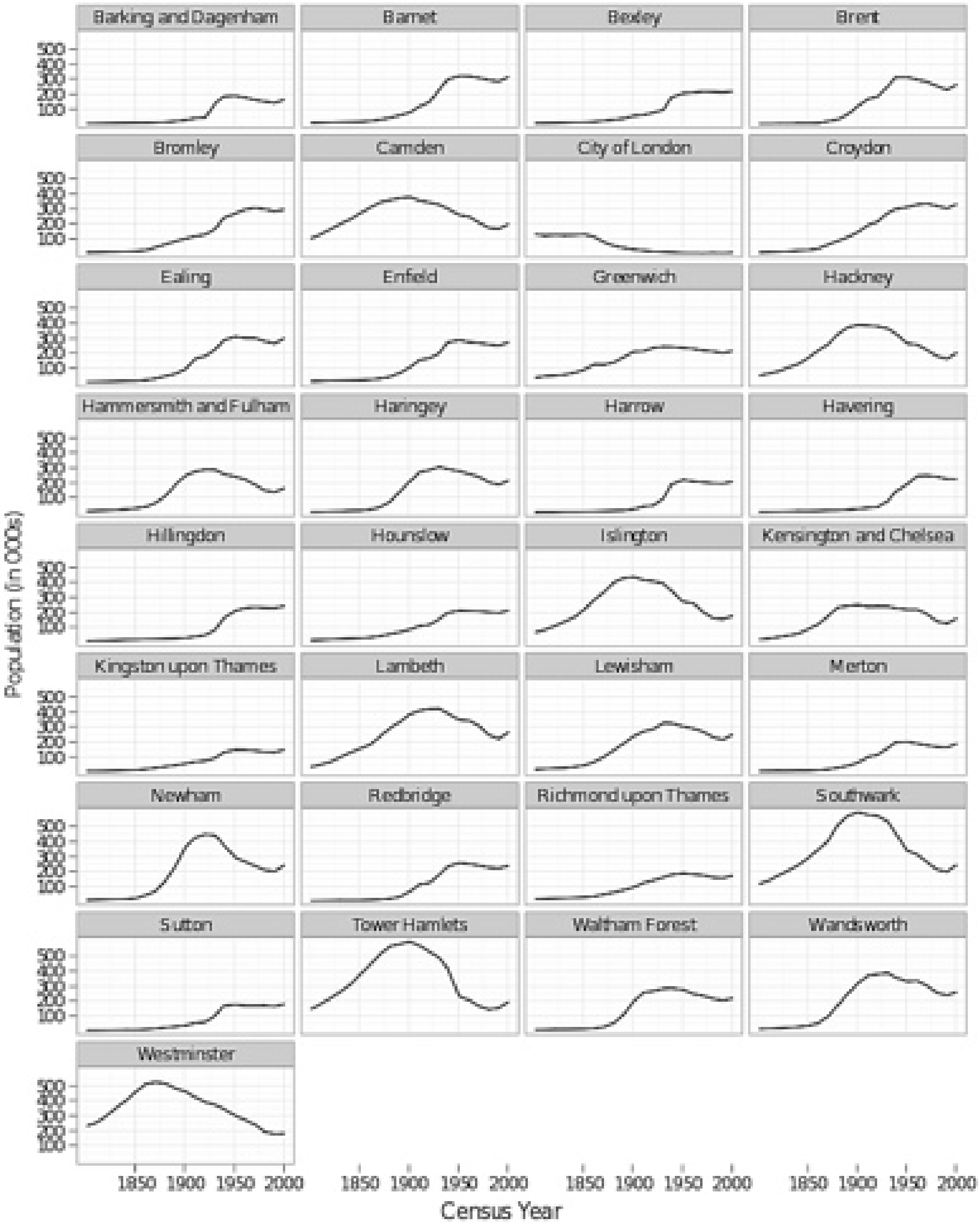


Figure 50: Changes in population density since 1801 by London Borough. Source: *London's Population Density by Borough.*

environmental degradation caused by the destruction of the countryside for building.[164]

Jensen's paper argued that city sprawl causes destruction of trees and plant life close to the city, is bound to increase air pollution, influence climate and obstruct solar energy. The solution required land reform, specifically aimed at concentrating metropolitan areas (as far as consistent with good living conditions) and bringing homes into closer proximity with work.[165] Over the course of the 1990s, the solutions that Jensen and others had proposed in the 1960s were gradually adopted as part of the planning agenda. Two significant pieces of government funded research were published addressing the importance of the issue of development strategy in relation to the promotion of a more 'sustainable' urban environment. Density was a crucial element of the discussion in both of these reports – prompting a further detailed investigation specifically focussing on the use of density within urban planning and the historical and international context.[166]

The first study was the *Sustainable Residential Quality* (SRQ) report, carried out by consultants Llewelyn-Davis and published in 1998.[167] It focussed on residential quality within the city. The report took from a series of typological studies carried out by Harley Sherlock which demonstrated that the common three and four-storey Georgian townhouses could achieve densities of 385 persons per hectare (higher than the limit of 350 persons per hectare set in the last published density standards of 1976). It was not necessary, Sherlock argued, to abandon the street scale in housing design in order to achieve Abercrombie and Forshaw's upper density standard of 336 ppl/ha, and it was not necessary now (in the 1990s) to suburbanise the city in order to provide an alternative to high-rise living.[168] The SRQ report demonstrated that the density of small sites within the city could be doubled without recourse to "unpopular" high-rise housing typologies.[169] A matrix was proposed, through which the optimal density ratio for development on a given site could be determined based on the character of the area – central, urban or suburban - and the availability of public transport. The amount of car parking required would also have a determining effect on the amount of development that could be accommodated.[170]

The second report to be published on the subject of urban development was the Urban Task Force report (published in 2000). The Task Force itself was commissioned by the then Deputy Prime Minister and chaired by the architect Richard Rogers. It set out a vision of an urban renaissance in Britain that would reverse the pattern of population decline in city centres and address the environmental imperative to reduce the consumption of greenfield land for house building. Greenfield development, they argued is "unsustainable and unacceptable".

> *It will lead to further erosion of the countryside. It will also increase traffic congestion and air pollution, accelerate the depletion of natural resources, damage biodiversity and increase social deprivation within our towns and cities.*[171]

164 Rolf Jensen, *High Density Living* (Hammersmith, London: Leonard Hill, 1966); Manthorpe, *'The Machinery of Sprawl'*; Hall and Ward, *Sociable Cities*.

165 Rolf Jensen, *High Density Living* (Hammersmith, London: Leonard Hill, 1966), 4.

166 The report is the Collins and Clarke, *"Planning Research Programme."* The findings of the report are discussed in more detail in Chapter Two.

167 Llewelyn-Davies (Firm), *Sustainable Residential Quality: New Approaches to Urban Living* (London: LPAC, 1998).

168 The report draws on the analysis in Harley Sherlock, *Cities Are Good for Us* (London: Paladin, 1991), 217.

169 Llewelyn-Davies (Firm), *Sustainable Residential Quality: New Approaches to Urban Living.*

170 The Density, Location and Parking matrix from the SRQ report would form the basis of the Density Matrix incorporated into the London Plan in 2004. The implications of this for the built fabric are considered below. However, Duncan Bowie gives a very thorough review of the policy in *Politics, Planning and Homes in a World City, Housing, Planning and Design* (Oxon: Routledge, 2010).

Figure 51: Aerial view of Barcelona, Spain. The city has an average density of around 400 dwellings per hectare. Source: BLOM, “Aerial View: Eixample District, Barcelona, Spain” (Bing Maps, 2013).

Figure 52: Aerial view Islington, London. Source: BLOM and Simmons, “Aerial View: Islington” (Bing Maps, 2013).

Figure 53: Aerial view Brighton. Source: BLOM, “Aerial View: Brighton and Hove, East Sussex” (Bing Maps, 2013).

171 Urban Task Force, *Towards an Urban Renaissance*, 7.

172 *Ibid.*, 64.

173 *Ibid.*, 7.

174 *Ibid.*, 27.

175 Jenks, Burton, and Williams, *Compact City: A Sustainable Urban Form?*, 5.

176 Sherlock, *Cities Are Good for Us.*

177 Esher (1981) cited in Hall, *Cities of Tomorrow: An Intellectual History of Urban Planning and Design in the Twentieth Century,* 226.

178 Coleman's infamous text is *Utopia on Trial: Vision and Reality in Planned Housing* (London: Hilary Shipman, 1985). It has been widely denounced for her disregard of the effect of poverty and other social factors on the environments that she observed. However, the stigma that her text undoubtedly contributed towards has been observed in a number of studies. The most rigorous of these was the report written by a team of researchers at LSE lead by Ricky Burdett. In interviews with residents they reported that the "visibility of large council estates" was associated with the perception of whether an area is high density or not. Ricky Burdett et al., *Density and Urban Neighbourhoods in London,* (Enterprise LSE Cities, 2004), 150.

In relation to density, the strategy was clear. Develop vacant sites within the city as a priority, increasing the density of the city fabric overall and reducing the pressure to develop on the edge of towns and cities, and secondly, increase the density of all new development.[172]

The Urban Task Force report stated that the main priority and challenge in bringing about the "urban renaissance" would be to do with quality of life and 'vitality' - about making cities attractive places to live.[173] The case studies that were cited - Barcelona, Portland, Amsterdam, Stockholm, as well as the UK please such as Islington in London and Brighton in Sussex - represented successful models of cities as convivial residential environments.[174] As Jenks, Burton, and Williams acknowledge:

> *The vision of the compact city has been dominated by the model of the densely developed core of many historic European cities. These are a great attraction not just to architects, planners and urban designers, but to countless tourists who flock to see them. They are seen, often by those from the outside, as ideal places to live and experience the vitality and variety of urban life.*[175]

The desire to associate the image of the city and of density with desirable urban environments and desirable housing typologies reflected the need (as Sherlock acknowledges) to disassociate the notion of density from the common preconception that high-density necessarily means high-rise.[176] Each of the case studies referred to, Barcelona (Figure 51), Islington (Figure 52) and Brighton (Figure 53) are characterised by modest building heights, four storeys in Islington, six in Barcelona. There was certainly no mention of the extreme densities of Manhattan or Kowloon. The case studies were intended to represent a particular type of urban environment: notably different from the inner-city estate redevelopment that had taken place during the 1950s, 1960s and 1970s, but yet familiar. A number of the inner-city schemes developed in the post-war decades had been heavily criticised for their architectural (and assumed) social consequences. Many had a particularly negative stigma attached to them and were associated with poverty, 'mobs of children' with nowhere to play and antisocial behaviour.[177] This association had been further exacerbated by studies such as Alice Coleman's *Utopia on Trial* published in 1985, which although methodologically flawed, nonetheless contributed to the popular association between types of housing that were described as 'high-density', and social and psychological pathologies.[178] Therefore, in order for higher-densities to be embraced as part of national planning agenda, there was a need to alter common preconceptions associated with density. This would not only include attitudes towards the types and form of housing associated with higher density, but also the perception of the impact of density on social relationships and the qualities of the urban environment.

Figure 54: Tottenham Hale Village, North London.

BDP and KSS Architects (2006-)

Gross site density 252d/ha

The housing is built over a tube, train and bus interchange. The high transport availability has allowed higher density ratios for development on the site. Note that the 252d/ha figure is the gross density. The net density of each development within the masterplan area will be higher. The surrounding housing areas have average density ratios of 100 to 150 d/ha.

Source: Building Design Partnership, Outline Planning Application: Tottenham Hale Village, Planning Statement (London: for submission to Harringey Council, 2006).

The implications of a compact city planning agenda for London

The Urban Task Force report paved the way for the introduction of a new approach towards density and its reinstatement as a core planning strategy. The publication of the *Planning Policy Guidance* note on *Housing* in 2000 saw the first revision to standards for the density of new development for 25 years, setting a new national minimum of 30 dwellings per hectare for all new housing developments. This was the first time that density standards in the UK had prescribed a minimum amount of development - historically, they had always been used to control against too much development. The subsequent publication of the Density Matrix as part of the 2004 London Plan represented the most explicit and most comprehensive policy on density to date, setting out appropriate density ranges for sites in different urban contexts with 35 dwellings per hectare as the minimum, and allowing for densities up to 405 dwellings per hectare at the upper limit.[179]

The Density Matrix sets out an appropriate density range for a given development site based on its transport connections and relative proximity to either the city centre, or a local town centre. The emphasis on transport accessibility has resulted in high density ratios for new development near to transport interchanges. For instance, this development at Tottenham Hale Station in North London (Figure 54) has a density ratio double that of the surrounding area. The optimal density, as defined by the Density Matrix, does take account of the character of the urban area (a supplementary table defines the characteristics of central, urban and suburban sites as they are used in the Density Matrix). However, there is also an expressed acknowledgement of the potential for a step change in density to act as a catalyst for the regeneration of an area.[180]

The uppermost density limits set out in the Density Matrix represented a four-fold increase on the previous maximum density standard for London (defined in 1976). Between 2001 and 2009, the average density of new housing built in London increased from 50 dwellings per hectare to 103d/ha in 2009.[181] This increase has not only been brought about as a result of changes in planning policy, however. There has also been a change in the type of residential development being built. The 2003 publication, *Housing for a Compact City* set out some urban models that could be used to achieve higher densities of development without resorting to building tower-blocks. It favoured the medium-rise, mixed-use block found in a number of European cities such as Barcelona, Paris and Berlin. The block, between four and six storeys in height, has a variety of shops, commercial and community facilities on the ground floor, creating an active street frontage, with dwellings on the floors above (Figure 55).[182]

One of the main advantages that the Compact City protagonists associated with the perimeter block was its relationship to the street. There was an also a renewed interest in the potential of more compact, apartment-

179 Greater London Authority, *'The London Plan: Spatial Development Strategy for Greater London'* (Mayor of London, July 2011, revised since 2004); Office of the Deputy Prime Minister, *'Delivering Planning Policy for Housing: PPG3 Implementation Study'* (Office of the Deputy Prime Minister, July 2003).

180 Design for Homes, *'Recommendations for Living at Superdensity'* (Design for Homes, July 2007), 8–9.

181 Land Use Change Statistics and Department for Communities and Local Government, *"Land Use Change: Proportion of New Dwellings on Previously Developed Land, and Density of New Dwellings 1994-97, 2006-09"* (Department for Communities and Local Government, July 30, 2010)

182 Greater London Authority, *"Housing for a Compact City"* (Greater London Authority, 2003),

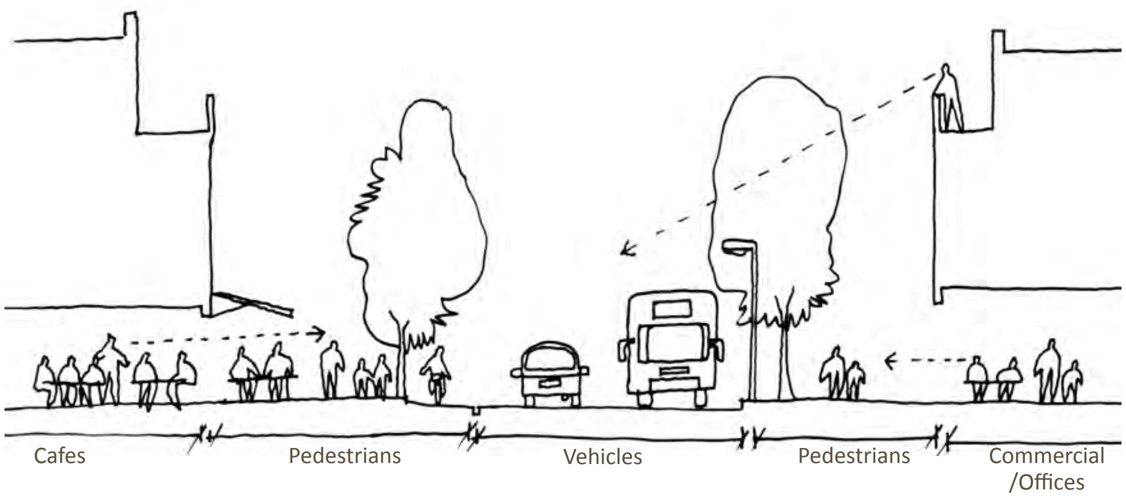


Figure 55: Section through a typical street (copied from a diagram in the Urban Task Force report). "Streets with continuous active frontages, and overlooked from upper storeys, provide a natural form of self-policing". The perimeter block also has clear advantages in terms of the space at the centre of the block available for communal space or amenities. Source: Urban Task Force, Towards an Urban Renaissance (London: Department of the Environment, Transport and the Region, 1999), 57 and 63.

Figure 56: Apartments over shops and commercial units on the ground floor, Greenwich Millennium Village.

Erskine Tovatt and Proctor and Matthews (2000)

134 d/ha

Source: *author*

Figure 57: Courtyard at centre of Adelaide Wharf, Hackney, East London.

332 d/ha

Allford Hall Monaghan Morris (2007)

Source: *author*

Figure 58: Boundary Street, East London.

411 d/ha

Owen Fleming and London County Council Architects' Department (1900)

Source: unknown

Greenwich Millennium Village was proposed for the redevelopment of a former industrial works site on the North Greenwich Peninsula. It manifests the ideals of the compact city approach, with a mixture of types of housing, including terraced housing and apartment buildings, with central squares located at key points in the site plan. There is a primary school on the site, and a number of shops and cafes at the base of the apartment buildings.

based housing types to establish communal facilities and gardens in the courtyards at the centre of blocks. The proximity between dwellings and the street would provide surveillance and natural policing, and a *"blend of urban vitality and safety that is characteristic of many successful urban areas."*[183] The greatest indication that a shift had taken place was in the proposal that public space ought to be "conceived as an outdoor room within a neighbourhood, somewhere to relax and enjoy the urban experience."[184] Reference to an enjoyable 'urban experience' was in stark contrast with old attitudes that promoted decentralisation and redevelopment of inner city areas at lower densities to reduce the congestion and overcrowding of these areas.[185]

There has been criticism of the compact cities approach. Jenks, Burton and Williams, in their extensive study on compact cities as a sustainable urban model questioned the use of historical, European case studies as a model for future urban development.

> *"The danger is that it is a romantic vision, one which assumes a golden age that can be recaptured through urban form, leading to sustainable and benign civility."*[186]

It was also suggested that the qualities sought from higher densities and a more compact urban fabric are attractive for certain types of people at certain time in their lives, but perceptions about lack of privacy and the negative side-effects of overcrowding, noise, parking stress and congestion continue to stigmatise the notion of higher density, therefore hindering its acceptability for many.[187]

The densities that are set out in the Density Matrix are modest by comparison with those considered in the previous episode. In terms of numbers, schemes such as Adelaide Wharf in Hackney, East London has a density ratio higher than would have been permitted in the post-war decades, but nonetheless lower than that of Arnold Circus considered in Episode One. For instance, Adelaide Wharf (shown in Figure 57) has a density of 332 d/ha compared with 411 d/ha at Arnold Circus (Figure 58).

However, in terms of attitudes towards density, the compact cities agenda in UK planning represented a reappraisal of the merits of density and proximity for the social, environmental and economic prosperity of the city. The idea that the built fabric of the city could generate overlap and juxtaposition between different activities and programmes, and which was central to MVRDV and Koolhaas' theses on density, was promoted (in a modest form) on the basis that it would bring different groups of people into contact, contributing towards a more convivial, socially and economically diverse city.[188] This brings the history of density up to date. It is clear that the promotion of higher urban densities as part of an urban development strategy needs clarification. Dempsey and Jenks pose the question:

> *"If sustainable development is so dependent on higher densities, then the question is higher than what, and what does it mean?"*[189]

This question will be considered in the following two chapters.

183 Urban Task Force, *Towards an Urban Renaissance*, 57.

184 *Ibid.*

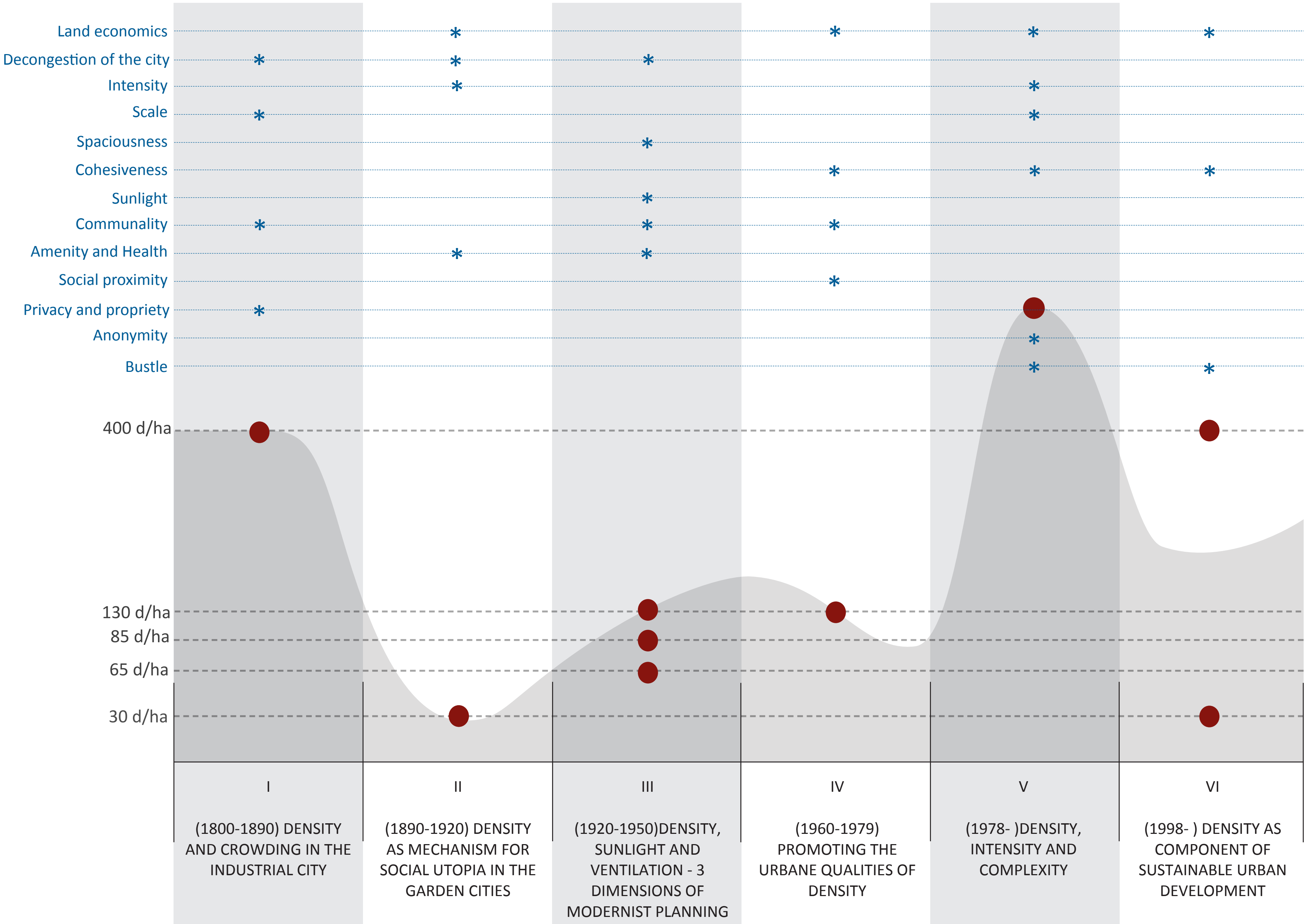
185 In this report the 'overcrowding' of the inner cities is cited as a reason for redevelopment of inner-city areas at lower densities. DoE (1976) *Residential Density in Development Briefs. Development Advice Note 2,* London, HMSO cited in Collins and Clarke, *"Planning Research Programme,"* 15.

186 Jenks, Burton, and Williams, Compact City: A Sustainable Urban Form?, 5.

187 Burdett et al., "Density and Urban Neighbourhoods in London," 152.

188 Rogers, Cities for a Small Planet. Protagonists of the New Urbanism movement, Duany, Speck, and Plater-Zyberk, propose that the opportunity for encounter is fundamental to the creation of community. In the absence of walkable streets, squares and parks, time normally spent in the physical public realm is instead spent in the car. "*As a motorist, you cannot get to know your neighbour, because the prevailing relationship is competitive"*. Suburban Nation: The Rise of Sprawl and the Decline of the American Dream, 5th ed. (New York: North Point Press, 2000).

189 Dempsey and Jenks, 'The Language and Meaning of Density', 304–305


Land economics
Decongestion of the city
Intensity
Scale
Spaciousness
Cohesiveness
Sunlight
Communality
Amenity and Health
Social proximity
Privacy and propriety
Anonymity
Bustle
400 d/ha
130 d/ha
85 d/ha
65 d/ha
30 d/ha
I
(1800-1890) DENSITY AND CROWDING IN THE INDUSTRIAL CITY
II
(1890-1920) DENSITY AS MECHANISM FOR SOCIAL UTOPIA IN THE GARDEN CITIES
III
(1920-1950)DENSITY, SUNLIGHT AND VENTILATION - 3 DIMENSIONS OF MODERNIST PLANNING
IV
(1960-1979) PROMOTING THE URBANE QUALITIES OF DENSITY
V
(1978-)DENSITY, INTENSITY AND COMPLEXITY
VI
(1998-) DENSITY AS COMPONENT OF SUSTAINABLE URBAN DEVELOPMENT

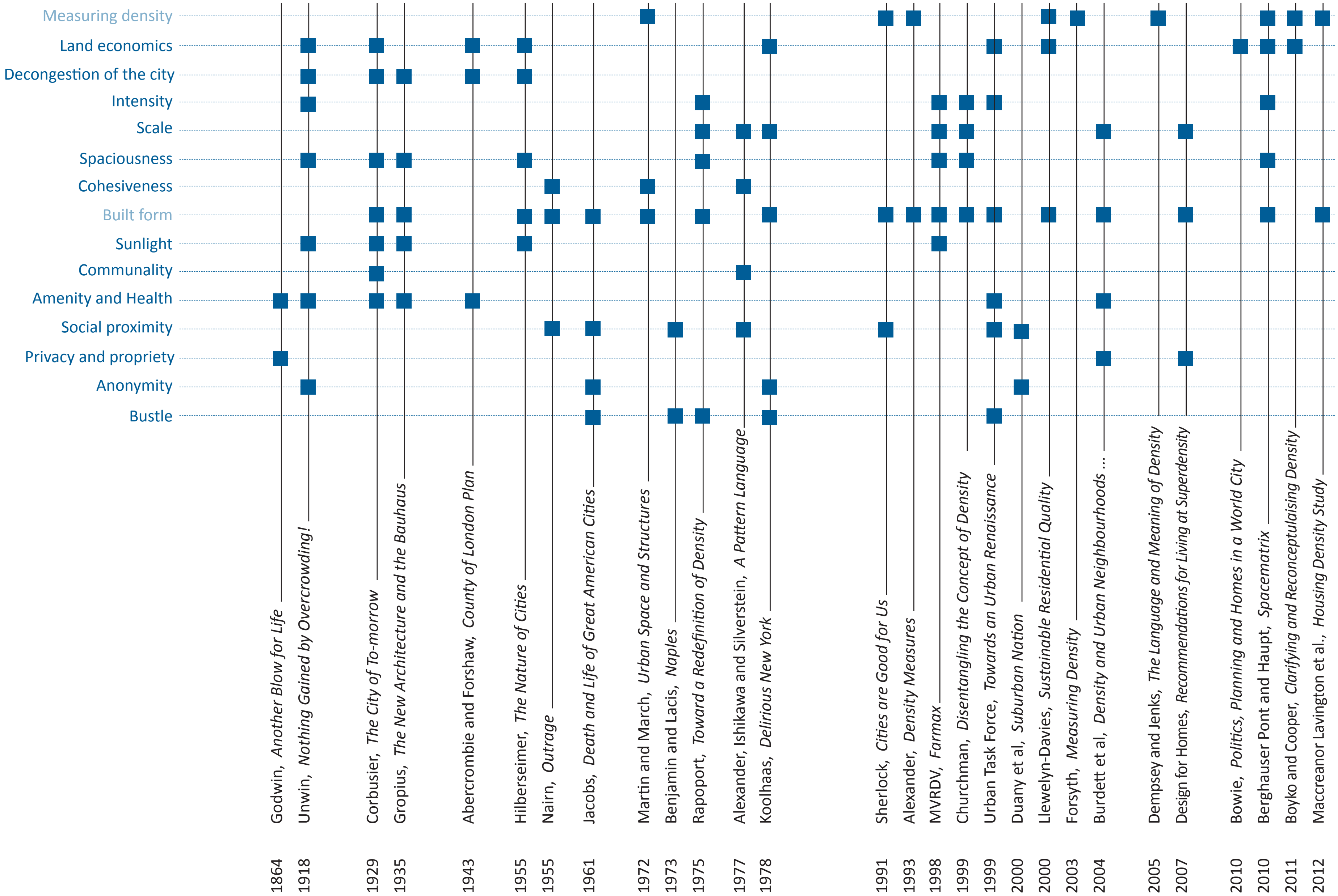
Conclusions

Over the course of the discussion in this chapter the notion of density has been expanded and attributed a range of economic, formal, social, political and experiential implications, which, when considered together posit density as a complex subject that can be interpreted in a variety of different ways. Arguably there are two main conceptions of density that have been recurring throughout the six episodes. One is the measurement of density as a numeric ratio. The other is the concept of density and the social and phenomenological implications attributed with it. The chart shown in Figure 59 highlights the key themes that have emerged out of the discussion in each episode.

Taking the definition adopted at the beginning of this chapter, of density as the relationship between the number of people and the amount of space that they inhabit, it can be seen that social and professional attitudes towards density have shifted significantly over the course of the episodes presented. In nineteenth century London density was measured in terms of people per room. The impetus to measure and to control it was motivated by concern over the physiological and moral inadequacies of too many people sharing too little space. Proximity between individuals and households was cast as a major deficiency by housing reformists of the day. In Episode Five, meanwhile, proximity and juxtaposition were being explored by Koolhaas and MVRDV and as quintessential qualities of a particular urban experience. They posited that the overlap of different functional uses (cross-programming) and the complex patterns of activity that result are an inherent phenomenon of the urban density and conditions of proximity. This qualitative conception is in no way represented by the measurement of density as a ratio value. In each of the episodes it was apparent that the measurement of density was motivated by a desire to control a particular condition. It was used to control proximity (Episode I), congestion (Episodes II and III), open space (Episode III), social proximity (Episode IV), and the efficient use of resources (Episode VI).

The first application of density ratios as a planning instrument was set out in Episode Two. Howard's set density ratios for the Garden Cities were expounded as economic measures intended to limit the amount of development on a site and control against the development of repetitive terraced streets that characterised the industrial cities. Unwin's studies began to introduce the idea that the qualities and character of the built environment could also be determined by controlling density ratios. The use of density ratios to determine built form was exemplified in the period of high-modernism (1920 to 1950) discussed in Episode III. Density ratios were apposite for the rationalism and quasi-scientific form-making methodologies

Figure 59: (opposite) Key themes prevalent in each of the episodes.


Measuring density
Land economics
Decongestion of the city
Intensity
Scale
Spaciousness
Cohesiveness
Built form
Sunlight
Communality
Amenity and Health
Social proximity
Privacy and propriety
Anonymity
Bustle
Godwin, Another Blow for Life 1864
Unwin, Nothing Gained by Overcrowding! 1918
Corbusier, The City of To-morrow 1929
Gropius, The New Architecture and the Bauhaus 1935
Abercrombie and Forshaw, County of London Plan 1943
Hilberseimer, The Nature of Cities 1955
Nairn, Outrage 1955
Jacobs, Death and Life of Great American Cities 1961
Martin and March, Urban Space and Structures 1972
Benjamin and Lacis, Naples 1973
Rapoport, Toward a Redefinition of Density 1975
Alexander, Ishikawa and Silverstein, A Pattern Language 1977
Koolhaas, Delirious New York 1978
Sherlock, Cities are Good for Us 1991
Alexander, Density Measures 1993
MVRDV, Farmax 1998
Churchman, Disentangling the Concept of Density 1999
Urban Task Force, Towards an Urban Renaissance 1999
Duany et al, Suburban Nation 2000
Llewelyn-Davies, Sustainable Residential Quality 2000
Forsyth, Measuring Density 2003
Burdett et al, Density and Urban Neighbourhoods ... 2004
Dempsey and Jenks, The Language and Meaning of Density 2005
Design for Homes, Recommendations for Living at Superdensity 2007
Bowie, Politics, Planning and Homes in a World City 2010
Berghauser Pont and Haupt, Spacematrix 2010
Boyko and Cooper, Clarifying and Reconceptulaising Density 2011
Maccreanor Lavington et al., Housing Density Study 2012

promoted by the key proponents of the period. They were used to control the amount of development on a site and ensure optimal conditions of sunlight, ventilation and open space between the buildings. Widening the spaces between buildings had to be offset against an increase in the height of the buildings, and so the term 'high-density' became synonymous with the high-rise slab and point block buildings through which the broader spatial strategy was achieved whereas it might have been more appropriate as a description of the design methodology underpinning this urban approach.

The experience of this urbanism designed-by-density was very different from the urban environments depicted in the other episodes; I, IV and V. Much (indeed most) of the existing research on the subject of urban density and design has focussed on the design methodologies exemplified in this period of high-modernism and 'high-density' considered in Episode III.[190] The various qualitative and experiential qualities of density that have been presented in the episodes considered in this chapter have been subject to far less detailed study (see Figure 60).

The conception of density as a means of collective organisation, for instance, was highlighted in a number of the historic episodes and has much potential for how density is thought about as a concept for urban and architectural design. Social proximity, harnessed by Team X in their design of low-rise, condensed housing models, exploited the potentiality afforded by the site density to make a social experience. The density ratio was not important. Even where the site would have allowed much more sparse development (as at Siedlung Halen), the architects deliberately condensed the housing together, demonstrating a different conception of density than the height-versus-distance games propounded by Gropius and Hilberseimer in Episode III.

The following two chapters are dedicated to exploring these different notions of density in more detail. Chapter Two considers density as a ratio measure. It sets out how density ratios are currently measured and the design implications associated with these ways of measuring. This is all set out in the context of current planning and design practice and considers the limitations of this conception of density in terms of the various applications that it might have. Chapter Three then returns to the qualitative conception of density. Having opened up the subject through these historical episodes, Chapter Three marks a point of departure, moving away from existing research on the subject and adopting a different approach and methodology in response to the subject. Drawing on the various conceptions of density considered in this chapter, it attempts to expand different ways of thinking about density for the design of the built environment.

190 The most significant of these studies are Leslie Martin and Lionel March's *Speculations*, and Berghauser Pont and Haupt's morphological studies set out in *Spacematrix*. The recent Housing Density Study, considered in some detail in the next chapter, also focuses on the manipulation of density ratios

Figure 60: (opposite) Timeline showing focus of the major studies concerned with density. The graph illustrates the emphasis that has been put onto measuring density and manipulating built form as a means of achieving certain densities. Whilst reference has been made to the social and experiential qualities of density such as bustle and social proximity, these themes have been subject to far less research.

Chapter II

Measuring Density - unpacking the units of density and their applications

Chapter II

Measuring Density - unpacking the units of density and their applications

Introduction

Since its first introduction to the discourse of architecture, urban design and planning by Ebenezer Howard and Raymond Unwin at the beginning of the twentieth century, both the concept of density and the way that it is measured have undergone multiple transitions. Each of the different conceptions of density outlined in the previous chapter were predicated on different ideas about the implications of density. As the conception of density has changed, and the deficiency that it is being deployed to control has changed, so too, the units through which density is measured and understood have changed. Depending upon whether density is being used as an index of overcrowding, congestion, monotony, or urban vitality, the way that it is measured and interpreted within architectural and planning practice has shifted historically.

The result is a conception of density that is at once loosely defined in terms of its units of measure, but at the same time, broadly implicated within the field of built environment discourse. Arza Churchman summarises the problem when she writes;

> *At first glance, the concept of density is wonderfully appealing to planners. It is an objective, quantitative, and, by itself, neutral term. However, a second and third glance reveals that it is a very complex concept. Some of the complexity is inherent to the nature of the phenomena associated with density, but part of the complexity stems from the different ways in which density is defined and used in different countries and different disciplines.*[1]

1 Arza Churchman, 'Disentangling the Concept of Density', *Journal of Planning Literature 13*, no. 4 (1999): 389.

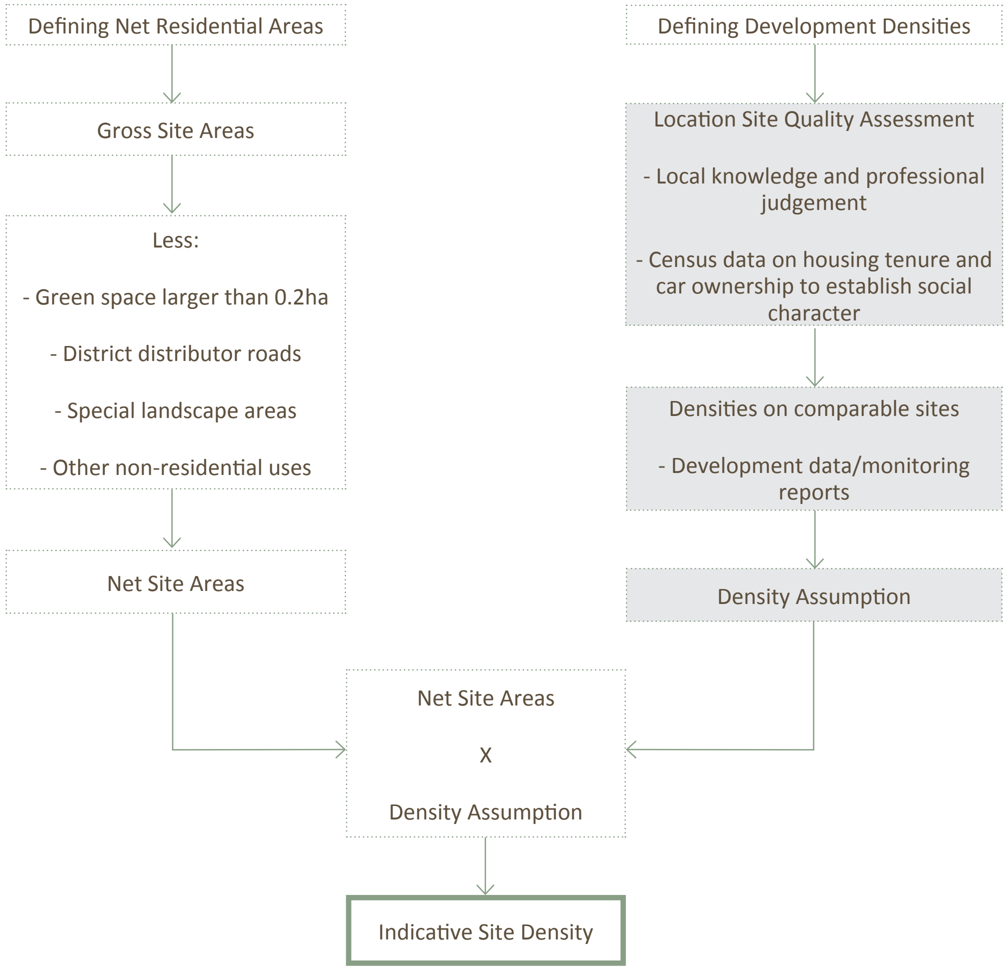


Figure 1: The Use of Density in Estimating Indicative Site Capacities. The diagram, taken from Collins and Clarke's report on density measures in practice, suggests that far from being an objective, calculated measure; site development densities are typically determined by a combination of professionals' experience of similar site conditions and the underlying idea that physical and typological characteristics are intrinsically linked to dwelling density. Source: Michael Collins and Patrick Clarke, *'Planning Research Programme: The Use of Density in Urban Planning'* (Department of the Environment, Transport and the Region, 1998), 33.

Anthropologists, architects, geographers, economists and psychologists use density, but apply measures at different scales and use different units suited to different objectives and fields of investigation.[2] However, because density is used across such a range of disciplines there is no one accepted measure used by all. Each profession has their own specific measurements of density that are relevant to their own tasks, yet rarely are these articulated, they are all simply referred to as density.[3]

Despite the accepted need for rigour in the interpretation of density measurements, there remains confusion between what might be thought of as the reality of what is measured, and range of potential experiential implications associated with different notions of density. That is to say that the various formal, social and phenomenological consequences of density considered in the previous chapter are often confused and conflated with densities that are measured. This is a remnant of the Modernist conception of density explored in Episode III: Chapter One in which numbers (density ratios) were translated with some certainty as an indicator of the built form as well as the occupancy and social organisation of housing. Ernest Alexander proposes that regularly cited consequences associated with density are often neither guaranteed, nor even related to the measurement of density in technical terms.

The application of density measures is suffused with a kind of 'folklore' that relates densities within quite narrow ranges to specific dwelling types.[4]

What Alexander describes as 'folklore' is arguably the same kind of assumption that Collins and Clarke identify as being a key factor in the determination of optimal development densities. Figure 1, taken from Collins and Clarke's report on the use of density in practice, suggests that optimum density ratios are determined by a combination of professional experience of the site and context and the kind of densities achieved on sites with similar conditions. This assumed density, multiplied by the net site area is used to give an estimation of the development capacity of a site.[5] The use of the density ratio of similar sites as a reasonable means of determining the type of development on a proposed site is imbued with a number of basic and potentially problematic assumptions. One is the assumption of a correlation between density ratios and built form or housing type. Another is the assumption of a relationship between density ratios and the social experience of density (alluded to by the reference to 'social character').

This chapter attempts to situate the understanding of density as a numerical ratio, in relation to the qualitative and experiential aspects of density that were considered in Chapter One. The first part of the analysis focuses on how density ratios are measured. Site measurements and the basic units of density are considered in terms of their applicability for planning and design practice. The second part considers how density ratios are currently used. Finally, it considers the conception of density as a measured ratio in relation to the experiential and organisational characteristics presented in the previous chapter.

2 Psychologists and sociologists focus on the detrimental effects of high density, economists, transportation experts and environmentalists assert the advantages and disadvantages of high density at the city or regional scale, whilst environmental psychologists examine cognitive and behavioural patterns and correlate these with urban density ratios at the scale of the neighbourhood or dwelling. Meanwhile architects, planners and urban designers use density as a means of describing spatial characteristics, built form, efficiency and development capacity. Christopher Boyko and Rachel Cooper, 'Clarifying and Re-conceptualising Density', *Progress in Planning* 76 (2011): 1–61; Arza Churchman, 'Disentangling the Concept of Density', *Journal of Planning Literature* 13, no. 4 (1999): 389 – 411.

3 Boyko and Cooper, 'Clarifying and Re-conceptualising Density', 7.

4 Ernest R. Alexander, 'Density Measures: A Review and Analysis', *Journal of Architectural and Planning Research* 10, no. 3 (Autumn 1993): 182.

5 Michael Collins and Patrick Clarke, *'Planning Research Programme: The Use of Density in Urban Planning'* (Department of the Environment, Transport and the Region, 1998), 33.

	Area (sq km)	People per sq. km	People per ha	Dwellings per ha
United Kingdom	242,514	244		
England	130,281	380	4	
London	1,572	4,679	46	
Inner London	319	8,980		
Inner London - East	210	8,816		
Tower Hamlets	20	10,462	99	
Bromley by Bow	107	11,358		
Bow Bridge Parish (LSOA 008A)			374	
Bow Bridge Estate			387.4*	149

Table 1: Population Density at different scales from National to Lower Level Output Area and Site Densities.

Source: Greater London Authority Intelligence Unit, 'London LSOA Atlas: Population Density 2011', London Datastore, 28 May 2013

Figure 2: Global Cities, London, Tate Modern, 2007, exhibition curated by Ricky Burdett

These models (Figure 2) show the density distribution for major global cities. They highlight the extremes of density that can be concealed within one, apparently homogenous density figure for the district or region. For example the London model shows peaks and extreme troughs right at the centre that could be accounted for by a large open expanse like Hyde Park, or the river Thames.

Part A: measuring density

At its most basic, density is a ratio of matter to space. However, the units of matter and the area of space affect what is implied by the measurement and how it should be interpreted. Most frequently it is recorded as the number of dwellings, rooms, people, trees or metres of floor space relative to the amount of space they share. However, measurements vary in terms of both the units (numerator) and the area (denominator), as well as what is included and excluded from the calculation.[6] The lack of a consistent measurement and a universal scale of density complicates the use of quantitative densities for comparison.

Area: Scale Matters

The area is the denominator in the calculation of density. The area can range from the building footprint, to the area of the site, neighbourhood, district, the city and finally, the principality. Typically, the larger the scale of the denominator, the lower the overall density will be. Site density is almost always higher than the overall neighbourhood density as the neighbourhood, by definition includes many land-uses other than housing which have the effect of diluting the residential density.[8] Table 1 opposite shows how the scale of the measurement area affects the density ratio that is produced, as well as the units that are used. As Ernest Alexander noted in his study on the relationship between density ratios and housing typology:

> *Many density measures are ratios of some 'occupier' or user as the numerator (persons, rooms, households, dwelling units) and a unit of area as the denominator (acres of residential land, neighbourhood, city area). Definitions of the area used in the denominator are critical, but frequently absent.*[7]

Because of the different ways that density is recorded at different scales, and the amount of un-built land included within the measurements at different scales, it is not possible to make comparisons between densities measured at different scales. The models shown in Figure 2 demonstrate how density ratios can vary across the city. This variation is concealed by density ratios measured at the regional or metropolitan scale and therefore shows the limitations associated with referring to densities at too large a scale. As Michael Batty notes:

> *We often think of density as being `dimensionless', a variable … useful in making comparisons between locations as if they were points. Clearly, the finer the level of areal resolution, the better the measure, although the discreteness of the entities used and the relative continuity of the area*

6 Boyko and Cooper, *'Clarifying and Re-conceptualising Density'*, 7.

7 Alexander, *'Density Measures: A Review and Analysis'*, 185.

8 Anne Forsyth, *'Measuring Density: Working Definitions for Residential Density and Building Intensity'* (Design Centre for American Urban Landscape: Design Brief, July 2003), 2.

9 Michael Batty, 'Defining Density', *Environment and Planning B: Planning and Design* 36 (2009): 571.

Density	Included/ excluded from the measurement	Useful when…
Town or district density	*A low gross density*	*Planning a major mixed use development such as a town extension or new settlement*
Neighbourhood density	*Allows for the provision of facilities and services such as open space, play space, primary schools, local shops, health services, roads, cycle and footpaths (all the uses needed to support the new housing)*	*Planning a residential community or new urban quarter*
Gross development density	*Includes distributor roads, cycle paths, landscape buffer strips or structural planting*	*A number of neighbouring sites are to be developed but have not yet been individually defined*
Net site density	*Measures only the area to be developed for housing and directly associated uses, including; access roads within the site, private gardens, car parking, incidental open space and children's play areas.* *It excludes major distributor roads, schools, open space serving the wider area and significant landscape buffer strips*	*Planned development sites where only residential uses are proposed and for infill sites where the boundaries are already defined*
Net developable site density	*Requires detailed knowledge of the site and excludes parts of the site not to be developed for residential uses such as roads, streams, children's play areas and mature trees*	*Detailed site planning and development control – especially where there are areas within a site not to be developed*

Table 2: The common scales at which density is recorded and the appropriate uses of each. Summarised from Collins and Clarke, *'Planning Research Programme'*, 64–67.

LCC (1943)	Definition	Equivalent measure DETR (1998)
		Net developable density Net density
<u>Density a</u> 'Net Density'	Persons per acre in the area comprising: - The curtilages of the dwellings - access or internal roads - half the width of boundary roads (up to 20 ft)	Gross density
<u>Density b</u>	Persons per acre in the area as defined under 'a' but also including: - space occupied by schools - shops - other communal buildings 20% of housing area allowed for these buildings	Neighbourhood density
<u>Density c1</u> <u>Density c2</u>	Persons per acre in the area as defined in 'b', but including: - open spaces (calculated at 4 acres per 1000 of the population) Persons per acre in the area as defined in 'b', but including: - open spaces calculated at 7 acres per 1000 of the population	
		Town/ District density

Table 3: Comparison between site area definitions 1943, 1998 and 2003.

Sources for figures: Patrick Abercrombie and John Henry Forshaw, *County of London Plan* (London: MacMillan & Co., 1943); Greater London Authority, *'Housing for a Compact City'* (Greater London Authority, 2003); Collins and Clarke, *'Planning Research Programme'*.

over which they are located confounds any analysis of their limits.[9]

What Batty alludes to is the fact that as much as there may be applications for density ratios at different scales, the arbitrariness of how the areas are defined means that important factors such as presence of large open spaces on the edge of the defined area - that have a significant impact on the experience of the density of an area - are not necessarily represented by the measured ratio.

As Collins and Clarke accurately note:

The effectiveness of density as a planning tool depends on applying the correct density measure to an appropriately defined site/development area.[10]

Table 2 situates different scales of density measurements with their uses and applications within planning. Smaller scale measurements, such as site and developable area densities are useful for determining the capacity of a given site. Larger scale neighbourhood densities are useful for strategic spatial planning because they allow for all of the different land uses that comprise a neighbourhood or district to be included. Expansion projects such as Thames Gateway would set district densities in order to make approximations about infrastructure and transport. However, it is important to note that the larger the scale of the measurement, the more variation is concealed within it and therefore densities at this scale should not be taken as indices of the built form or character of a neighbourhood, town or city, and certainly not of a particular site.

In addition to the problem of scale, there is also a problem with how the areas used for measuring densities are defined. Because there is no universally accepted definition of area used in density measurements and scales of measure such as 'neighbourhoods' are not always defined in the same way, comparison between different cities can be compromised by inconsistency in the way that site areas are defined. In practice, this leads to massive variation and complicates effective comparison between measurements.[11]

Dempsey and Jenks note that the same inconsistency exists when referring to historical density figures.[12] Throughout the twentieth century, a variety of different measurements of density have passed in and out of use; houses per acre (Tudor Walters, 1918), persons per acre (Dudley Report 1944), habitable rooms per acre (Ministry of Housing and Local Government, 1952), dwellings per acre (MoHLG, 1962) and dwellings per hectare (PPG3, 2000). Whilst acres can be converted to hectares, it is frequently not possible to determine exactly the boundaries of the measurement area and what was included and what was excluded. Table 3 demonstrates the variation between definitions of site area in the 1943 London Plan and the current standards. It shows that what was measured as 'net density' in 1943 would be regarded as gross density under current definitions.

Furthermore, it is apparent that the way that site areas are defined in the 1943 Plan reflects the prevalent planning doctrine of the time and typical site layouts that were

10 Collins and Clarke, *'Planning Research Programme'*, 65.

11 Alexander cited in Churchman, *'Disentangling the Concept of Density'*, 1999, 390. Forsyth, *'Measuring Density: Working Definitions for Residential Density and Building Intensity'*, 3. Burdett et al outline the difficulty of defining equivalent areas for comparison between cities. Neighbourhoods, they write are often perceived differently by different residents, whilst Super Output Areas and political boundaries are abstract and often do not reflect the boundaries that are relevant to the lifestyles and patterns of movement of residents in these areas. *'Density and Urban Neighbourhoods in London'* (Enterprise LSE Cities, 2004).

12 Nicola Dempsey and Mike Jenks, 'The Language and Meaning of Density', in *Future Forms and Design for Sustainable Cities* (Amsterdam: Architectural Press, 2005), 291. Where possible, the density ratio of the case studies cited in this thesis have been recalculated by measuring the site area from digital Ordnance Survey maps; however, some of the densities cited for the historical case studies in the previous chapter are taken from other sources and therefore some variation in the calculation of the density ratios has been assumed and direct comparison, in numeric terms has been avoided.

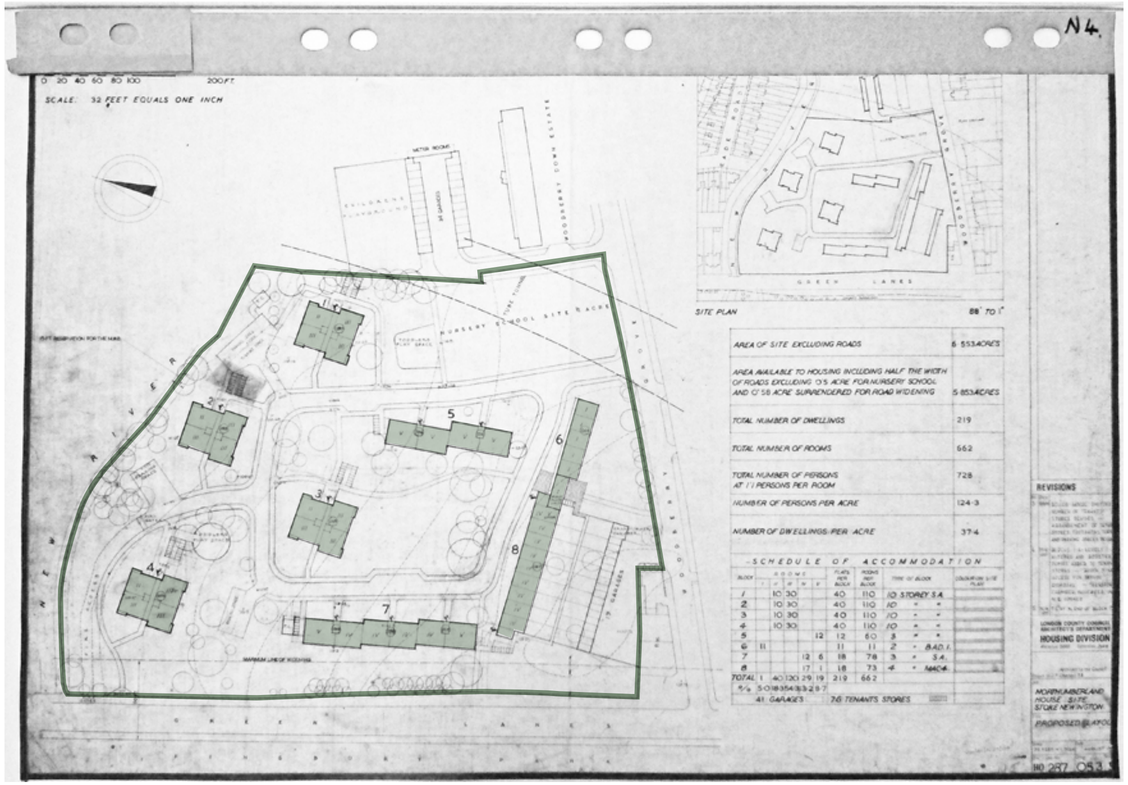


Figure 3: Site Plan Northumberland House, Stoke Newington (1957) London County Council Architect's Department Housing Division.

The site plan for the Northumberland House site includes a schedule of areas as was common at time. It sets out the areas included in the calculation and resulting site densities in terms of dwellings and occupancy (based on an estimation of persons-per-room). The net site density is 124.3 persons per acre and 37.4 dwellings per acre [equivalent to 92 d/ha].

Source: London County Council Architect's Department: Housing Division, 'Site Plan Northumberland House Site, Stoke Newington' (London County Council, 1957), London Metropolitan Archives.

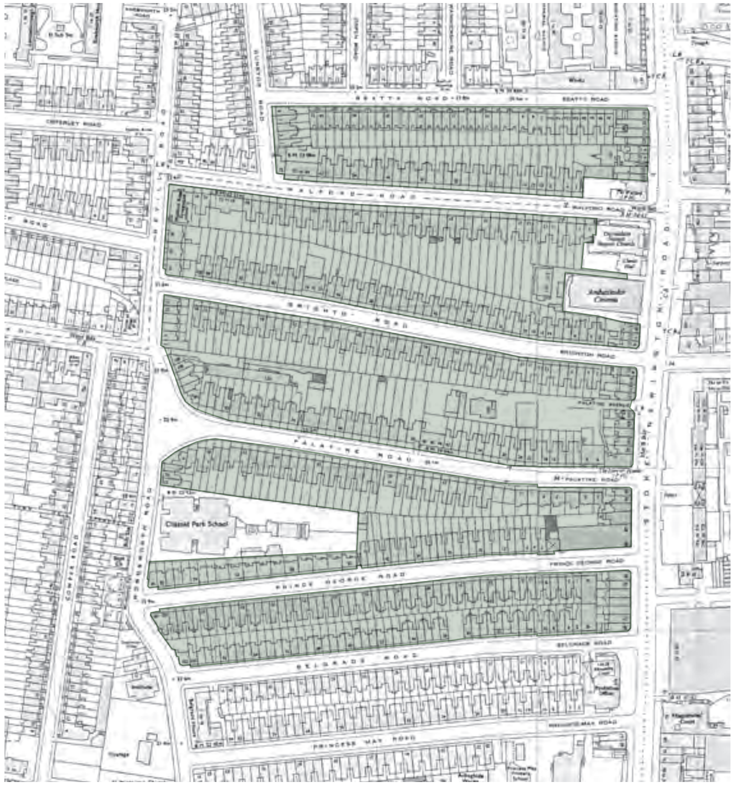


Figure 4: Typical terraced housing, Stoke Newington

The net density of each terraced block is between 80d/ha and 100d/ha. Note that buildings with residential accommodation on the upper floors are included in the calculation, whilst those with none - Churches and cinemas for instance, are excluded.

Source for map: National Grid, 'Historic Map Stoke Newington, North London' (Digimap, 1960).

generated. Figure 3 shows the large areas of open space and road area that are included in the measurement, compared with the typical terraced street layout. The difference between what is included and excluded from the measured area affects the resulting density ratio. However, it also reflects the approach towards the site layout. In the terraced street layout (Figure 4) the road areas are excluded from the site measurement because the road and public footpaths alongside remain part of the public domain. In the post-war mixed-development layout measured according to 1943 site area definitions the roads and footpaths are included in the area because:

a) They are not public thoroughfares and do not provide access to anywhere else, and

b) They comprise part of the space between the buildings which is an essential component of the Modernist approach to controlling density ratios and the impact of density on the urban fabric.

Net and gross site area

At the scale of the residential development the most relevant density measurements are the 'gross development density', the 'net site density', supplemented occasionally by 'net developable site density' – although this measurement requires detailed knowledge of the site and therefore is not always possible to calculate prior to detailed site analysis. Large scale measurements, such as neighbourhood, district or city densities, use gross measurements since they include areas dedicated to non-residential uses. Gross site densities are sometimes used in mixed-use development, or where multiple sites are being developed simultaneously with amenity and other ancillary functions or spaces shared between a number of distinct development sites.[13]

Despite the importance placed on site densities (particularly net densities) in development and planning practice, they are also problematised by lack of clarity in how they are defined. The Town and Country Planning Association for instance, defines gross density as including "certain nearby non-residential development" which is unhelpfully ambiguous in what it means.[14] For clarity and consistency, at least within this thesis, the measurements of net and gross site area used are taken from the site area definitions used by the Greater London Authority (GLA).[15] The measurements of density used in this study are set out in Figure 6 below.

Variations in how net densities are measured typically include variation in whether bounding roads are included in the measurement, and to what extent communal gardens and play areas are included. By comparison with gross measurements, net density is relatively specific and closely reflects the actual development area of the site. Because of this specificity, it is presumed to give a reasonable means of comparison between two sites. However, as Dempsey and Jenks observe in their review of density as an instrument of planning practice; the amount of un-developed or un-developable land can vary greatly between sites.

13 Collins and Clarke, *'Planning Research Programme'*.

14 The Town and Country Planning Association in 2003 (coinciding with the GLA publication, Housing for a Compact City – the source of the above definition), defined net site area as "land covered by the residential development, with any gardens and other spaces that are physically included in it, and usually half the width of any adjacent roads." Whilst gross site area includes "certain nearby non-residential development, in order to reflect the amount of services and amenities such as schools and parks that are needed to support the housing element." Town and Country Planning Association, *'TCPA Policy Document: Residential Densities'* (TCPA, 2003), 1.

15 Greater London Authority, *'Housing for a Compact City'* (Greater London Authority, 2003), 11. For consistency, the definition of net and gross density adopted by the GLA is used for all original calculations carried out as part of this thesis. This method has been adopted because:

- The GLA definition sets the most clear boundaries for what is included and excluded, therefore minimising the risk of inconsistency.

- It ensures that calculations in this thesis are comparable with secondary data sourced from GLA publications. The GLA publish the

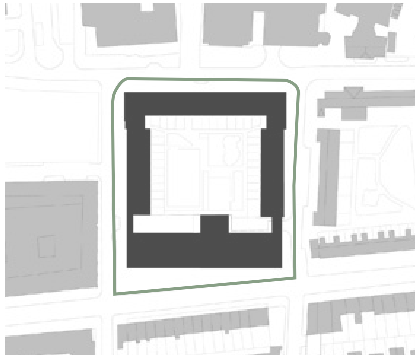
Site plan perimeter block		
View central courtyard		
	Iroko, Southwark **Haworth Tompkins (2001)** Site Area: 0.8 ha Building Height: 4-5 storeys 68 d/ha (net) 332 hr/ha	**Adelaide Wharf, Hackney** **AHMM (2004)** Site Area: 0.43 ha Building height: 5 storeys 332 d/ha (net) 1011 hr/ha

Table 4 (left): Comparison of two London housing schemes with similar forms but different net densities

Where net density is used, it only takes residential areas into account, and omits all the other desirable mixed uses. Gross density takes other land uses into the calculation, but the figure is merely reduced and borders on being meaningless as there is no way of measuring the other uses.[16]

Berghauser Pont and Haupt demonstrate the impact that the definition of the site area can have on the resulting density ratio (as in Figure 5).

The schemes shown in Table 4 further demonstrate that even where net density is used, there can be significant variation in the amount of the site that is developed which affects the resulting density ratio. The two schemes are similar in terms of their building height and site layout (both would be described as perimeter block schemes), yet the net density varies to a huge extent as a result of the larger size of the Iroko site and the amount of open space that is therefore included as part of the site area. Factors such as this problematise the use of density ratios as a descriptor of built form (however specific in scale they are). Furthermore, they draw into question the kind of presumptions shown in the process map at the beginning of this chapter (Figure 1) which suggests that decisions about optimal density are often determined on the basis of the type of development achieved on similar sites with similar conditions. On this basis, the density of a scheme such as Adelaide Wharf might have been capped at one quarter of what was actually built in attempt to establish a similar type of development as on the Iroko site. It is apparent, however, that density ratios are not a very sophisticated means of capturing or recreating the qualities of a site and there is need for a separate means of apprehending the physical consequences of density in a more useful way than the current approximations based on density ratios.

Internal Densities and Crowding

One of the common misconceptions surrounding density is that high site density is correlated with high levels of crowding. It is necessary therefore to clarify the difference between site measures of density and density inside of the dwelling which is used to measure overcrowding. Ann Forsyth decribes the difference between the two as such:

It is possible to live at very high density in a spacious apartment with no crowding, and conversely it is possible to live in a detached farm house that is crowded in terms of having many people per room.[17]

Clearly she is measuring both the urban density and the occupancy of the dwellings as ratios. Arguably, however, her statement presumes that neither is based on experience or perception. The distinction drawn by Ernest Alexander is more flexible. He defines two types of density: molecular and molar densities. Molecular densities are concerned with the space inside the dwelling, whilst molar densities are those concerned with the space outside of the dwelling.[18] He suggests that the molecular, or internal, density of a dwelling can have a significant impact on how densities

most detailed data on residential density and housing capacity at ward level (SOA) across all London Boroughs and by being consistent in measurement areas, these resources can be used comparably.

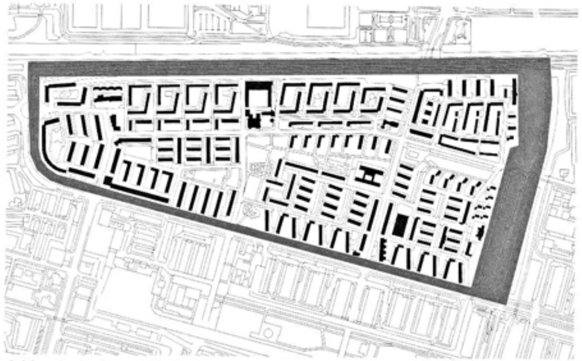
16 Dempsey and Jenks, *'The Language and Meaning of Density'*, 306.

17 Forsyth, *'Measuring Density: Working Definitions for Residential Density and Building Intensity'*, 4.

18 Alexander, *'Density Measures: A Review and Analysis'*.

19 Meta Berghauser Pont and Per Haupt, 'The Spacemate: Density and the Typomorphology of the Urban Fabric', *Nordic Journal of Architectural Research* no. 4 (2005): 57.

1 Bureau for Research and Statistics in Amsterdam: 40 dw/ha



2 Van Lohuizen: 50 dw/ha

3 Van Lohuizen excluding larger green areas: 60 dw/ha

Figure 5 (right): Diagrams showing the density ratio for the same site with the area defined differently. The top diagram shows the gross site area. The middle shows the net, and the bottom shows the area excluding large areas of open space. In the UK, the latter would be called the 'net developable area'. Source: Meta Berghauser Pont and Per Haupt, *Spacematrix: Space, Density and Urban Form* (Rotterdam: NAI Publishers, 2010), 82.

outside (molar densities) are perceived. Berghauser Pont and Haupt argue, however, that:

> *The individual perception of density can differ completely from density in technical terms. These are different categories, and it should be clear that it is dangerous to use analyses in one category to draw conclusions in the other.*[19]

Although it is important to recognise the difference between the measurement of density and the perception of it, the statement from Forsyth would suggest that the distinction is not always clear. There is a body of research that suggests that personal experience of high density environments (internal or external) affects an individual's tolerance towards certain conditions of crowding and density.[20] Drawing on this research, Rapoport suggested that the very small minimum space standards for dwellings in Hong Kong compared with Europe and North America was indicative of the increased cultural tolerance of crowding in Hong Kong society. North Americans, he suggested, 'required' twice as much space as Europeans and more than eight times that of Hong Kong residents.[21] Ylvisaker also proposed that the popularity of decentralised urbanism in North America reflected a cultural tendency to want for more "elbow and ego room".[22] The simplistic model of causality between amount of space inside the dwelling and tolerance for crowding outside of it is seriously questionable. But it does, however, highlight the fact that crowding and the definition of overcrowding is a subjective and culturally defined limit.

Indeed, for all that the environmental-determinist slant apparent in Rapoport's study is problematic, he does go on to suggest that rather than differentiating between density as something measured, and crowding as perceived; that density and crowding are both perceived. He proposed that 'perceived density' is an individual's perception and estimate of the number of people or space available and its organisation.[23] There will be a more detailed discussion on perceived density in Chapter Three. However, it is relevant to note at this point since, on the back of that definition, Rapoport goes on to suggest that the distinction between density and crowding therefore is that crowding is always a negative perception, whereas density can in theory be neutral.[24]

Arguably, at the time that Rapoport was formulating his ideas, the conception of density was primarily as an instrument of built form. The notion that density could be harnessed as a positive attribute of the urban environment had begun to inform architectural conceptions of density (see Episode IV in the previous chapter). However, the idea that it could be an experiential, or perceived quality, rather than simply measured as a ratio value, had not been articulated in academic discourse on the subject. Rapoport therefore proposed the idea of perceived density as something completely distinct from density in terms of a measured ratio.

Returning to the discussion about internal densities, room densities and occupancy ratios are amongst the

20 Studies by the anthropologist Edward Hall considered the relationship between experience, culture and behaviour. His studies are cited by MVRDV who state that Japanese and Arab populations have a much higher tolerance for crowding in public areas than Americans and Northern Europeans, reflected in huge differences between the minimal space requirements in the USA and Europe compared with Hong Kong. See MVRDV, *Farmax - Excursions on Density*, 134.

21 Rapoport cited the following figures taken from Mitchell (1971); USA: 340 square feet per person (as a minimum for housing), Europe: 170, and Hong Kong: 43.'Toward a Redefinition of Density', *Environment and Behavior* 7, no. 2 (June 1975): 148.

22 Urban Land Institute, *'Density: Five Perspectives - A ULI Special Report'* (Urban Land Institute, 1972), 22, British Library.

23 Rapoport, *'Toward a Redefinition of Density'*, 136

24 The perception of density can also be positive and this is central to the promotion of higher urban densities as part of current UK planning policy and was discussed in the final two episodes of the previous chapter.

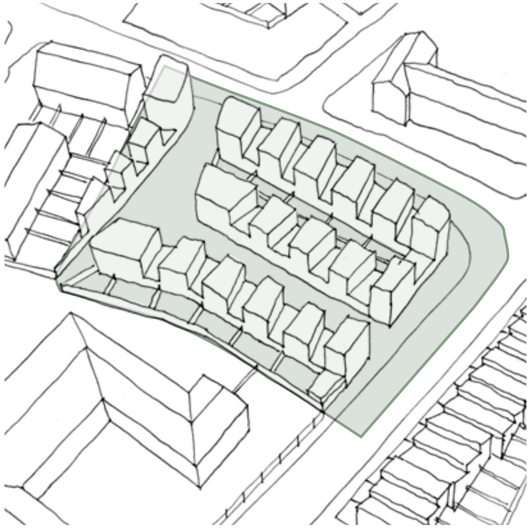
25 Three common measurements of overcrowding are currently used, all are based

Left hand page:

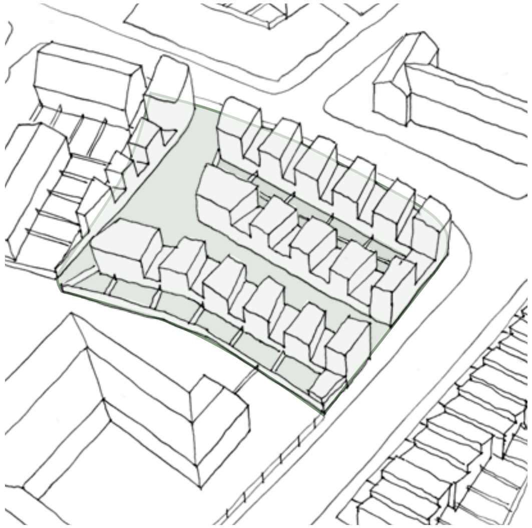
Figure 6: The calculation of net and gross site areas. As set out in Greater London Authority, *'Housing for a Compact City'* (Greater London Authority, 2003), 11.

Right hand page:

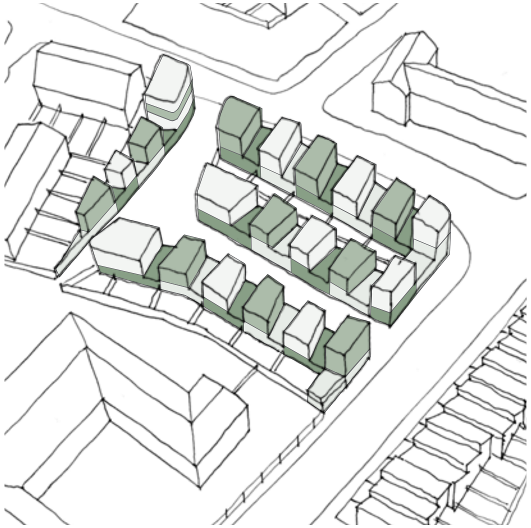
Figure 7: Calculating density ratios using dwellings, habitable rooms and plot ratios



Gross site area includes:
public space
non-residential land use on the site
half the width of surrounding roads

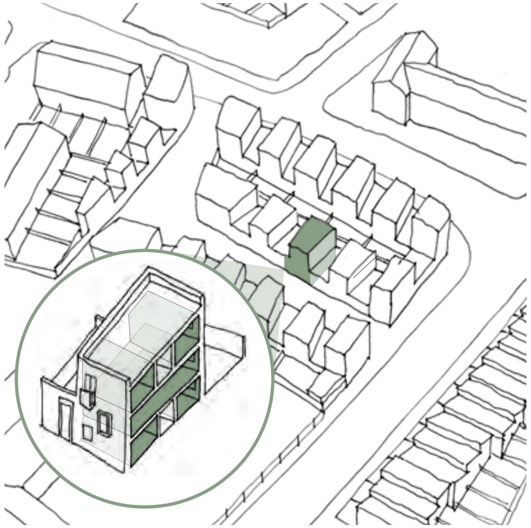


Net site area includes:
Access roads within the site
Private garden spaces
Car parking areas on site (where this located off adopted public highways)
Incidental open space and landscaping
Children's play areas
It excludes:
Major distributor roads
Primary schools
Open spaces serving the wider area
Significant landscape buffer strips



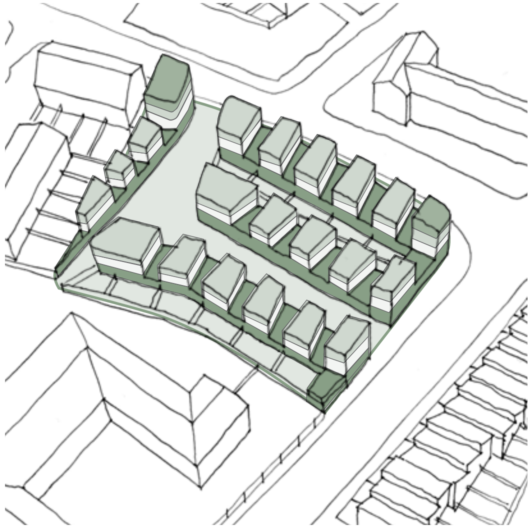
Dwelling densities

$$\frac{\textbf{Number of dwelling units}}{\textbf{Net Site Area}}$$



Habitable Room densities

$$\frac{\textbf{Number of habitable rooms on site}}{\textbf{Net Site Area}}$$



Plot Ratio

$$\frac{\textbf{Building footprint (Gross Area)} \times \textbf{Number of storeys}}{\textbf{Net Site Area}}$$

Publication	**Date**	**Units of density**
Tudor Walters report	1918	Dwellings / acre
The Country of London Plan	1943	Persons/ acre
The Density of Residential Areas	1952	Rooms/ acre
Flats and Houses: Design and Economy	1958	Habitable rooms /acre
Homes for today and tomorrow	1961	Habitable rooms /acre
Housing cost yardstick for schemes at medium and high densities	1963	
Cars in Housing: Some medium density layouts	1966	Houses /acre
Land Use and Densities in Traffic-Separated Housing Layouts	1968	Dwellings / acre
		Bedspaces/acre
Designing a low-rise housing system: the 5M system and its development	1970	Persons/acre
Greater London Development Plan	1976	Habitable rooms/ acre
GLC Draft Policy H08 Greater London Plan	1983	Habitable rooms/ acre[1]
Towards an Urban Renaissance	1999	Dwellings/ hectare
Sustainable Residential Quality: Exploring the Housing Potential of Large Sites	2000	Habitable rooms/ hectare
		Dwellings/ hectare
Planning Policy Guidance 3: Housing	2000	Dwellings/ hectare
London Plan: Density Matrix	2011 (2004)	Habitable rooms/ hectare
		Dwellings/ hectare

Table 5: Units of density in publications about housing density since 1950. For more references see Woodford et al (1976) who describe the range of different density measures that have been used since 1918; Persons, dwellings, dwellings, habitable rooms and bed spaces. Comprised from information in Nicola Dempsey and Mike Jenks, 'The Language and Meaning of Density', in *Future Forms and Design for Sustainable Cities* (Amsterdam: Architectural Press, 2005), 293.

least frequently cited density measurements used. Room density (or the number of persons sharing a room) is used as the statutory indicator of overcrowding.[25] Overcrowding is considered to exist wherever the number of persons per room in a dwelling exceeds one. However, it is not frequently used in planning and design practice. One reason for this is that information about the occupancy of dwellings can be difficult to ascertain, especially in private housing. Furthermore, occupancy, and conditions of overcrowding are affected by a range of social, economic, cultural and policy factors that are beyond the remit of architects and planners.[26]

Therefore, because internal densities are difficult to ascertain, are affected by a number of factors outside of the scope of design and planning, and because the experience of density in the interior can be completely at odds with the density of the urban fabric, the two are considered to be distinct. A whole thesis could be written on internal densities, crowding and the experience of the home, but for the purpose of defining a better understanding of the experience of density for the design of the urban environment, internal densities are not considered further in this thesis.

Units of Measurement

As well as the different scale and definition of site areas used in density measurements, different units of density are also applied to different purposes. Over the course of the history of density ratios being used within planning and architecture, the units of density have shifted in response to changing societal and professional concerns, as well as changes in the way that density ratios are used by these disciplines. Raymond Unwin, for instance, was concerned with promoting an alternative layout for housing development to replace what he considered to be the monotony of the by-law terraces; his unit of choice was dwelling densities. Abercrombie and Forshaw, enthused by the technocratic methodologies proposed by Le Corbusier and the early modernists, referred to population densities, assuming with some autocratic certainty that population could be determined by the number and size of dwellings that were to be built. Table 5 sets out the preferred units of density used in key planning documents since the Tudor Walters report of 1918. Over the course of 100 years, only three units of density have been used: dwellings, habitable rooms and people. Person densities have fallen out of use in planning practice in recent decades for the reasons set out above. Habitable rooms and dwelling densities continue to be the prevalent units of density, with dwelling densities used primarily in national planning guidance and policy, and habitable rooms favoured in London-specific guidance. The three most commonly used units of density (and those used through the course of this study): dwellings, habitable rooms and plot ratio, are described in the diagrams in Figure 7.

Dwellings

Dwelling density is defined as the ratio of dwelling units to the net site area (see Figure 7). Raymond Unwin used

on a calculation of the number of rooms in a dwelling and the number, age and gender of those sharing the rooms.

i) The bedroom standard: the required number of bedrooms for each household is calculated in accordance with its age/sex/marital status composition, and relationship between household members. A separate bedroom is required for each couple, for any other person aged 21 or over, for each pair of adolescents aged ten to 20 of the same sex, and for each pair of children under ten. ii) Persons per room: A simple division of the number of people in a household by the number of rooms in the property. Bathrooms, toilets, halls/ landings and storage spaces are excluded.

iii) Occupancy: A room standard, much like the bedroom standard, but more generous - all households are assumed to require two common rooms. Laim Reynolds, Nicola Robinson, and Rita Diaz, *'Crowded House: Cramped Living in England's Housing'* (Shelter, October 2004), 35.

26 Despite this, there have been a number of studies carried out in the impact of urban form and dwelling types on crowding. See Hitchcock cited in Churchman, *'Disentangling the Concept of Density'*, 1999.

27 Dempsey and Jenks, *'The Language and Meaning of Density'*, 293.

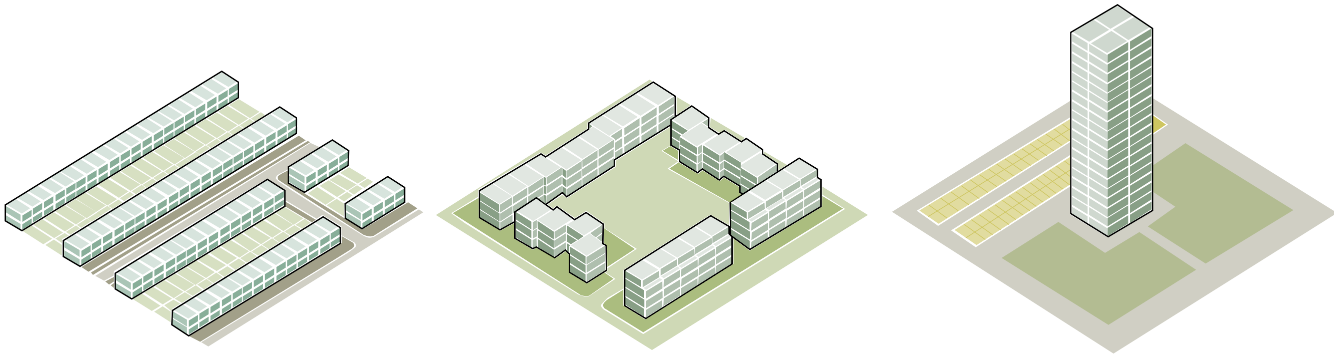


Figure 8: Diagram showing how three different types of housing and urban form, an urban block, terraced streets and a point block can be developed at the same dwelling density, in this case 75 d/ha.

Taken from diagrams presented in *Greater London Authority, 'Housing for a Compact City', 20.*

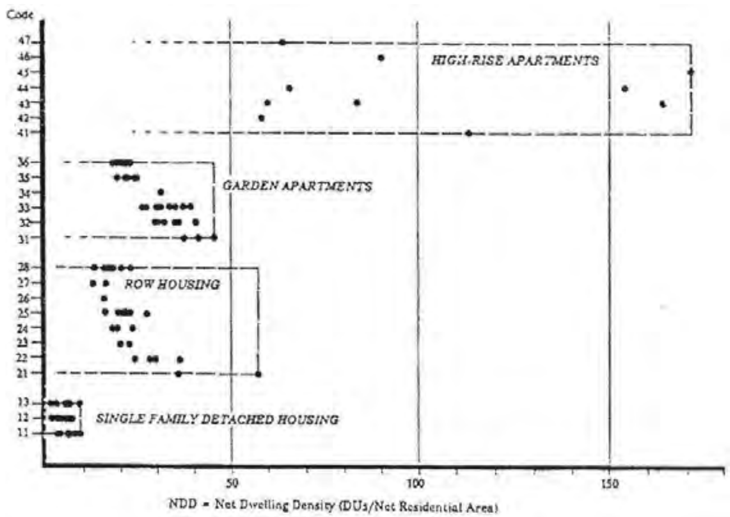


Figure 9: Graph taken from Ernest Alexander's study into the potential dwelling densities of different housing typologies. Source: *Ernest R. Alexander, 'Density Measures: A Review and Analysis', Journal of Architectural and Planning Research 10, no. 3 (Autumn 1993): 181–202.*

Alexander's methodology was to devise a series of abstract layouts based on four dwelling types (99 layouts in total), by adjusting different parameters; dwelling size, lot size and block configuration, for each of the four basic types. These factors, along with dwelling type were presumed to have an altering affect on the dwelling density of the scheme. However, the limited design consideration given to other the fundamental spatial issues of site coverage, access, outdoor space and vertical organisation underplay the capacity of good design to produce higher or lower dwelling densities within certain spatial constraints.

dwelling densities in his early plans for the Garden Cities. However, since the 1930s they have been relegated in favour of population densities (1930-1950) and later, densities of habitable rooms (1960-1980) (see Table 5). In recent decades however, dwelling density has regained popularity and is currently the measure of density most commonly used in UK planning policy and guidance.[27] Indeed, the last iteration of the Planning Policy Statements, PPS3: Housing (2011) defined density in terms of dwellings:

Density is a measure of the number of dwellings which can be accommodated on a site or in an area.[28]

Collins and Clarke suggest that dwelling densities are the preferred measure of density for estimating the land required for housing development, allocating land for housing and for monitoring completions. In the context of a critical housing demand defined in terms of 'new households', dwelling densities provide a relatively simple way of estimating the effectiveness with which land is being used in the provision of new housing.[29] Dwelling units are also relatively easy to comprehend in comparison with habitable room densities, or floor areas which are more difficult to visualise.[30]

Although dwelling density is frequently cited as an indicator of the capacity of a development site, the information that it provides about the amount of accommodation on the site is limited. It gives no indication as to the size of the dwellings or the layout of the site for instance. As Collins and Clarke note:

[Dwelling density] does not, however, give useful information as to how dense a development will look. Apartments at 60dph may actually have a smaller built volume than larger houses at 30dph with related garaging. Using dwellings per hectare to identify different character areas on a masterplan is not, by itself, reliable.[31]

The diagrams shown in Figure 8 demonstrate the fallibility of using dwelling densities to describe the site layout or built form of development on a site. Each of these hypothetical sites has an equivalent density of dwellings. Collins and Clarke suggest that the promotion of dwelling densities as the sole measurement of density impacts on the type of housing development that is encouraged. They write:

By defining the maximum number of dwellings, developers are encouraged to build the largest dwellings possible (i.e. large family houses) on a given site up to the maximum permitted density.[32]

Dwelling densities are also premised on the assumption that housing is developed as a distinct entity, on solely residential sites. As Berghauser Pont and Haupt note:

Houses per hectare does not take other programs (such as offices, schools, and other amenities) into account and, due to different sizes of dwelling units, is a very elastic variable.[33]

A mixed-use development with a high plot ratio, making relatively effective use of the site, could have a very

28 Department for Communities and Local Government, *'Planning Policy Statement 3 (PPS3): Housing'* (Her Majesty's Stationery Office, 2011), para. 50. Note that the PPS series was superseded by the *National Planning Policy Framework* in 2012. It does not specify a national minimum density as in the PPS series but emphasises a 'presumption in favour of sustainable development'.

29 Population growth, and decreasing household size is contributing to accelerated growth in the number of households and number of new homes required. Kate Barker, *'Review of Housing Supply: Delivering Stability: Securing Our Future Housing Needs'* (Her Majesty's Stationery Office, 2004), 15–16.

The government also publish regional projections for housing demand (housing market areas) in terms of numbers of households which gives currency to the measurement of land-take in these terms as dwellings-per-hectare. Department for Communities and Local Government, *'PPS3'*, 12; Greater London Authority, *'The London Plan: Spatial Development Strategy for London'* (Greater London Authority, February 2008); *'The London Housing Strategy: Delivery Plan'* (Greater London Authority, 2010).

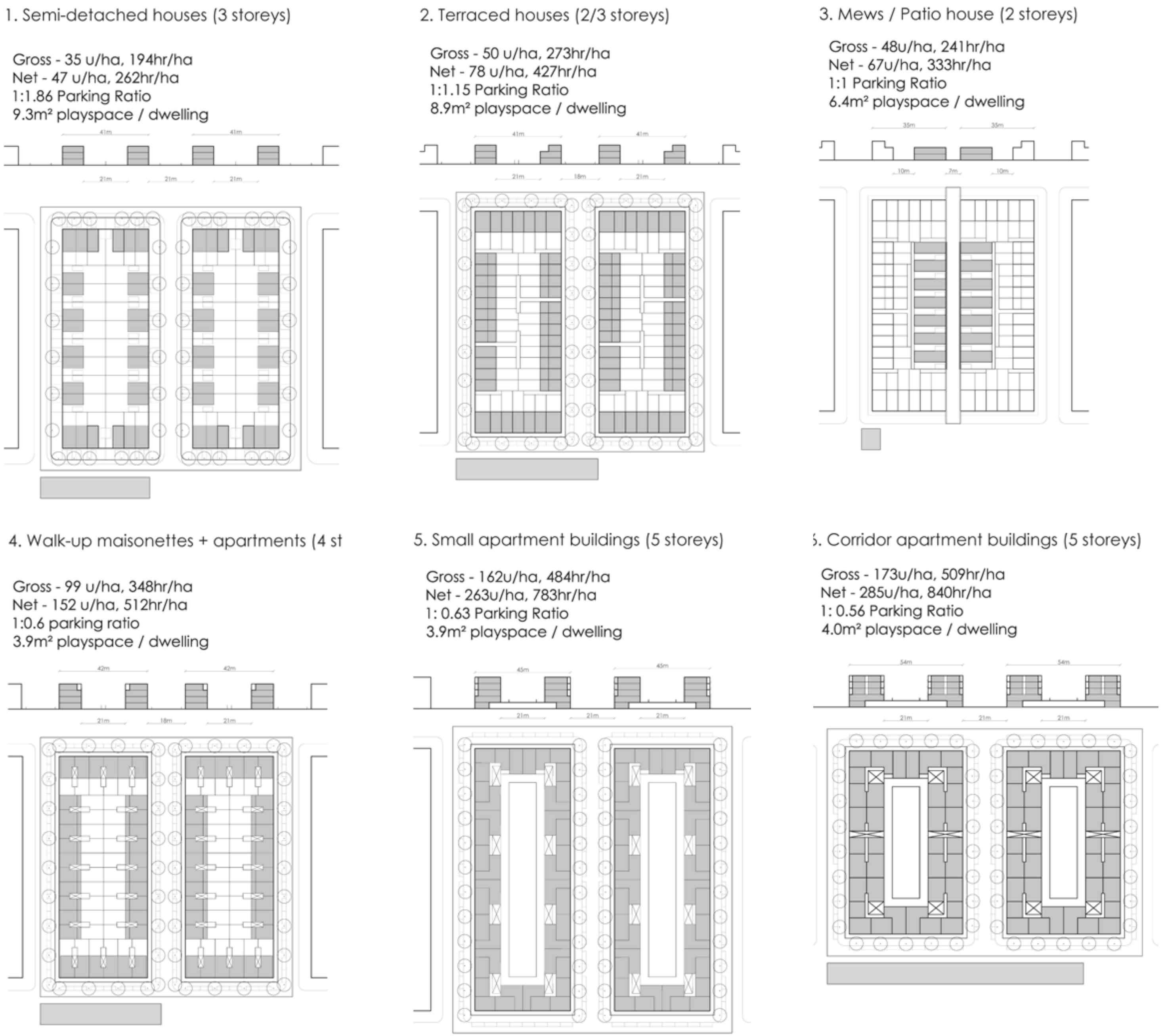


Figure 10: Diagram showing the density potential of different housing 'typologies'. Source Maccreanor Lavington Architects, Emily Greeves Architects, and Graham Harrington Planning Advice, 'Housing Density Study' (Greater London Authority, 30 August 2012), 129

Three storey terrace of houses with 5m frontage and 18m separation distances = 64dw/ha

Four-storey block maisonettes = 67 dw/ha

Three storey apartment block = 115 dw/ha

Four and five storey lift access apartment building with low prop single-aspect = 200 dw/ha

30 Helen Cope, *Capital Gains: Making High-density Housing Work in London* (London: London Housing Federation and the Housing Corporation (London), July 2002), 24–25.

31 Roger Evans Associates Limited, *'Delivering Quality Places: Urban Design Compendium 2'* (English Partnerships and The Housing Corporation, September 2007), 92.

32 Collins and Clarke, *'Planning Research Programme',* 55.

33 Berghauser Pont and Haupt, *'The Spacemate: Density and the Typomorphology of the Urban Fabric'*, 58.

34 Campaign to Protect Rural England, *The Proximity Principle* (London, May 2008).

35 Alexander, *'Density Measures: A Review and Analysis'*.

36 Maccreanor Lavington Architects, Emily Greeves Architects, and Graham Harrington Planning Advice, *'Housing Density Study'* (Greater London Authority, 30 August 2012), 145.

low dwelling density because a large proportion of the development is not residential. Despite the limitations identified with using dwelling densities to describe the built form, capacity or mass of building on a site, they nonetheless continue to be used as an index of the effectiveness with which land is being used.[34] The continued and dominant use of dwelling densities arguably promotes reliance on standard dwelling types and urban configurations as a means of visualising the amount, type and capacity of development associated with a given density ratio. For instance, a typical semi-detached layout, typical perimeter block layout, or typical urban terrace layout might each be associated with a given dwelling density. These assumptions might be used to inform decisions about optimal densities for development on a site – as was alluded to in the diagram cited at the beginning of this chapter (Figure 1).

Ernest Alexander's typological study into the relationship between net dwelling density and housing typology demonstrated that, by adopting certain typological characteristics as a given (i.e. row houses always have on-site parking and a certain size of garden), that typology can be used to infer dwelling density and vice versa (see Figure 9).[35] The recent Housing Density Study goes into more depth and suggests that there are certain site conditions (such as car parking and outdoor space) and characteristics of different dwelling typologies that limit the maximum densities that different typologies can generate (Figure 10).

Every housing typology has a particular density range within which it works well, and above which certain conditions tend to become compromised; privacy, daylight, amenity space are reduced, or there is an increase in single aspect dwellings.[36]

This suggests that a correlation between dwelling densities and dwelling typologies can be made, but is dependant on other supplementary information such as the amount of outdoor space and a more detailed and nuanced understanding of the characteristics that limit the potential density ratio of different typologies such as how building mass is extended, adjoined and the critical distances of separation between buildings. Taken on their own, however, dwelling densities remain a rather simplistic measurement with limited scope for describing the physical characteristics of development on a site and only where supplemented with site area measurements can they be used to indicate capacity.

Habitable Room densities

When habitable room densities were introduced into architecture and planning in the early 1950s they replaced persons as the primary measure of density. Although of "narrower currency" than people densities, habitable rooms along with bedspaces were seen as providing a close approximation of the number of occupants.[37] However, as with dwelling densities, habitable room densities do not take account of non-residential floor-space on site and provide a poor indication of the actual floor area, even of

CHAPTER II

Measuring Density - unpacking the units of density and their applications

the residential part of a development. In addition to this, habitable rooms lack the ease of conceptualisation that makes dwelling densities the popular (if not necessarily accurate) density unit of choice.[38] Even a simple measure of 'rooms' per hectare has a semantic simplicity that would enable it to be conceptually understood as number of cells that together constitute dwellings, and eventually buildings.

Defining 'habitable rooms'

Part of the difficulty in conceptualising habitable rooms is that are defined in complex, academic terms, which have little relevance to the way the dwelling is inhabited. The England and Wales Building Regulations (2010), define a 'habitable area' (as a replacement for the term 'habitable room') as:

- A room used, or intended to be used, for dwelling house purposes (including for the purposes of Part B) a kitchen but not a bathroom. (Part B: Fire Safety)

- A room used for dwelling purposes but which is not solely for a kitchen, utility room, bathroom, cellar or sanitary accommodation. (Part F: Ventilation)

- A room used, or intended to be used, for dwelling purposes including a kitchen but not a bathroom or a utility room. (Part M: Access and Use)[39]

Not only does the 'habitable area' lack consistent definition, but the inclusion and exclusion of kitchen 'areas' from some measurements but not others means that measurements cannot be easily compared. The contested definition of what constitutes a habitable room or habitable area further complicates effective comparison between secondary sources, especially international or historic sources which use alternative definitions or do not make the definition explicit at all.

Number of rooms and dwelling size

One of the fundamental issues with using habitable rooms as an indicator of site development is the lack of consistency between the number of rooms and size of a dwelling.[40] The HATC report Housing Space Standards (published in 2006) challenged the usefulness of habitable rooms as an indicator of either dwelling size or occupancy:

> *[It] is impossible to determine whether a dwelling with (for example) 4 habitable rooms and with an internal dwelling floor area of 60m² is of an adequate size or not. If the habitable rooms are a dining room, a living room and two single bedrooms (designed for occupancy by two people), it would be spacious. If the habitable rooms are one living/dining room and three double/twin bedrooms (designed for occupancy by six people) it would be completely inadequate.*[41]

Occupancy, is critical therefore in order to determine whether space - defined in terms of habitable rooms - is adequate. Collins and Clarke also suggested that neither habitable room density, nor dwelling density showed any consistent relationship with building footprint and both

37 Miles Glendinning and Stefan Muthesius, *Tower Block: Modern Public Housing in England, Scotland, Wales and Northern Ireland,* 1994, 37. However, the 1952 design manual, *The Density of Residential Areas* distinguishes between 'accommodation density', measured in habitable rooms and 'density', measured in persons. Ministry of Housing and Local Government, *'The Density of Residential Areas'* (Her Majesty's Stationary Office, 1952).

38 Cope suggests that as an index of density, habitable rooms are hard to visualise. *'Delivering Successful Higher-Density Housing: A Toolkit- Second Edition'* (East Thames Group, 2008), 25.

39 Cited in Scott Wilson, *'Dwelling Size Survey: Housing Standards: Evidence and Research'* (CABE, 2010), 5.

40 Collins and Clarke, *'Planning Research Programme',* 55. The study shows a series of floor plans ranging from a studio flat with one habitable room (floor area 37.5m²) up to a four-bedroom house with five habitable rooms (floor area of 126m²) to demonstrate the lack of a consistent relationship between floor area and number of habitable rooms.

41 HATC et al., *'Housing Space Standards'* (Greater London Authority, August 2006), 65.

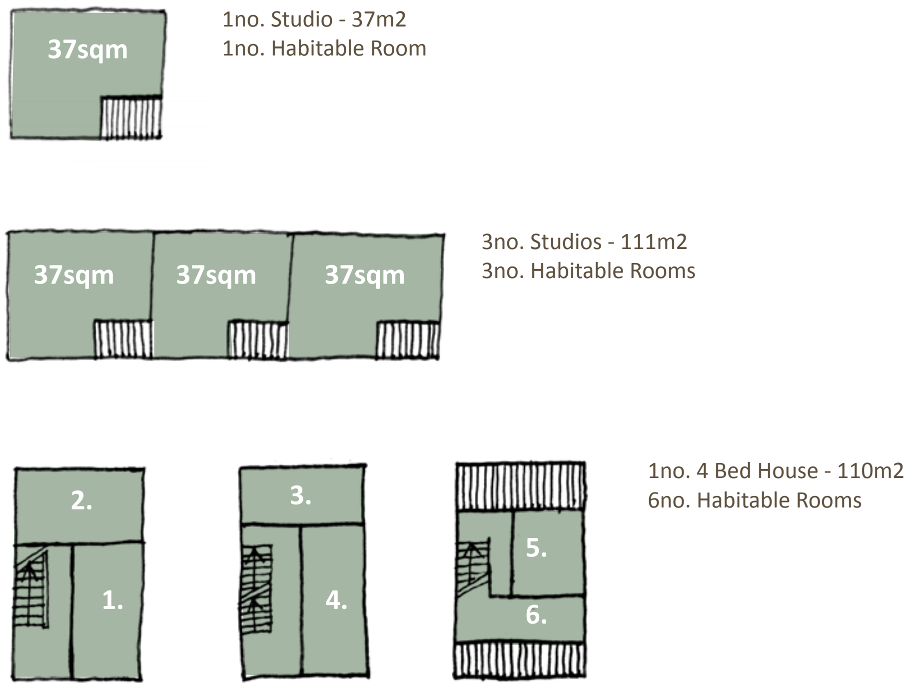


Figure 11: Diagram showing the incentive for developers to build more small dwellings with fewer habitable rooms in order to maximise development area within the permissible quota of habitable rooms

By defining maximum development densities in terms of dwellings, developers are encouraged to build the largest dwellings possible in order to maximise the amount of development on the site. By contrast, when maximum development is defined in terms of habitable room densities, more development can be achieved using small dwellings since there is (typically) a greater proportion of non-habitable to habitable rooms in studios than in four-bedroom houses.

measurements are therefore poor descriptors of built form.[42] However, just as dwelling densities provide a means of appraising housing production in relation to a shortage defined in terms of dwellings, the use of habitable room densities reflects the emphasis on the number of rooms as the measurement of dwelling size favoured in UK property markets.

> *Unlike in many other countries, homes are marketed by the number of bedrooms rather than floor space. This idiosyncrasy of the UK housing market means that space is not easily understood or translated into any meaningful information for consumers.*[43]

Elsewhere in Europe, the size of dwellings is described by measured floor area rather than number of rooms and allows for more effective comparison between dwellings. In his review of density policy in London, Duncan Bowie suggests that the emphasis on habitable room densities in the first edition of the London Density Matrix (discussed in Episode Six of the previous chapter) contributed to a preponderance of smaller dwellings in new housing development in London (Tables 6 and 7 show the Density Matrix as published in 2011).[44] Bowie's study of recent housing completions in London demonstrated that schemes with higher dwelling and habitable room densities correlated with more dwellings having fewer rooms and a significant decrease in dwellings with three bedrooms or more. Figure 11 demonstrates this effect in simple terms.

Bowie explains that efforts were taken to limit this effect by expanding the London Plan Density Matrix after its initial publication in the London Plan (2004) to include three dwelling densities for each habitable room density range. It set out a correlation between the maximum density of habitable rooms and the size of the dwellings.[45] Whilst this still falls short of providing a measure of the amount of space being provided, it at least goes some way to limiting the otherwise prevalent trend towards smaller dwellings at higher densities on central urban sites, resulting in homogeneity of dwellings types and household types in these locations.

Occupancy

Population densities are used to measure the number of people who occupy a given district, neighbourhood, site, building, or room. Depending upon their scale, population densities have a variety of uses. At the neighbourhood and district scale, population density is used to calculate demand for services and infrastructure.[46] These population densities are recorded as part of the census and other demographic surveys, and collated according to administrative boundaries such as Lower Level Output Areas (LLOA) and Super Output Areas (SOA). These administrative units are generally too large to provide a useful indication of the density of people within the immediate context of a development site, or as Burdett *et al* suggest, do not correspond with the way in which a neighbourhood or site is defined and understood by those who occupy and use it.[47] Larger scale measurements

42 Collins and Clarke, *'Planning Research Programme'*, 54–55.

43 Royal Institute of British Architects, *The Case for Space: The Size of England's New Homes* (London: Royal Institute of British Architects, September 2011), 4.

44 Duncan Bowie, *Politics, Planning and Homes in a World City: Housing, Planning and Design* (Oxon: Routledge, 2010), 98.

45 *Ibid., 119.*

This trend also suggests that the adoption of internal space standards for new housing might have an impact on the usefulness of habitable room and dwelling densities to describe the amount of development on a site.

46 Collins and Clarke, *'Planning Research Programme'*, 68.

47 Burdett et al., '*Density and Urban Neighbourhoods in London'*.

such as SOAs have the effect of describing a whole area with homogenous characteristics and concealing the variation, peaks and troughs that naturally occur.

At the room scale, population density is the primary measurement used to identify overcrowding as discussed above. However, because it is difficult to measure at the scale of the dwelling or block, occupancy is rarely used within the planning and design process. In the period post -1945; person densities were expounded as the primary unit of density since it was perceived that dwelling units and bedrooms could be used with some certainty to determine the number of occupants.

A number of proxy measures of occupancy are used, such as average household size, or bedspaces, but all provide only a limited representation of the actual number of people who inhabit an area at any given time. Bedspaces can potentially be recorded as part of the planning process and therefore provide a means of estimating occupancy at the scale of the development site. This is more appropriate for certain types of housing over others. Student accommodation for example, is developed with such definitive, cellular floor plans comprising private, en-suite bedrooms and shared common space, which limit its adaptability for other uses that the number of habitable rooms or bedspaces is probably a fairly accurate representation of the actual site occupancy. The management of the site also limits the scope for over or under-occupation. In socially rented housing, acute and continued demand ensures that socially-rented housing stock is more likely to be occupied at capacity (or more) compared with private housing.[48]

It is now acknowledged, however, that the way that a dwelling is inhabited varies according to diurnal patterns, and also across the age of the building. Population densities are far more transient than the densities of built form. Berghauser Pont and Haupt write:

> *A monofunctional working area does not physically transform during the night although it is crowded during the day and empty at night. Its physical form can certainly change, but occurs in time spans measured in decades and centuries, rather than days and years.*[49]

Clearly, this emptying out impacts on the density of activity in the area. Clarke also contends that even the most accurate recording of the number of residents would still be limited because it records only the domicile population and is therefore only a partial indicator of the occupancy of an area.[50] Employment densities have begun to be used to give a picture of overall daytime populations and to provide a more realistic indication of the activity and demand for public transport and amenities in the vicinity. However, this measure is not commonly cited and provides only an abstract representation of the commercial or recreational activity of an area.

The discussion on internal densities above suggested that the perception of density is essentially the perception of other people. Whilst population density ought to go some

48 Nick Bailey et al., *'Creating and Sustaining Mixed Income Communities: A Good Practice Guide'* (Chartered Institute of Housing for the Joseph Rowntree Foundation, 2006), 73. The report highlights the disparity between socially-rented housing which tends to be fully occupied, and privately owned housing which is more likely to be under-occupied.

49 Meta Berghauser Pont and Per Haupt, Spacematrix: *Space, Density and Urban Form* (Rotterdam: NAI Publishers, 2010), 87.

50 Using the example of the dormitory suburb, Clarke proposes residential densities provide a relatively weak indication of the actual demand for certain services and that the increasing fluidity of work and home, as well as the promotion of mixed development means that work as well as residential populations are critical to calculating demand. Paul Clarke, *Metricity: Exploring New Measures of Urban Density* (London: Royal College of Art, 2008), 28.

Figure 12: Dolphin Square, Pimlico
Gordon Jeeves (1936-38)

The extent of the façade of the building and the repetitive pattern of windows conceals the variety within the building floor plan. Not all of the windows are bedrooms or living spaces, but they nonetheless contribute to the sense that the capacity of the building could be vast.

51 Cope, *Capital Gains: Making High-density Housing Work in London*, 25.

52 Berghauser Pont and Haupt, '*The Spacemate: Density and the Typomorphology of the Urban Fabric*', 58.

53 The calculation of Gross Internal Floor Areas for FARs normally excludes all non-enclosed space such as balconies, access decks, terraces and podiums. Plot Ratios by comparison, use the whole building footprint and therefore include these elements therefore increasing the built area for the purposes of the calculation. The exclusions and inclusions in calculating bulk density ratios can have a significant impact on the resulting figure. The authoritative source for defining standards for measuring GEAs, GIAs and GIFAs is the Royal Institution of Chartered Surveyors, *Code of Measuring Practice : a Guide for Property Professionals,* 6th ed., RICS Guidance Note (Coventry: RICS, 2007)

way to describing the number of people present, there are so many limitations involved in how it is measured or approximated, and complicated further by the temporality of a buildings occupancy that it is in fact of limited use. Large scale measurements are too vague, whilst small scale, building and site measurements are estimates at best. For design, it is the impact of the population density, or occupancy of the buildings on the perception of people and activity that is of most relevance. Therefore, as Clarke alludes to in his study, understanding how buildings or neighbourhoods are inhabited, in terms of patterns of activity would be useful, but this is not represented by the current proxy measurements of bedspace densities or local population densities. More useful still, would be an understanding of how the occupancy of the buildings is perceived, i.e. how that contributes to the perception of density. In the previous chapter, the residential hotel was discussed as a typology that responded in scale and organisation to the pressure to increase plot ratios in early twentieth century Manhattan. However, the hotel could be either full or empty of residents but this would not be perceived in the façade of the building, or in the experience of residing in one of the rooms since the layout of the hotel maximises privacy and minimises the impact of neighbours. The perception of people might be guided therefore, by the large number of windows across the façade, or the sheer scale of the building itself (see Figure 12). It might also be affected by the coming-and-going of residents from the front doors of the building. In this sense, it is the relationship between the dwelling, or building and the space around it that affects the perception of people and therefore the perception of density. These factors: the scale of the building, the number of units, and the visual presence of people arguably have much more relevance for understanding how the experience of density can be understood and used by designers, than the abstract measurements of population and bedspaces that were considered above.

Floor Area Ratio and Plot Ratio

The final numeric index of density is that of Plot Ratio or Floor Area Ratio. Floor Area Ratio and Plot Ratio are built mass or 'bulk' measurements. Bulk densities differ from the unit-based measurements in that they include the floor space of non-residential functions. They are based on the total amount of building on the site and are therefore more representative than unit densities for describing mixed-use development.[51] As Berghauser Pont and Haupt observe:

> *[Floor Area Ratio] is more informative [than dwellings per hectare] as it reflects the building intensity independently of the programmatic composition. But ... it is still not precise enough to differentiate between different spatial layouts.*[52]

In the UK, bulk densities are defined as follows:

<u>Floor Area Ratio (FAR)</u> is the ratio of enclosed floor area to the area of the site. In the UK this is measured as the Gross Internal Floor Area (GIFA), or Gross Internal Area (GIA) in housing, in relation to the site area (which is usually net).

Plot Ratio measures the total area of the building footprint (Gross External Area) at each floor, divided by the area of the site.[53]

Whereas Floor Area Ratios are based on the internal area of dwelling space, and therefore represent more closely the 'saleable floor area'. Plot Ratios measure the building footprint – the gross external area (GEA) and therefore represent the overall built mass on the site.[54]

There are a number of caveats, however. As with the other measurements considered above, the definition of the areas used for measuring bulk densities vary. In France, the plot ratio (coefficient d'occupacion du sol) excludes cellars, attics, operational plant and open land used for parking and amenity space.[55] In the UK, these same exclusions normally apply, although partial basements (such as parking podiums) would be included in plot ratios. Similarly, attic space (space within the roof construction) that is part of the designed floor area would be included, whereas when it is provided as storage space or a service void it would be excluded. As has been highlighted in the earlier discussion, these exclusions make comparison difficult with regions that calculate the built area differently.[56]

Bulk measurements are not commonly used in the UK. Their application is usually limited to design briefing and developmental budgeting stage.[57] They are also more likely to be used in relation to commercial and industrial developments than housing which continues to use dwelling densities or habitable room densities to describe the amount of development. Elsewhere in Europe, however, they are more frequently used. In part this reflects the more common use of floor areas to describe the size of dwellings in France, Germany and the Netherlands, as opposed to bedrooms, as are used in the UK. In Germany at least, there has also been a longer history of using the ratio of built area to site area to set limits for the amount of development. The 1925 Building Ordinance of Berlin used the ratio of built area to site plan as the means of describing permissible development limits. It was described by the term '*Ausnutzungsziffer*', or 'exploitation number'.[58]

The Spacematrix study

Berghauser Pont and Haupt's study provides a comprehensive analysis of the use of bulk density ratios in urban planning and design and further expands the history and intent behind these measurements. The study is an extensive piece of research looking at the usefulness of different measurements of density for understanding or conveying an impression of the physical characteristics of a neighbourhood, scheme or block. They focus in particular on the implications of bulk density (in this case Floor Space Index, or F.S.I.).[59] Having established that F.S.I. on its own is a poor means of describing the physical differences between different areas, they go on to consider other measurements of site development that might provide an alternative to, or supplement the use of bulk density for describing the amount and character of the urban fabric.

54 It should be noted however that the definition of Gross Internal Floor Areas used to Calculate FARs and the units used in plot ratios can vary by municipality and are frequently not defined at all. Boyko and Cooper, *'Clarifying and Re-conceptualising Density'*; PRP, *'High Density Housing in Europe: Lessons for London'* (East Thames Housing Group Limited, 2002).

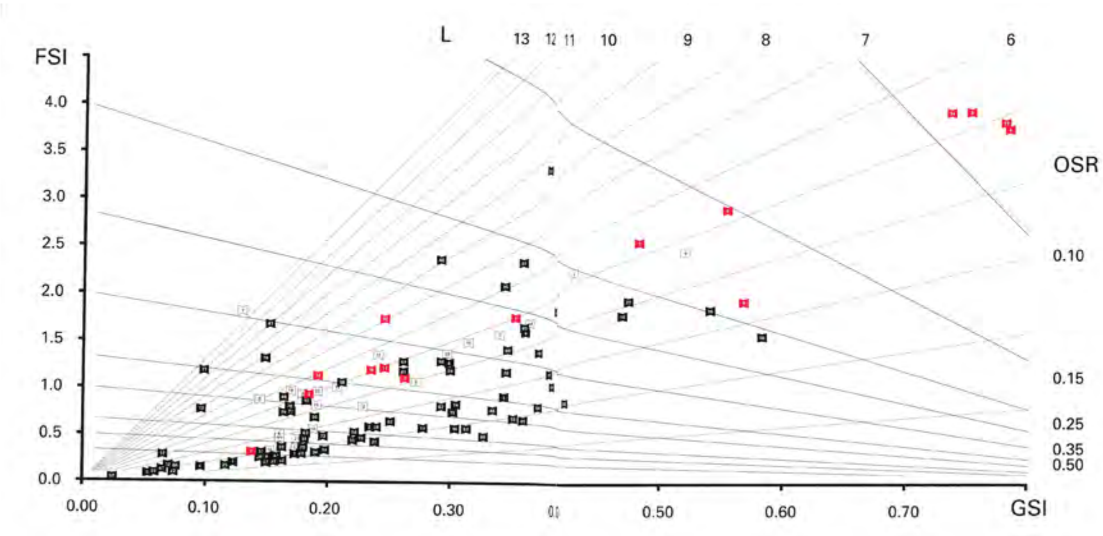
55 Collins and Clarke, '*Planning Research Programme*', 23.

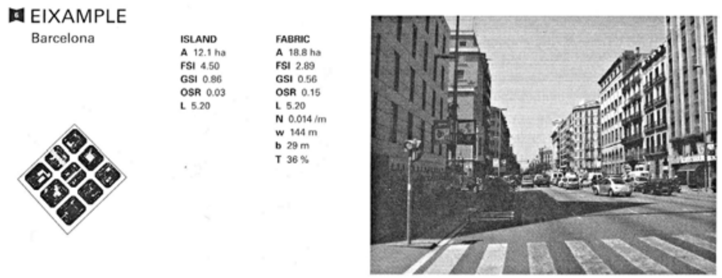
56 According to Berghauser Pont and Haupt's discussion of the history of Floor Area Ratios, the American F.A.R. or Floor to Area Ratio is similar to the UK Plot Ratio and describes the building bulk in relation to the site area. *Spacematrix: Space, Density and Urban Form,* 87.

57 Boyko and Cooper, '*Clarifying and Re-conceptualising Density'*, 7.

58 Berghauser Pont and Haupt, *Spacematrix: Space, Density and Urban Form,* 87.

59 Note that F.S.I. is the same as Floor Area Ratio in the Netherlands





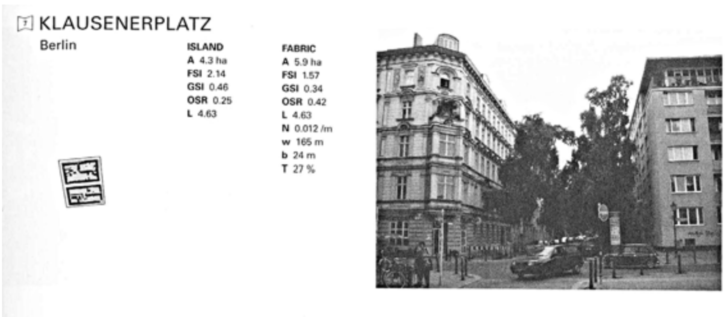


Figure 13: Graph showing Floor Space Index (FSI) correlated against Site Coverage (GSI) as a means of comparing the physical characteristics of different urban environments in the Netherlands, Germany and Spain.

The Open Space Ratio (OSR) and Height (L) dimensions add to the description provided by the index. It shows that the Eixample district (red 6 highlighted), has a high site coverage and high floor space index, a height of less than six storeys and a relatively low Open Space Ratio. By comparison, the typical Berlin block represented by Klausenerplatz is similar in height, but has a much higher Open Space Ratio and lower site coverage resulting in a Floor Space Index around half that of the Eixample. This is apparent at the scale of the building, and at the scale of the neighbourhood (or fabric). Source: Berghauser Pont and Haupt, *Spacematrix: Space, Density and Urban Form*, 126–166.

They begin with site coverage, building height and 'spaciousness', as indices that have been used in the past to try to control the permitted development. In Germany limits to site coverage were applied in order to "limit the negative effects of solid urban patterns", they write. Ildefons Cerdà's 1860 plan for the extension of Barcelona (the Eixample district) set a limit of fifty per cent coverage.[60] In Cerdà's plan, the maximum coverage was supplemented by maximum permitted heights (20 metres or four storeys) and set road widths (35 metres) that would ensure adequate open space for the good health of the city's inhabitants.[61]

They also consider the notion of 'spaciousness' which has a long history as part of the toolkit used to limit development ratios. A paper by Anton Hoenig (1928) defined 'Weiträumigkeit' or 'spaciousness' as the ratio of open space to built floor area on any given site. A ratio of less than one to one was considered to demonstrate a crowded or cramped urban fabric. The same index, referred to as the Open Space Ratio (or OSR) is still used in New York Zoning Regulations.[62]

Berghauser Pont and Haupt suggest that, taken on their own, these indicators of density do not adequately describe either the spatial properties or urban types present on a given site. They suggest however, that using a number of these variables at once begins to build up an impression of the amount of building on the site and how it is laid out. In addition to these three base dimensions of coverage, building height and open space, they add a dimension called 'network density' to give some idea of the scale of the building lot that is depicted. Network density is defined as the length of network (road or path), per square metre of ground space.[63] The higher the network density, the smaller the size of the development site.

Their analysis fed into the development of a tool, 'a space calculator' that measures the critical dimensions that were found to have an instrumental effect on the density of the built form. Its application is demonstrated by the examples shown in Figure 13. An example of the calculator itself is shown in Figure 14. The model is based on the premise that the density of built form (bulk density) can be viewed as a composite of key dimensions such coverage, building height, spaciousness and the intricacy of the urban fabric. In this way, a multi-variable model can be used to describe the physical characteristics of the built form.[64]

The Spacematrix project is a formidable and comprehensive piece of work. It provides a thorough analysis of the dimensions of built form that affect bulk density and, through the database of examples included in the spacecalculator, demonstrates a variety of ways in which designers might manipulate the design and layout of new urban developments, within the constraints of a maximum or minimum bulk density ratio. It provides a means of visualising physical differences between schemes with equivalent bulk densities and exploring the significance of the different parameters on built form.[65] However, the model is also complex, and in this complexity of variables

60 Berghauser Pont and Haupt, *Spacematrix: Space, Density and Urban Form,* 88.

61 Figures from MIT faculty, *'The Density Atlas',* 2011. Note that during construction, many of Cerdà's rules were broken and subsequent development has allowed Plot Ratios of up to 8, with site coverage of nearly 90 per cent.

62 Berghauser Pont and Haupt, *Spacematrix: Space, Density and Urban Form,* 88–92.

63 *Ibid.*, 96.

64 Meta Berghauser Pont and Per Haupt, 'City or Sprawl? The Need for a Science of Density', *'Scape* no. 1 (April 2007): 62.

65 A survey of Built Environment professionals carried out as part of a large research project, the respondents suggested that there was a lack of guidance on good and bad examples and case studies at a range of densities to demonstrate the different physical forms and quality of buildings and spaces that could be achieved. Christopher Boyko and Rachel Cooper, *Urban Futures Density Survey Report*, (Lancaster University, October 2011), 28–29.

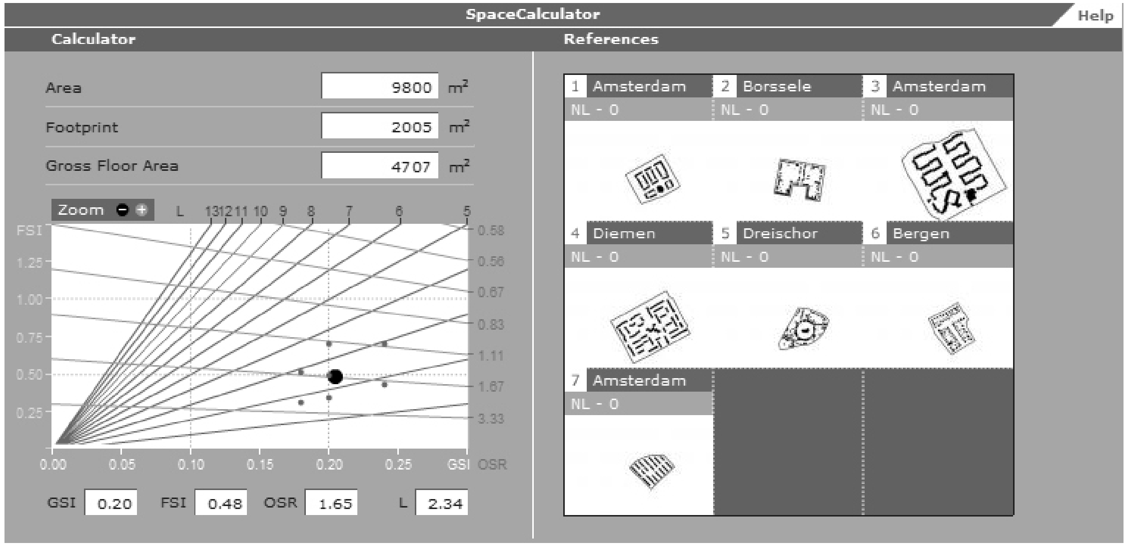


Figure 14: Screenshot from the 'Space Calculator'. The black dot represents the input data. The red dots represent schemes with similar measurements- shown in the floor plans on the right. The database stores site plans and photographs of different schemes so as a way of describing the fabric possibilities that might generate a given density. Source: Meta Berghauser Pont and Per Haupt, *'Space Calculator'*, Online application, Spacemate, 2001

66 Berghauser Pont and Haupt, *Spacematrix: Space, Density and Urban Form,* 92.

and dimensions, arguably reinforces the sense that the relationship between density ratios and the spatial qualities of a residential development is an abstract one. By codifying different, critical elements of the built environment into measureable dimensions, the matrix only adds to the complexity of comprehending density, or visualising it in terms of physical attributes. For example, if the density or intricacy of the urban fabric is taken as an important index of density, it is arguably best understood either in visual terms, or in qualitative description, as opposed to abstract quantities (N, w and b) whose meaning is decipherable only in relation to an unfamiliar scale. It also, and perhaps this is a useful place to draw to a close the discussion of numeric density measurements, perpetuates the notion of density ratios as the primary conceptualisation of density.

In the previous chapter it was established both that density ratios are essentially a modernist instrument, derived out of the desire at the beginning of the twentieth century to establish rational, even scientific methodologies for the decongestion of the city. In this context, density ratios were an attractive supplement to other measurable dimensions such as the daylight factor and building height. However, in the later episodes the density ratio became less important than the experience of the city and the intensity of activity and exchange that it offered and the potential for density to generate new urban and dwelling typologies. Whilst the numeric densities considered here have a pervasive simplicity and familiarity that arguably contributes to their continued use, they are not ‘density’ in the broadest sense.

Density ratios represent only one conception of density, different from the perception of density with which Amos Rapoport is concerned, and different from the experience or phenomenology of density introduced in the previous chapter. The history of how the different units of density have been applied point to their emergence in response to a particular need or problem. The measure of breathing-room-per-person for instance was introduced in response to the suffering caused by too many people inhabiting too little space in the sub-let and sub-divided townhouses and tenements of the industrial cities. Berghauser Pont and Haupt refer to the use of the Open Space Ratio (or spaciousness) being introduced in response to the problem of solid urban blocks with inadequate light, space and air.[66] Therefore it is important to consider density ratios in terms of how they are useful and how they are applied. The second part of this chapter therefore sets out briefly how the measurements of density considered in this section are applied in planning practice and how this potentially impacts design.

Part B: Applications of Numeric Densities

Density is an integral component of current planning policy in the UK. However, there is continued debate over the use of density ratios per se as a core component of sustainable urban development.

There are serious questions about whether the objectives [benefits they claim] can be achieved by following policies to encourage higher densities of buildings and people… There is increasing doubt that the range of 'financial, social and environmental objectives currently associated with urban consolidation can be fulfilled on a metropolitan scale with a strategy based primarily on density'.[67]

The environmental psychology scholar, Arza Churchman argues that the automatic relationship between action X (an increase in urban density), and result Y (sustainability objective) is far from proven. Instead, the relationship between urban density and the various claims about transport, economic and social benefits are interwoven in a complex web that is almost impossible to unravel in order to demonstrate unequivocally the effect of increasing or decreasing urban density at a variety of scales.[68] Boyko and Cooper suggest that part of the difficulty in identifying the implications of density comes from a lack of understanding about what density ratios and measurements mean. Indeed, the first part of this chapter has highlighted a number of limitations and complications associated with the measurement of density at different scales and using different units. In their extensive review of the scope of density-related studies Boyko and Cooper suggested that:

Barriers related to definitions, calculations, concepts and correlations with relevant issues prevent people from understanding density beyond a simple ratio of units to area… Understanding that density is more than a ratio of units to area, that it involves thinking about context and other qualitative issues, is fundamental to broadening decision-makers' awareness of the wider impact of density on the design of urban environments.[69]

They suggest that the over-use of dwelling densities in urban policy and research has the effect of passing over other, potentially more useful measurements of density. Harris and Longley have also questioned the usefulness of static measurements of density such as dwelling densities to describe the urban condition:

[Population density is] a discrete, one-dimensional measure of whether or not a space is occupied. However, cities are three dimensional in scope and scale; thus, there is a need to develop measures that are able to represent the three-dimensionality of urban form.[70]

67 Minnery, 1992, p. 26 cited in Katie Williams, 'Urban Intensification Policies in England: Problems and Contradictions', *Land Use Policy* 16 (1999): 172.

68 Churchman, *'Disentangling the Concept of Density'*, 1999.

69 Boyko and Cooper, *'Clarifying and Re-conceptualising Density'*, 1 and 4.

70 Cited in *Ibid.*, 8.

PTAL		0-1	2-3	4-6	
SUBURBAN		150-200	150-250	200-350	hr/ha
	Large	*35-55*	*35-65*	*45-90*	*dw/ha*
	Medium	*40-65*	*40-80*	*55-115*	
	Small	*50-75*	*50-95*	*70-130*	
URBAN		150-250	200-450	200-700	hr/ha
	Large	*35-65*	*45-120*	*45-185*	*dw/ha*
	Medium	*40-80*	*55-145*	*55-225*	
	Small	*50-95*	*70-170*	*70-260*	
CENTRAL		150-300	300-650	650-1100	hr/ha
	Large	*35-80*	*65-170*	*140-290*	*dw/ha*
	Medium	*40-100*	*80-210*	*175-355*	
	Small	*50-110*	*100-240*	*215-405*	

Large *3.8 – 4.6 habitable rooms per dwelling*

Medium *3.1 - 3.7 hr/dw*

Small *2.7 – 3.0 hr/dw*

Table 6: Density Matrix taken from London Plan (2011) – revised since 2004

It is interesting to note that the matrix does not consider dwellings of less than 2.7 habitable rooms per dwelling. The majority of new one-bedroom flats have two habitable rooms; a bedroom and a living room. It assumes therefore that the majority of new housing will be built with two bedrooms or more.

LOCATION	DENSITY	*EXISTING BUILDING FORM/ MASSING*	EXISTING BUILDING HEIGHT	PTAL	EXISTING BUILDING USES
Central	Very dense development	*Large building footprints*	Typically 4-6 storeys	Within 800m of International, Metropolitan or Major town centre or on main arterial route	Mix of different uses
Urban	Predominantly dense development	*Terraced houses or Mansion blocks*	Typically 2-4 storeys	Within 800m of a District centre or along an arterial route	Mix of uses
Suburban	Predominantly lower density	*Detached and semi-detached houses Small building footprints*	Typically 2-3 storeys		Predominantly residential

Table 7: Definition of terms - Density Matrix 2011. Source: London Plan (2011) – revised since 2004

This table is published alongside as a guide to determining the urban character of a given site. It indicates that a central site (those where the highest densities are permitted) is determined by its proximity to a major town centre, the scale of the buildings, the type of uses of the buildings and a (relatively) high density ratio on adjacent sites.

Arguably, the urban realm is best considered in four-dimensions with time also been taken as a crucial element affecting the experience of the urban environment. In spite of their limitations, however, numeric density ratios continue to be the primary conception of density used in planning, and across the range of disciplines concerned with the study of the built environment. The discussion below will highlight briefly how density ratios are used in current planning policy in London in order to provide a case study for further discussion. It will draw on the understanding of what is represented by the different units of density and their limitations considered in the first part of this chapter. The chapter will conclude with a discussion about the implications of numeric density measurements for design practice.

A London-specific density scale

The determination of an 'appropriate' quantitative density for London has been the subject of debate in politics, public health, planning and more recently architecture and urban design, throughout the nineteenth and early twentieth century. The most recently devised 'appropriate' densities for London are set out in the 'Sustainable Residential Quality', or 'Density' matrix, published as part of the London Plan (2011, revised since 2004).[71] The upper and lower limits it sets out (see Tables 6 and 7) define what are considered, in planning terms to be appropriate net site densities for a given development in terms of dwelling densities and habitable room densities. These so-called 'appropriate' densities are mapped out across the city thereby establishing that the assessment of a density ratio as being too high or too low is a local and contextual judgement. They are determined by the character of the site's location, and access to public transport in the vicinity (see Table 7).

The minimum limits are intended to ensure 'optimum use' is made of development land. The upper most limits control against the impact of over-development. However, the table and map shown in Figure 15 show that approximately two out of three schemes granted Planning Approval in London over the past five years have had density ratios in excess of those defined for their location by the Density Matrix. In his report on Mayoral planning decisions for the period, Bowie highlights concerns over the potential impact of these densities on amenity space provision, transport infrastructure, social infrastructure such as schools, and finally the impact on London's protected viewing corridors.[72] In the particular planning cases cited in the report, Planning Permissions were granted on the basis that initial concerns raised in relation to the impact of the high density ratios had been negated. In the case of a residential tower in Canary Wharf, the density of 4,172 habitable rooms per hectare (compared with an upper limit of 1,100hr/ha) was permitted on the basis that the scale of the development was deemed to be not-out-of-context in its location. Another scheme near Stratford in East London with a habitable room density of 2,701 but with an under-provision of amenity space on site was permitted on the basis that the design was of high enough quality to

71 Greater London Authority, *'The London Plan: Spatial Development Strategy for Greater London'* (Mayor of London, July 2011).

72 Duncan Bowie, *Review of Mayoral Planning Decisions* (University of Westminster Department of Planning and Transport, 13 March 2012).

The Future Alterations to the London Plan Report (2007) cited responses from housebuilders to the Density Matrix. It was suggested that some did not regard the upper limit as the maximum and that the policy was broadly perceived as a mechanism to increase the density ratios of new housing development. For this reason the wording was changed in the 2008 amendment to the London Plan to 'optimise' use of the site area, rather than 'maximise'. Shepley, Chris, Alan Langton, and Stuart Nixon. *"Draft Further Alterations to the London Plan: Examination in Public 18 June – 10 July 2007: Panel Report."* Greater London Authority, September 2007.

73 Detailed in *Ibid.*, para. 5.18 and 5.16 – 5.17.

Financial year	within range	above range	below range
2006/07	30%	69%	1%
2007/08	36%	63%	2%
2008/09	36%	62%	2%
2009/10	35%	63%	2%
2010/11	31%	68%	1%

Table 8: The proportion of planning applications for residential developments over the past five years that have corresponded with the density range set out in the matrix - Source: London Development Database (Greater London Authority, 'London Plan: Annual Monitoring Report 8, 2010-11'

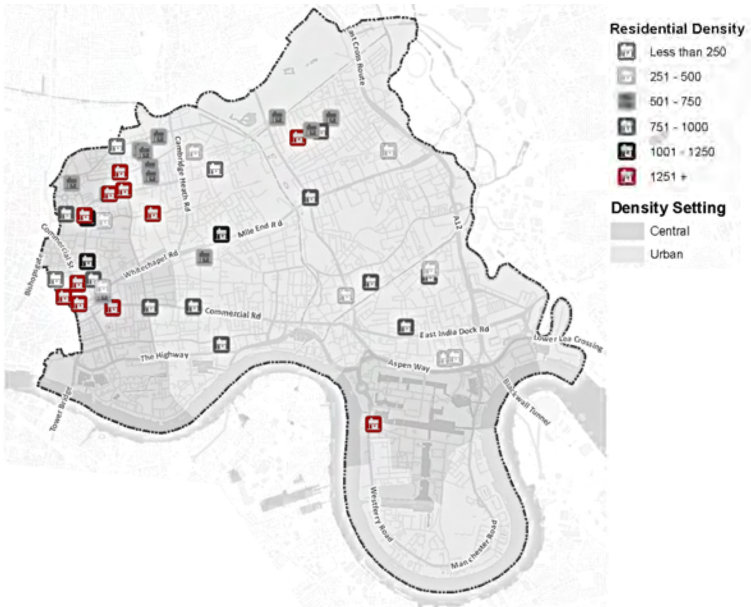


Figure 15: The schemes highlighted in dark red are those which exceed the uppermost limit of even the most central and most well connected sites. In terms of the density matrix scale, these schemes are considered excessively high. The average density for new residential developments submitted for planning in Tower Hamlets for 2010-11 was 1,024 habitable rooms per hectare – at the upper threshold for Central sites as defined in the Density Matrix (650-1100 hr/ha). A number of schemes were, however, well in excess of this density.

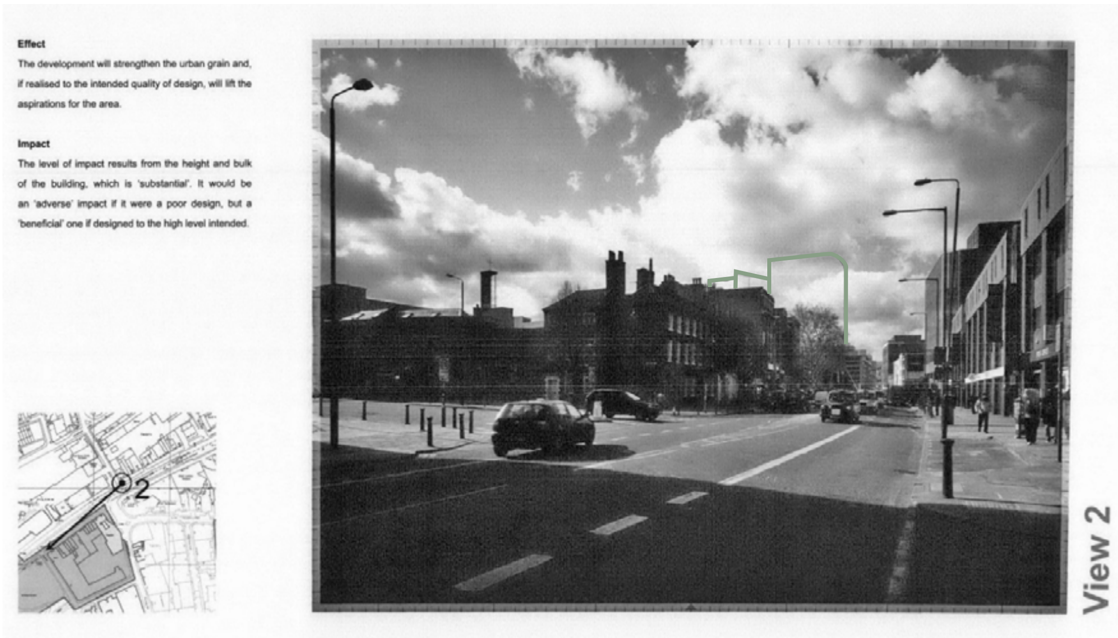


Figure 16: Example Visual Impact Assessment for new development (outlined) in Aldgate, East London. Source: The Richard Coleman Consultancy, 'Aldgate Union 3 & 4: Townscape, Conservation and Visual Impact Assessment' (London Borough of Tower Hamlets, March 2006)

justify development at densities higher than those set out in the Regional Plan.[73] Although there is a suggestion that in setting upper limits, the Density Matrix is intended to control against over-development, these examples raise the question as to what is actually represented by the density limits it sets out. The cases appear to show that the density limits are not to be used to determine the massing, or layout of the site, and furthermore that provisions such as open space and transport infrastructure that are defined planning requirements for new housing development, can also be negotiated if a proposed scheme is of a scale or typology appropriate to its context. Therefore, if building mass and open space provision are the critical issues, would standards for building height and 'spaciousness' as used in the Berlin Building Ordinance or the New York Zoning Regulations not be more useful than dwellings or habitable rooms per hecatre?[74]

Other supplementary scales are used to measure the impact of building mass. Visual Impact Assessments (see Figure 16) are based on the picturesque principles of planning the 'view' and are used to assess the mass of the building in relation to its immediate, visible context.[75] Although no explicit reference is made to density, the visual impact assessment method provides a scale against which the appropriateness of the mass of a building (or buildings) is appraised. Using this method, judgements about too big, too high or too low, are more contextually specific than the location criteria used in the density matrix.

In recognition of the limitations of the Density Matrix to provide a scale for assessing appropriate building mass, the Greater London Authority have recently commissioned a report intended to illustrate the density matrix with a number of built case studies or designed examples that indicate the type of site conditions, context and dwelling type corresponding with each 'cell' within the density matrix.[76] The report is intended to supplement the Density Matrix and to aid planners in assessing design issues such as height, massing and form in relation to site and context. It sets out to illustrate the type of urban setting represented by each of the cells on the Density Matrix, and to highlight the conditions that ought to be considered in relation to the design and massing of development on such a site. In effect, it is a more cogent version of the simple process diagram presented at the beginning of this chapter (Figure 1). The report summarises the complex range of factors affecting the density ratios of new development, stating:

> *Residential density policy is about everything and nothing. On the one hand it informs everything to do with housing design and management. On the other hand, the actual density calculation of an acceptable development (in terms of units or habitable rooms per hectare) is a product of all the relevant design and management factors; if they are met, the resultant density figure is what it is and arguably irrelevant.*[77]

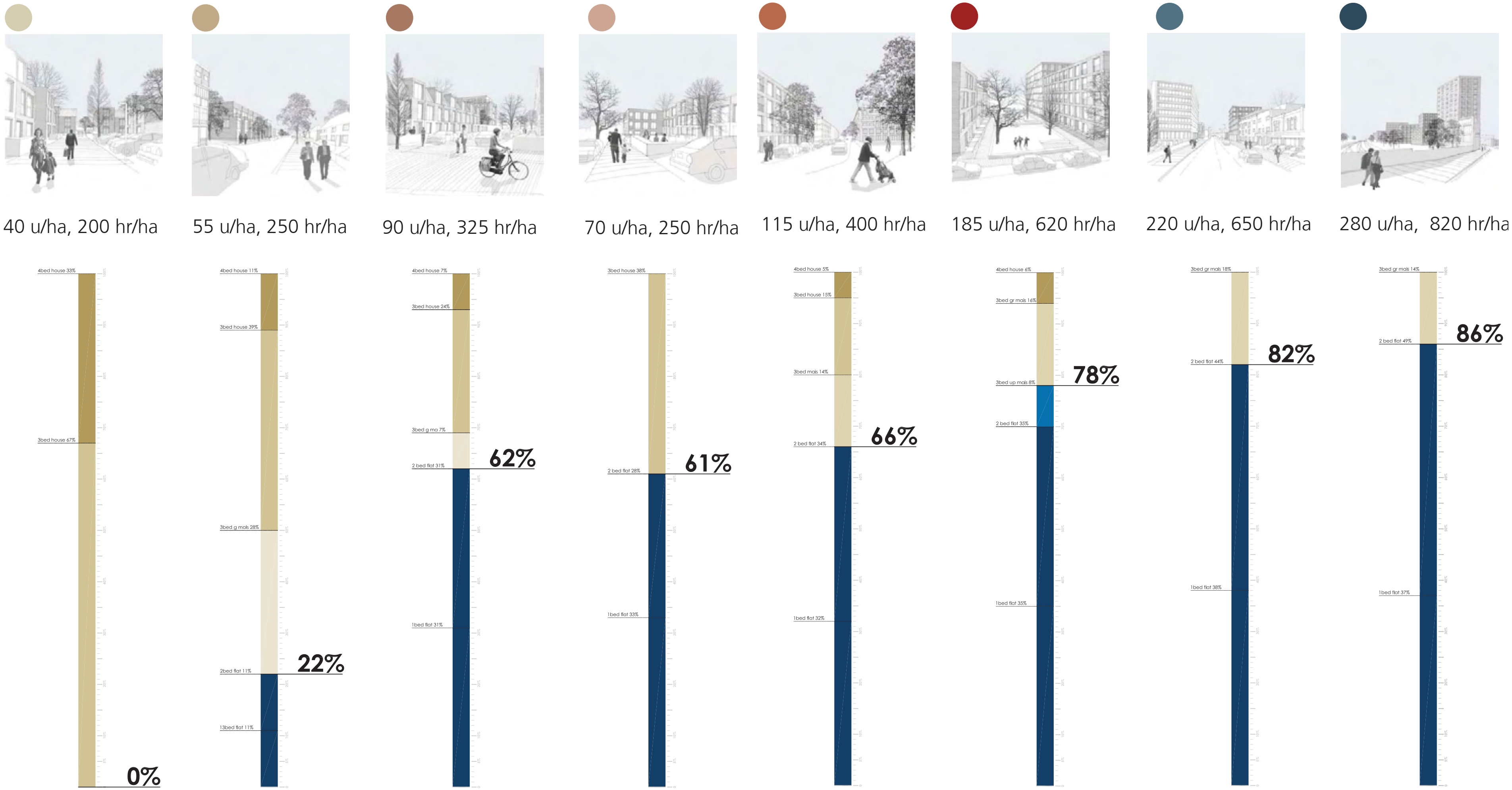
One of the most interesting contributions that the report makes is to demonstrate how planning policy in relation

74 The discussion above on Floor Area Ratio suggested that bulk density ratios are much more useful as a means of describing the amount of built mass on a site as they take into account all functional uses, as opposed to dwelling and habitable room densities that record only residential space (and not even all of that).

75 Robert Tavernor proposes that situating big within a context of bigness provides a methodology for dealing with scale that has its historical basis in the planning of English gardens. R. Tavernor, *'Scale and Context....'*, in *Scale* (presented at the AHRA Conference, University of Kent, Canterbury, 2010).

76 Maccreanor Lavington Architects, Emily Greeves Architects, and Graham Harrington Planning Advice, *'Housing Density Study'*.

77 *Ibid.*, Executive Summary.



The diagrams show typical proportions of flats (dark shading) relative to houses (light shading) for the numeric densities cited in the London Density Matrix. The demonstrate that:

<300 hr/ha – flexible in amount of "stacked accommodation" (0-20% in examples used)

300 – 600 hr/ha – require stacked accommodation around 60% of total

>600 hr/ha – around 80% stacked accommodation

Figure 17: Diagram showing typology mix of the different illustration schemes referred to in the Housing Density Study. Source Ibid., 149.

to density intersects with a number of other policies that have a determining effect on the design and density ratio of new urban housing. They include, car parking, type and size of housing (particularly requirements for family-sized housing and 10 per cent of units to be wheelchair accessible) and the requirement for open space. 'Land hungry' uses such as car parking and outdoor space can have a significant impact on the overall density ratios that can be achieved on a site.[78] These 'cross-cutting issues' (as they are termed) correspond with those highlighted by Bowie as potential concerns arising out of the impact of high density ratios. Figure 10 (cited in the first part of this chapter) demonstrated the approximate density ratios that could be achieved with different housing typologies, taking into account the relevant planning requirements outlined above. It shows that, above a certain density ratio, houses are no longer feasible, and above a higher ratio still (they suggest 200 d/ha), dual aspect dwellings become unrealistic. Figure 17 shows the proportion of apartments relative to houses that are typically needed to achieve certain density ratios. This perhaps venerates the trends observed in the historical analysis, for high density ratios to necessitate compromises in the qualities of the dwelling itself. However, this surely defines a role for design, to mitigate the worst impacts of density and make the most out of the positive implications.

There are a number of implications that can be drawn from the Housing Density Study in regards to understanding how dwelling densities and habitable room densities are used to prescribe appropriate levels of development through the London Plan (2011) Density Matrix. The first is that, in their current form, dwellings and habitable room densities are clearly inadequate to control the physical bulk of development on a site. This was apparent from the discussion above on the definition and use associated with each of these measurements. The need for a supplementary report to guide judgements about the scale, massing and typology of new housing suggests that these are clearly key issues of concern, and furthermore, that there is a need to improve the understanding of the relationship between density, physical form, and the organisation of residential environments in the city.

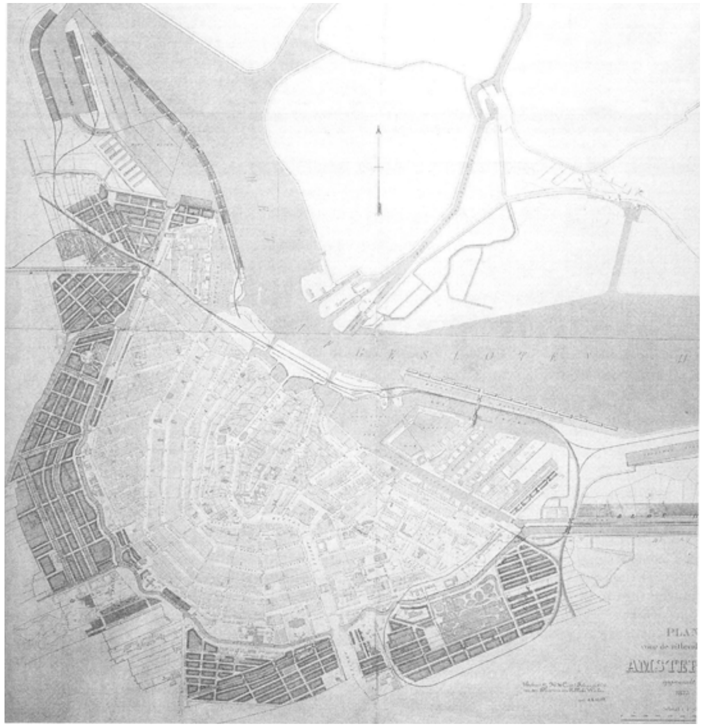
The Housing Density Study itself acknowledges that the density matrix is not a useful representation of scale and massing, activity or demand for services in relation to mixed use schemes.[79] As noted above, neither dwelling densities nor habitable room densities are able to measure non-residential elements as part of the built fabric. Therefore, by taking these terms as the starting point, the report is restricted to, at best, improving the way in which dwelling and habitable room densities can be approximated in terms of their implications for the layout of new housing.

Dwelling, and to an extent, habitable room densities do have veracity for urban planning, however. One, because they can be easily visualised,[80] and two, they correspond with the units used to measure housing demand and production.

78 Car parking, for instance, can take up between 25% and 40% of the area of small sites and the cost of providing basement car parking can be five of six times that of surface-level car parking. Therefore, strategies for mitigating the impact of car parking on the development density, such as nearby car storage, free-up site area and allow higher densities of units on the site. The study also notes the impact of other dwelling standards, such as space standards and access requirements and how these limit the potential to develop certain typologies to higher densities. *Ibid., 112 - 145.*

79 Maccreanor Lavington Architects, Emily Greeves Architects, and Graham Harrington Planning Advice, *'Housing Density Study'*, 161.

80 Suggested by Cope, *'Delivering Successful Higher-Density Housing: A Toolkit- Second Edition'.*



Left

Figure 18: Van Niftrik's plan for the expansion of Amsterdam (1866)

Right

Figure 19: Klaff's expansion plan for Amsterdam (1877). Niftrik's plan was never built and was superseded by Klaff's plan that now forms the De Pijp area to the south of the centre of Amsterdam. Source for both Berghauser Pont and Haupt, Spacematrix: Space, Density and Urban Form, 44.

81 Berghauser Pont and Haupt, *Spacematrix: Space, Density and Urban Form,* 45.

82 The streets in Klaff's plan are described as "narrow, long and depressing." *Ibid.*, 46.

83 *Ibid.*, 46–47.

84 John Callcutt, *'The Callcutt Review of Housebuilding Delivery'* (Communities and Local Government, November 2007), 145.

Development, density and politics

The basic correlation between increased density and increased land value was promoted by the earliest protagonists of instrumental densities. Unwin predicated his twelve-to-the-acre manifesto on the principles of land economics, and Le Corbusier peddled his Plan Voisin on the basis that the fourfold increase in the density of the city would multiply the economic prosperity of the city. In their historical account of the development (and density) of the city of Amsterdam, Berghauser Pont and Haupt consider the impact of social and economic policy on the density of the built fabric. Their comparison between two expansion plans for Amsterdam, van Niftrik's plan of 1866 and Klaff's plan of 1877, is intended to reveal the difference between the density ratios of the two schemes and to "illustrate the tension between state-managed and market-oriented development plans".[17] The large areas of open space and broad streets allowed for in Niftrik's plan (Figure 18), they suggest, represents a concern to regulate development for the health and well-being of the city's inhabitants. Klaff's plan (Figure 19), by comparison, closely retained the existing division of land ownership and created uniform, straight streets of terraced housing which, Berghauser Pont and Haupt suggest, benefits the efficiency of construction over the qualities of the urban fabric.[82] The important thing is not the density of the proposals in numeric terms, but how the availability of capital (plentiful in the case of Niftrik's plan, compared to Klaff's plan which was prepared at the outset of recession) impact on the layout and character of the urban fabric. More expansive, and lower-density development, they suggest, is constructed when and where there are enough financial means to let aesthetic considerations take a central role.[83] Applying a similar analysis to the development of London, the lower densities and more broadly spaced-out urban development of the post-war period is a model of socially-oriented welfare planning. The regulation of density was equated with a conception of public health and universal minimum standards of daylight, sunlight and adequate space. In contrast, the very high density schemes highlighted by Bowie in his analysis of planning decisions in London (Figure 15) represent not only a potential impact in terms of the physical scale of the buildings, or the pressure on infrastructure provision (one of Duncan Bowie's concerns), but the prioritisation of profit over the quality of the residential (and potentially the urban) environment.

The *Callcutt Review of Housebuilding Delivery* (published in 2007) provides an insight into the relationship between the current economic frameworks of housing production, and density ratios:

> *[Increased density] tends to support higher land values, but only to the point at which the additional costs of construction outweigh the additional revenue from the higher density. The lack of garaging and the feeling of "cramming" may also tend to reduce sales values and lower the point at which higher density becomes uneconomic.*[84]

85 The Callcutt Review into Housebuilding in the UK reported that the inflation in house prices over the past decade and planning policies to increase densities have conspired to inflate the strategic value of land. *Ibid.*, 137.

86 Ibid., 178.

The report goes on to suggest that density standards can inflate the strategic value of land.[85] Set maximum dwelling densities are easily translated into assumed site development capacities and become the benchmark by which the economic value of a site can be assessed. On this basis, the regulation of maximum dwelling densities through planning policy has a direct impact on the economics of housing production. It also posits dwelling densities as a key measurement through which this regulation is imposed.

In order that dwelling densities can be translated into an indicator of the amount of development permitted, a number of assumptions and approximations are required. The *Callcutt Review* suggests that the use of dwelling and habitable room densities as the primary measurements of site capacity requires (and makes necessary) assumptions about the size, layout and massing of different dwelling types. The report states:

> *Standard house types are also designed to allow the optimum compliant densities to be achieved. Optimum density is not necessarily the highest density, but the combination of house types and densities which yields the highest value per hectare at a given rate of sale.*[86]

It can be seen therefore how presumptions about housing types provide a short-cut for developers seeking to maximise the development potential of a given site and begin to establish rules of thumb about the formal characteristics that are associated with the density ranges set out in the density matrix. This, in effect, is how the process set out in the diagram in Figure 1 comes to have such a determining effect on the discussion about density and its implications for the design of the built environment. Developers use dwelling densities and habitable room densities with some degree of certainty to approximate the type and character of development on a site. These assumptions can only have a limiting impact on design. It has been demonstrated in the first part of this chapter that dwelling and habitable room densities provide a fairly poor indicator of the amount or type of development on a site, and this is less accurate still when the densities are measured at a larger scale. Berghauser Pont and Haupt have also demonstrated quite comprehensively that even bulk density ratios are insufficient to represent the qualities of built form.

Understanding the methodological and conceptual limitations of numeric density measurements

Whilst the broad notion of density was attributed a variety of spatial, social and organisational implications in the first chapter, its definition as a numeric ratio gives it fairly limited currency. Further analysis of the units of density indicated that density as a simple ratio has a range of potential implications for the built environment but these are primarily as indicators of site capacity. Even this, however, is based on a number of assumptions and generalisations about the type of housing and urban development that is proposed.

Since dwellings and habitable rooms do not give any indication of the size of the dwellings, or measure any

non-residential land-use, they are not a useful indicator of the physical mass of development on a site, particularly on sites with mixed development. Bulk densities and other critical dimensions such as height, coverage and ‘spaciousness’ are much more useful as descriptors of form than dwellings or habitable rooms. However, as has been clearly demonstrated by the *Spacematrix* study, these measurements at best provide only an abstract representation of the built form of a development.

It is clear that the various spatial qualities and organisational implications affected by, and contributing to, the experience of density that were drawn out in Chapter One are not represented or even correlated with the measurement of density as a ratio. The remaining three chapters of this thesis are therefore dedicated to exploring alternative ways of identifying, defining and making use of these spatial qualities in the design of the built environment.

Chapter 3

Towards a Phenomenology of Density

Chapter 3

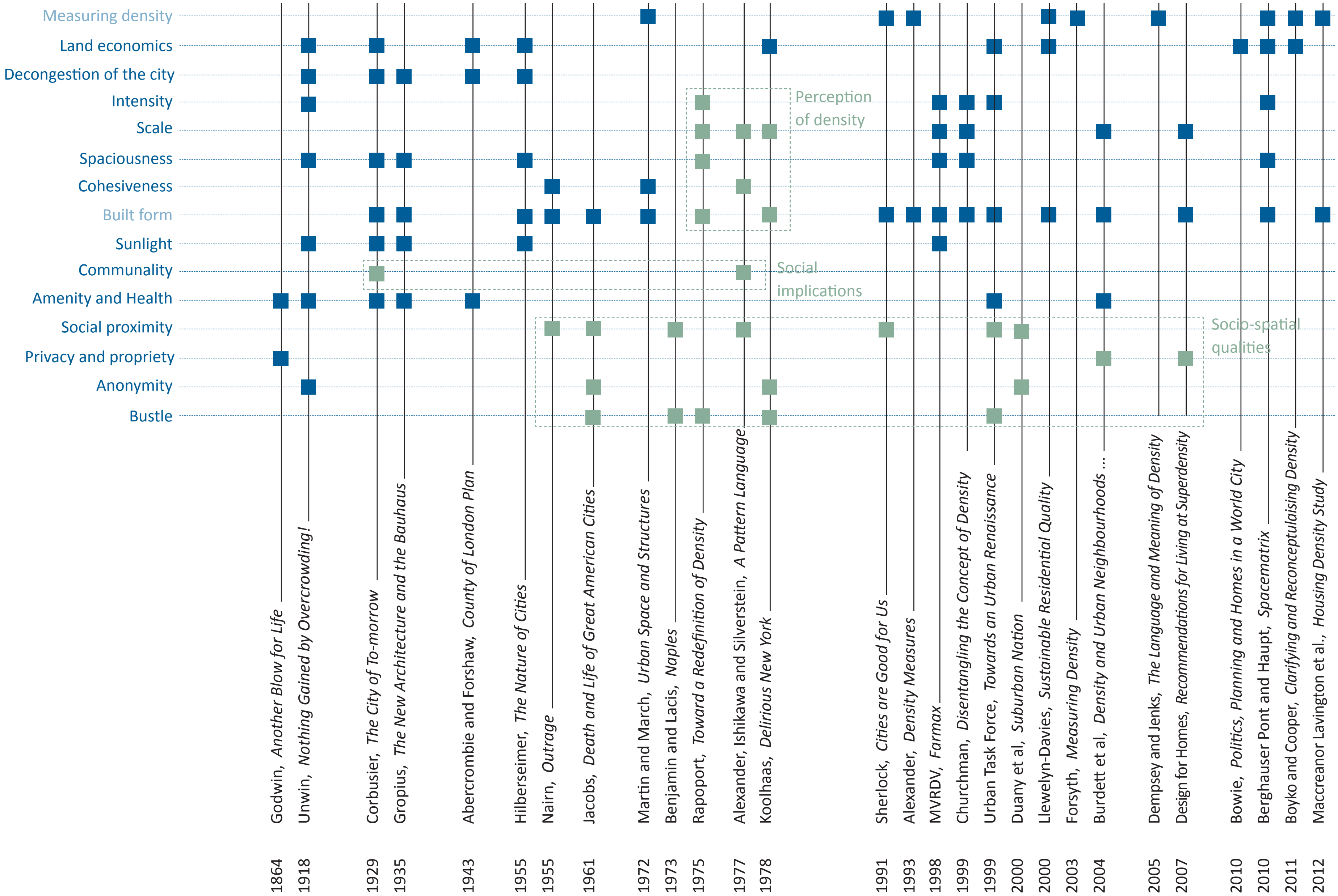
Towards a Phenomenology of Density

The city is manifestly a complicated thing. Part of the difficulty we experience in dealing with it can be attributed to this inherent complexity. But our problems can also be attributed to our failure to conceptualize the situation correctly. If our concepts are inadequate or inconsistent, we cannot hope to identify problems and formulate appropriate policy solutions. …. One set of problems arises from academic and professional specialization on certain aspects of city processes. Clearly, the city cannot be conceptualised in terms of our present disciplinary structures. Yet there is little sign of an emerging interdisciplinary framework for thinking, let alone theorizing about the city. Sociologists, economists, geographers, architects, city planners, and so on, all appear to plough lonely furrows and to live in their own confined conceptual worlds.[1]

1 David Harvey, *Social Justice and the City* (London: Edward Arnold Publishers, 1973), 22.

The problem with the current understanding and application of density lies in the limitations of the way that it is currently conceptualised. Density as a ratio is considered in terms of units: dwellings, people, squared metres of floor space. It also requires that space, as the denominator of the equation, be thought of in terms of a measurable, dimension-able area. Yet, the experience of density, on which most of the spatial transformations considered in Chapter One are based, are motivated by the qualities, the social impact or the experiential impact of density and physical proximity to others. For understanding this, the conception of density as a numeric ratio measure is clearly inadequate. In order to begin to define an understanding of density in terms of its phenomenological characteristics, it is necessary to expand upon the notion of density as something measured and move towards a notion of density as something experienced and perceived.

For much of the previous century, the use of density as an instrument of planning and architectural practice had density ratios equated, almost equivocally, with building height, site layout and typology (either high-density high-rise, or low-density low-rise). Chapter One established the need to distinguish between the measurement of density as a ratio and how the implications, and indeed, objectives associated with density are conceptualised. The


Measuring density
Land economics
Decongestion of the city
Intensity
Scale
Spaciousness
Cohesiveness
Built form
Sunlight
Communality
Amenity and Health
Social proximity
Privacy and propriety
Anonymity
Bustle
Perception of density
Social implications
Socio-spatial qualities
Godwin, Another Blow for Life 1864
Unwin, Nothing Gained by Overcrowding! 1918
Corbusier, The City of To-morrow 1929
Gropius, The New Architecture and the Bauhaus 1935
Abercrombie and Forshaw, County of London Plan 1943
Hilberseimer, The Nature of Cities 1955
Nairn, Outrage 1955
Jacobs, Death and Life of Great American Cities 1961
Martin and March, Urban Space and Structures 1972
Benjamin and Lacis, Naples 1973
Rapoport, Toward a Redefinition of Density 1975
Alexander, Ishikawa and Silverstein, A Pattern Language 1977
Koolhaas, Delirious New York 1978
Sherlock, Cities are Good for Us 1991
Alexander, Density Measures 1993
MVRDV, Farmax 1998
Churchman, Disentangling the Concept of Density 1999
Urban Task Force, Towards an Urban Renaissance 1999
Duany et al, Suburban Nation 2000
Llewelyn-Davies, Sustainable Residential Quality 2000
Forsyth, Measuring Density 2003
Burdett et al, Density and Urban Neighbourhoods ... 2004
Dempsey and Jenks, The Language and Meaning of Density 2005
Design for Homes, Recommendations for Living at Superdensity 2007
Bowie, Politics, Planning and Homes in a World City 2010
Berghauser Pont and Haupt, Spacematrix 2010
Boyko and Cooper, Clarifying and Reconceptulaising Density 2011
Maccreanor Lavington et al., Housing Density Study 2012

historical studies established that the units of density and the standards set for maximum and minimum density ratios reflected societal concerns and attitudes towards density. As those shifted, so too, the numbers were revised up and down. But these numbers, so relied upon in practice, are only one part of the broader conception of density.

In spite of the variety of approximations and generalisations required in order to translate dwelling densities (or any ratio measure) as a descriptor of the form or organisation of the built environment as were expanded in the previous chapter, there persists a general understanding that density X will produce building typology Y, with a given amount of garden space and parking ratio.[2] The approximations and generalisations that are involved in arriving at these general rules of thumb are problematic for a number of reasons. These assumptions are inherently based on normative generalisations about the size, layout and occupancy of certain dwelling types. They can be indicators of site capacity and economic viability, but different ways of appraising the physical form or organisational consequences of density are needed. Arguably, the continued emphasis on density ratios in practice posits those factors represented by them - economics and strategic planning issues as the priority. Design issues, such as the impact of density on built environment, these are relegated to mere by-products or inherent consequences of those factors.

The episodes considered in Chapter One presented a number of potential consequences associated with the concept of density rather than with the ratio (see Figure 1). For example, the potential for communality identified in Le Corbusier's plan for the Unité (Figure 2), and the social propensity associated with proximity between dwellings in the 1960s low-rise, 'carpet' housing schemes. Having considered the measurement of density ratios and their capacity to provide a representation different measured dimensions of the built environment in detail in the previous chapter, this chapter is dedicated to exploring the immeasurable, spatial implications of density.

The chapter begins by considering different conceptions of density. The notion of perceived density exists as a separate field of study, distinct from but parallel to the notion of density as a measured ratio.[3] A number of scholars have considered how density is perceived in the built environment, what cues and symbols identify 'density', and furthermore, what the psychological and social impact is of the perception of density. This part of the chapter also considers the experience of density, drawing on literary and theoretical narratives to provide a lucid portrayal of the qualities, even phenomenology of density. This then sets up a proposed expansion of density based on four distinct ways of thinking about density. The chapter begins by situating the notion of the perceived in relation to the measure.

Expanding on the 'spatial'

In order to begin to articulate the spatial qualities of density it is necessary first to expand on what is meant by 'spatial' and how this differs from the measurements of site

2 Meta Berghauser Pont and Per Haupt, *Spacematrix: Space, Density and Urban Form* (Rotterdam: NAI Publishers, 2010). The recently published Housing Density Study discussed in the previous chapter is premised on the notion that there are numerical densities are equated with certain types of urban environment and certain types of housing development. Maccreanor Lavington Architects, Emily Greeves Architects, and Graham Harrington Planning Advice, *"Housing Density Study"* (Greater London Authority, August 30, 2012).

3 Berghauser Pont and Haupt note that the perception of density and the measurement of it differ completely, and findings based on research into one or the other should not be applied to the other. "The Spacemate: Density and the Typomorphology of the Urban Fabric," *Nordic Journal of Architectural Research* no. 4 (2005): 57.

Figure 1: (opposite) Timeline showing focus of the major studies concerned with density, shown at summary of Chapter One. The highlights show the areas that are considered further in this chapter.

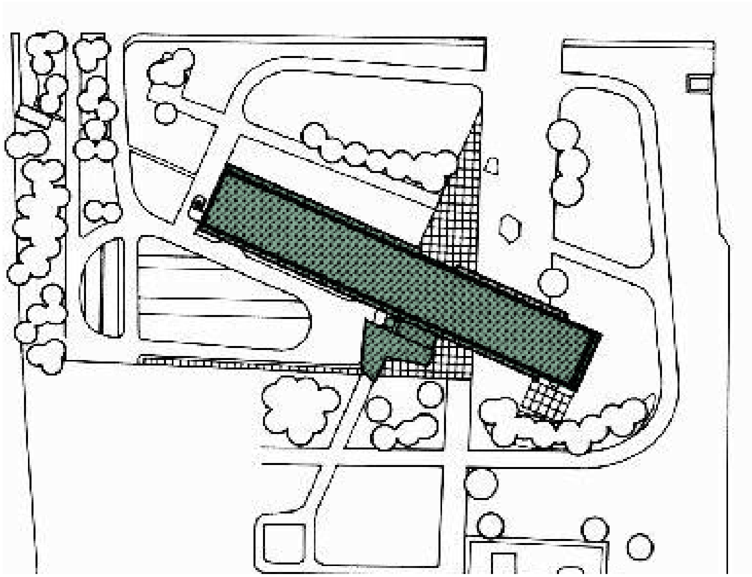


Figure 2: Unité d'Habitation Site Plan

85 d/ha, 400 hr/ha

area considered in the first part of the previous chapter. Berghauser Pont and Haupt's Spacematrix model, and Leslie Martin and Lionel March's Speculations study - both of which have been considered in some detail for their respective contributions to the understanding of density within architectural and planning practice, represent the most thorough analytical studies on the subject of density. Both are premised on the idea of space as measured: Cartesian space, or as Lefebvre termed it, conceived space. Cartesian space is an abstracted, representation of a particular conception of space, but one which, as Martin and March put it, can be useful for describing a complex physical situation more simply.[4] However, as was determined in the previous chapter, measured density ratios are unable to adequately capture the use and inhabitation of buildings and spaces – factors that were essential to the phenomena depicted by Koolhaas in *Delirious New York*, for instance. Indeed, even the most complex numeric index set out in Berghauser Pont and Haupt's Spacematrix describes only the dimensions of the buildings and spaces in between. It gives very little indication of what the spaces and buildings are like, or the experience of being in them.[5]

Developing a conception of density in which socio-spatial and socio-cultural processes, and furthermore the experience and perception of space are considered, requires a way of thinking about the complex patterns found in the physical environment that are omitted from the abstract models based on Cartesian conceptions of space. Awan, Schneider and Till's unravelling of key terms at the beginning of their book *Spatial Agency* provides a good starting point for an expansion of a broader understanding of the 'spatial'. They write;

> *Spatial does not so much replace architectural as a term, but radically expands it. It is now generally understood that space describes something more than the idea of empty stuff found between physical objects, or the white expanses left between the black lines of architects' drawings. As the residue of the construction of those lines, space is abstracted and emptied of its social content, so better and easier to subject to control.*[6]

The triad of space that Lefebvre proposes in his seminal text *The Production of Space* provides a model for expanding a more complex definition of space as the basis for thinking about and apprehending the consequences of density. The first type; 'conceived space', is the kind of abstracted model of space used by planners, developers and geographers for instance; it is not real, but forms a representation of selected characteristics of the space considered. The notion of space as a numerical denomination, against which to measure the density of units within an abstract hectare of space, is an example of this type, as are the models of bulk density as a composite of measurable dimensions, as expanded by Berghauser Pont and Haupt and Martin and March. The second type that Lefebvre sets out; 'lived space', is space as it is experienced by those who occupy, use and inhabit it. The notion of 'lived space' is potentially very useful as it introduces perception as a means of

4 Lionel March and Leslie Martin, "Speculations," in *Urban Space and Structures* (Cambridge: Cambridge University Press, 1972), 4.

5 The Spacematrix is based on eight indices of built form which, in addition to plot ratio (FSI) include; building height, site coverage, space between buildings, the intricacy of the urban grain (N and w), street width and tare. The model was discussed in some length in the previous chapter. Berghauser Pont and Haupt, Spacematrix: Space, Density and Urban Form, 94–123; Meta Berghauser Pont and Per Haupt, *"Space Calculator,"* Online application, Spacemate, 2001.

6 Nishat Awan, Tatjana Schneider, and Jeremy Till, *Spatial Agency: Other Ways Of Doing Architecture* (London: Routledge, 2011), 29.

appraising the implications of density. The third type; 'perceived space', is based on the 'spaces of production' as Lefebvre describes them. These are the spaces defined by the types of movement and types of activity that take place there. Lefebvre calls these patterns of activity 'modes of production', because rather than happening within a space, these activities describe and define the space.[7] These spaces are therefore personal as well as social. The parents' laundry space, for instance, is also the child's play space; but in reality the combination and overlap of these two activities defines the experience of both the drying room and the play space.

As a basis for thinking about density, these three conceptions provide a useful starting point.

The experience of density

There has been much previous study on the implications of density in terms of 'conceived' representations of space (see studies noted above). There is also a body of research within the social-science disciplines, particularly environmental-psychology and social geography, that has considered the perception of density and these are discussed briefly below. However, the notion of density as described through practice, use and activity remains relatively under explored. That is with the exception of some interesting, yet somewhat problematic studies that sought to expand a theory of the impact of crowding (defined in terms of internal density), based on observed behaviour in animals exposed to different conditions of crowding. The most notorious of these was John Calhoun's famous mouse experiments that were used to purport the idea that overpopulation would lead to eventual societal meltdown.[8] A number of academic studies drew on these anthropomorphic experiments as evidence of "animalistic resistance to higher densities" and attempted to use them to substantiate proposed limits on housing density.[9] Aside from the methodological issues surrounding these studies, they were premised on an essentially negative conception of density.

Density has long been considered as contributing to the negative experience if the city (see Episode One, Chapter One, for a start). Georg Simmel, in his text *The Metropolis and Mental Life* of 1903 contemplated the effect of the urban environment on social behaviour and interaction. He suggested that the experience of the large metropolis generates such a rate of rapidly shifting visual, aural and sensory stimuli that the city dweller eventually becomes 'blasé', detached from genuine emotion.[10] He suggested that the physical closeness generated by the city environment had an inverse relationship with intellectual engagement. The density of interaction (if it can be thought of as such), he argued, created an environment in which people were in close proximity to one another, but without meaningful social connexion.

The portrayal of the city in literature has often presented the chaos and activity that Simmel contemplates, as not altogether negative, however, but part of the enticement

7 Henri Lefebvre, The Production of Space, trans. Donald Nicholson-Smith (Oxford: Blackwell, 1974).

8 His proposition was published in a paper called "Population Density and Social Pathology" in 1962 and was seized on by sociologists, anthropologists and city-haters as offering a solution to the perceived social wantonness of the cities. Will Wiles gives an detailed and enthralling description of Colhoun's mouse utopias in "The Behavioral Sink," Cabinet, Summer 2011.

9 A number of claims as such as cited in Urban Land Institute, "Density: Five Perspectives - A ULI Special Report" (Urban Land Institute, 1972), 22, British Library.

10 Georg Simmel, 'The Metropolis and Mental Life', in *Rethinking Architecture: A reader in cultural theory*, ed. by Neil Leach (London: Routledge, 1997).

of the metropolis. The Marxist philosopher Friedrich Engels wrote;

The very turmoil of the streets has something repulsive, something against which human nature rebels. The hundreds and thousands of all classes and ranks crowding past each other, are they not all human beings with the same qualities and powers, and with the same interest in being happy?... And still they crowd by one another as though they had nothing in common, nothing to do with one another, their only agreement is the tacit one.... The brutal difference, the unfeeling isolation of each in his private interest, becomes more repellent and offensive, the more these individuals are crowded together, within a limited space.[11]

For novelists, poets and artists, the industrial city, with its density and conditions hitherto unknown, the spectacle of the city streets were both absorbing and menacing. The poet, Charles Baudelaire described it as:

The pleasure of being in a crowd is the mysterious expression of the enjoyment of the multiplication of numbers.[12]

The sentiments of Engels and Baudelaire, posit the crowd and the crowdedness of the city street, as an experience that is at once harrowing, and enthralling. In the passage from Engels' text, the 'blasé' attitude is recognisable in the indifference that people show as they 'crowd by one another'. There is also a sense that the 'multiplication of numbers' that Baudelaire describes generates a kind of freedom to behave as one pleases – a product of the anonymity of the crowd. The residential hotel, depicted in Chapter One as a vernacular of the density and speculation of early twentieth century Manhattan, effectively traded on the anonymity that it afforded its residents. The possibility to be one resident amongst hundreds, but at the same time, to be amongst the city was integral to Koolhaas positing of the hotel as instrument of anonymity and complete liberation.[13]

The experience of density that is portrayed by Engels, Baudelaire and also in Benjamin and Lacis' text cited below is premised on the perception of people. It is inherently social. Walter Benjamin and Asja Lacis' famous Naples essay depicts an atmosphere of density that is the product of the myriad people and the interplay of the various activities, intentions and distractions that comprise the street scene.

Porosity results not only from the indolence of the Southern artisan, but also, above all, from the passion for improvisation, which demands that space and opportunity are at any price preserved. Buildings are used as a popular stage. They are all divided into innumerable, simultaneously animated theatres. Balcony, courtyard, window, gateway, staircase, roof are at the same time stage and boxes….Even the most wretched pauper is sovereign in the dim, dual awareness of participating, in all his destitution, in one of the pictures of Neapolitan street life that will never return, and

11 Friedrich Engels, *The condition of the working class in England*, ed. David McLellan (Oxford: Oxford University Press, 2009).

12 Walter Benjamin, *Charles Baudelaire: A Lyric Poet in the Era of High Capitalism,* trans. Harry Zohn (London: New Left Books, 1973), 38 and 58.

14 Koolhaas, *Delirious New York*.

of enjoying in all his poverty the leisure to follow the great panorama.[14]

Benjamin and Lacis' text points to two important conditions associated with density. One is the presence of many people, or the suggestion, at least, of a density of people, whose activities and interests are, for the time being concentrated in this particular part of the city. Arza Churchman, in summarising the literature on perceived density suggested that the perception of density is inherently determined by the perception of other people and their traces.[15] In this sense, every clue to another person, the sight, sound, detritus left behind, adds to the perception of density. The other factor that is critical in Benjamin and Lacis' scene is the spatial opportunity. They talk about the porosity of the city's mass as being essential to creating the density of activity experienced in the Naples street:

As porous as this stone is the architecture. Building and action interpenetrate in the courtyards, arcades, and stairways. In everything they preserve the scope to become a theatre of new, unforeseen constellations. The stamp of the definitive is avoided. No situation appears intended forever, no figure asserts its 'thus and not otherwise'.[16]

The porosity of the built fabric is essential to revealing the activity and people present in the scene. There is a sense in which the occupancy of the buildings is also essential to the experience of the space around them – their inhabitants and their activities spilling out into and animating the street itself. The design of openings, apertures, and routes through the site that make visible the presence of people become spatial opportunities, strategies through which the architecture of the city contributes to and expounds the perception of people, activity and bustle. In Benjamin and Lacis' essay, the activity and bustle of the street is the subject of their intrigue and is undoubtedly depicted in a positive way. Similarly, in Dickens' portrayals of the conditions of industrial London – that which motivated the Garden Cities and other strategies for de-congesting and de-densifying the city –the intricacy of the city's fabric and crowdedness of the buildings are part of the essential character of the places he describes.

The stranger who finds himself in 'The Dials' for the first time, and stands Belzoni-like, at the entrance of seven obscure passages, uncertain which to take, will see enough around him to keep his curiosity and attention awake for no inconsiderable time. From the irregular square into which he has plunged, the streets and courts dart in all directions, until they are lost in the unwholesome vapour which hangs over the house-tops, and renders the dirty perspective uncertain and confined and lounging at every corner, as if they came there to take a few gasps of such fresh air… are groups of people.[17]

This passage taken from Dickens' *Sketches by Boz* emphasises the complexity and intricacy of the city's urban grain in the portrayal of the qualities of the space. Dickens' sketch depicts a condition that is a product of the density at

14 Walter Benjamin and Asja Lacis, "Naples," in *Reflections: Essays, Aphorisms, Autobiographical Writings,* ed. Peter Demetz, trans. Edmund Jephcott (London: Helen and Kurt Wolff, 1925), 166–167.

15 Arza Churchman, "Disentangling the Concept of Density," *Journal of Planning Literature* 13, no. 4 (1999): 403.

16 Benjamin and Lacis, *"Naples,"* 165–166.

17 Charles Dickens, *Sketches by Boz,* Net library (Boulder: Champaign, Ill. : Project Gutenberg, 1907), 41.

which the buildings are inhabited, the intricacy of the urban fabric and the closeness of the buildings and the cumulative effect of these factors in defining the phenomenological experience of city street. There is a sense that the amount of building, coupled with the narrowness of the spaces in between concentrates the density of activity that Dickens describes.

These literary depictions are useful because they go beyond the issues considered in architectural studies, (used as the primary sources in Chapter One), and planning studies (the primary sources in Chapter Two). They introduce the idea of a phenomenology of density, that is the product of the physical density of the built fabric, its occupancy, but also the spatial opportunities that are created.[18] The architect and writer Michael Sorkin talks about the opportunity of density. He posits density as one of the defining phenomenological characteristics of the city.

> *Density can produce efficiency and pleasure as much as it can bring on the nightmare. With this is mind, density must be considered from the standpoint both of its defining phenomenological character in the making of cities but also its management as a component of the endeavour to improve the quality of urban life.*[19]

The idea of density as an essential characteristic of the city immediately problematises the notion that it could be represented in a simple, numerical model. Thinking about density in terms of its phenomenological characteristics requires consideration be given not only to the physical manifestation of density, as was the premise of the Cartesian models considered in the previous chapters, but also the lived experience of density and how it is perceived. The experience of bustle, for instance, or the anonymity afforded by the numbers present – these conditions are presented as defining consequences of density in the literary narratives presented above – but are not necessarily concurrent with density measured in numeric terms. There may be many people present, for instance, but if their presence is not apparent in the activity and animation of the street, then the perception of bustle is not apparent either. For this reason, the apprehension of these qualities requires different methods other than counting the number of people.

The perception of density

The question of how density is perceived has been subject to a considerable body of investigation (some of which was briefly introduced in the previous chapter). The majority of the interest in the subject has been from the field of environmental psychology and environment-behaviour studies. In his text, *Toward a Redefinition of Density*, published in 1972, Amos Rapoport, an architect and environment-behaviour theorist, set out to define density as something that is perceived and experienced.

> *At the heart of both density and crowding seems to be an awareness of other people through all the senses and, directly or through physical cues, a consciousness of the sharing of spaces and facilities.*[20]

18 It is acknowledged that the phenomena depicted by Benjamin and Lacis, and by Dickens, go beyond the scope of the designer. However, they are closer to the social content embued within the 'spatial' that Awan *et al* refer to.

19 Michael Sorkin, "Density Noodle," *Lotus International* no. 117 (2003): 5.

20 Amos Rapoport, "Toward a Redefinition of Density," *Environment and Behavior* 7, no. 2 (June 1975): 135.

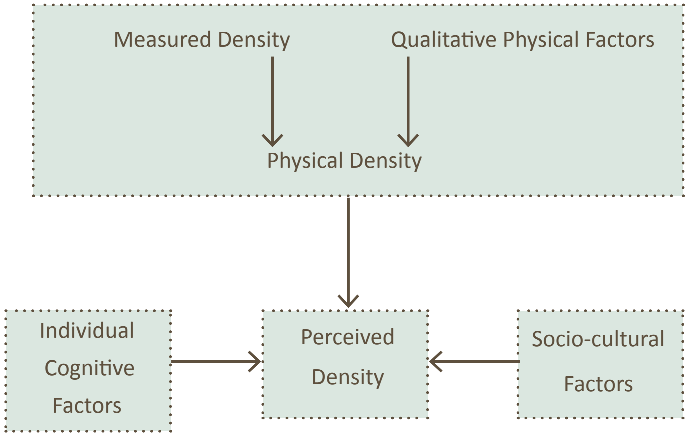


Figure 3: Summary of Rapoport's notion of Perceived density - reproduced from Ernest R. Alexander, "Density Measures: A Review and Analysis," *Journal of Architectural and Planning Research* 10, no. 3 (Autumn 1993): 181–202.

Table 1: Factors that affect the perception of density as being high. Source: Amos Rapoport, "Toward a Redefinition of Density," *Environment and Behavior* 7, no. 2 (June 1975): 140.

Physical factors:
Tight spaces
Intricate spaces
Large building height: space ratio (large amount subtended building in field of vision)
Many signs
Many lights (many artificial)
Many people/ traces visible
High noise levels
Many man-made smells
High traffic density
Associational or symbolic factors:
Tall buildings - "may indicate high density even when spaces and other perceptual cues indicate low density"
Absence of gardens and entrances (in residential areas)
Temporal factors:
Fast tempos and rhythms of activity
Activities extending over 24 hours

21 Churchman, *"Disentangling the Concept of Density"* provides a very good overview of the body of research which was concerned primarily with the impact of built form on the cognitive experience of the individual.

22 Summarised in Ricky Burdett et al., *"Density and Urban Neighbourhoods in London"* (Enterprise LSE Cities, 2004), 142.

23 Rebecca Tunstall, *"Housing Density: What Do Residents Think?"* (East Thames Housing Group, 2002), 4.

As opposed to distinguishing between crowding as a subjective interpretation and density as an objective measure of built form, he proposed that both density and crowding should be thought of as subjective and perceived phenomena. His proposition that density is perceived rather than measured opened up the idea that density – at the time accepted as an instrument of site planning and form-making - might have implications for the experience of the built environment. He further suggested that the perception of density is affected by personal, cognitive factors such as previous experience of similar environments, and socio-cultural factors that influence expectations of a particular environment (see Figure 3) and is therefore not universally perceived in the same way.[21]

Rapoport proposed a list of physical factors (set out in Table 1) that impact on an individual's perception of density. Some of the physical features that he associates with the perception of density are those that make the space feel smaller or enclosed. Others, such as the number of artificial lights, or signs, are related to the perception of human activity. The built form characteristics that he attributes with the perception of density arguably manifest ideas common at the time about what forms of housing constitute higher or lower densities - for instance, he suggests that higher densities are associated with tall buildings and the absence of entrances. In addition, the other perceived qualities such as smells and sounds, the perception of lights, traffic, movement and activity, that he includes go some way to capturing the qualities and characteristics of the urban environment depicted in the literary portrayals of the city cited above.

Using residents perceptions of density

A number of social-science studies have sought to investigate the relationship between different aspects of the built environment and the perception of density. In a research paper dedicated to the question of understanding residents' perceptions and preconceptions of higher density housing, Tunstall suggests that density is a technical concept, used by planners, architects and policy makers, but is alien knowledge to the general public.[22] She suggests that there is a general lack of popular understanding about what is meant by the term density in relation to the built environment.

> *Residents' attitudes to housing are inherently difficult to research. 'Density' can be a loaded term, often seen as inherently negative. Many people use the term 'dense' to mean 'too dense', while they may use the term 'compact' to refer to density in a positive way.*[23]

This is an interesting observation. It suggests that the term density has a negative stigma attached to it, but given the lack of certainty about how the term is interpreted and what conception or quality of density is being considered, it is unclear how that stigma might be challenged. Tunstall's observations also point to a short coming in the use of interviews, or residents' perceptions per se, as a means of understanding how density is experienced and perceived.

Her study suggests that when asking people about their perceptions and experiences of density there is a lack of clarity about how the term itself is understood and interpreted.

Despite these potential limitations, however, residents' perceptions of density are amongst the most frequent areas of study within the subject of urban density, particularly in relation to housing. Research based on residents' perceptions of density is often cited as an indicator of public 'demand' for the development of low-density, detached or semi-detached houses – as being the type of development that people want. Social Policy researchers, Bramley and Power and Howley et al have attempted to determine residents' and consumer preferences towards density as an indicator of the sustainability of planning policies aimed at increasing densities. This passage from Howley et al gives an insight into the kind of preconceptions that are attached to the idea of 'higher density'.

Most households do not wish to live at higher residential densities, with less garden and parking space per dwelling, on brownfield land in inner-urban and city centre locations. Residential preferences of those already in the owner-occupied sector are weighted towards the consumption of more, rather than less, space in terms of the dwelling itself and external space.[24]

This suggests that higher density is assumed to equate with less space both inside and outside of the dwelling. Evidence referred to in the previous chapter supports this as a broad trend – highlighting a correlation between higher density ratios and a higher proportion of smaller dwellings (in terms of rooms per dwelling).[25] Forsyth has suggested that the two are not necessarily linked – it is possible to live in a very high density environment, in a very large dwelling, but the prevalent trend in many cities is closer to that which Howley et al allude to.[26] What is important, however, is that the perceptions cited in the report, are not necessarily motivated by the conditions or qualities of density, but by an associated implication of density on space in and around the dwelling. Bramley and Power sought to correlate residents' satisfaction with their dwelling environment in relation to indices of social sustainability. They found that residents of lower density environments tended to be 'more satisfied' with their environment than residents of higher density environments, and therefore that lower densities represented a more socially sustainable form of residential development.[27] Residents were asked about problems in their neighbourhood including litter, graffiti and access to local amenities and these were correlated against the population density of the neighbourhood. It is relevant to note that the case study areas had densities up to 200 habitable rooms per hectare (between 40 and 50 d/ha) – relatively low for urban density ratios. Furthermore, the indicators of satisfaction did not include any of the more phenomenological qualities of density suggested in the fictional writings above such as anonymity, bustle, or intensity. Residents were not asked, for instance, whether their various dissatisfactions were outweighed or neutralised by the potential positive aspects of density such

24 Howley, Scott and Redmond cited the choices of buyers on the property market to support the proposition that 'higher density' development is unsustainable because it is counter to the expressed preferences of consumers. They cite Breheny (1997), who "suggested three tests of urban compaction policies, namely for veracity, feasibility and acceptability to the public. He argued that the acceptability test 'is the most neglected of the three, yet may be the point on which the whole issue turns'". "Sustainability Versus Liveability: An Investigation of Neighbourhood Satisfaction," *Journal of Environmental Planning and Management* 52, no. 6 (September 2009): 851.

25 Note the studies cited in the previous chapter that have demonstrated a correlation between density ratios and the size of dwellings (in terms of rooms). Duncan Bowie, *Politics, Planning and Homes in a World City, Housing, Planning and Design* (Oxon: Routledge, 2010).

26 Anne Forsyth, *"Measuring Density: Working Definitions for Residential Density and Building Intensity"* (Design Centre for American Urban Landscape: Design Brief, July 2003).

Positive attributes of higher density living (people-related factors)	Negative attributes
Community cohesion	Parking stress
Cultural diversity	Lack of open space
Community life	Strain on amenities and services
Vibrancy	
Liveliness	

Table 2: Positive and negative attributes associated with higher density a cited by respondents.

Summarised from Ricky Burdett et al., *"Density and Urban Neighbourhoods in London"* (Enterprise LSE Cities, 2004) as social opportunities, access to amenities, or the bustle of the environment.

The interviews conducted as part of the extensive Density and Urban Neighbourhoods study at the London School of Economics (LSE) were more insightful because they were correlated with a detailed demographic and locational site study of the environment in which the interviewees lived.[28] In this way, it was possible to gain an understanding of the types of physical features that informed residents' experiences of living at higher densities, and also to understand how residents perceptions of 'higher density' correlated with numeric density ratios.

The LSE researchers found that respondents tended to compare their area to other areas that they were familiar with when considering whether they perceived their neighbourhood to be high or low density. They found that the desirability of higher density environments was largely associated with lifecycle and lifestyle factors unique to the respondents, and many residents felt that the judgement of density to be either positive or negative was a product of their social and economic situation.[29] For instance, residents who were able to make regular trips out of the city generally responded more favourably towards the idea of higher density. This reinforces Rapoport's suggestion that an individual's perception of their environment is based on personal and past experiences. The LSE researchers also found that respondents would perceive their area to be higher or lower density than another area based on the presence of particular indicators or conditions such as, a tight urban grain, closeness of roads, the amount of residential building that is apparent - houses and blocks of flats – and whether housing was terraced as opposed to detached (these factors are summarised in Table 2). The presence of natural elements such as trees, riverside and parks was associated with lower perceived density. They also cited the 'visibility of large council estates' and excessive levels of noise as factors affecting their judgement as to whether the neighbourhood was high or low density.[30]

The suggestion that the visibility of 'large council estates' is a signifier of high density exposes the implicit association that exists between certain forms of housing and the terminology of density. Whilst the architectural character of the estates referred to was not elaborated, the response reveals that the signifiers of density are not only physical mass, or the presence of many people, but that there might be an architectural language associated with density. This is not necessarily surprising. Much post-war planning rhetoric propounded terms such as 'high-density high-rise' and 'low-density low-rise' as catch-all descriptions of the massing, typology and appearance of new housing, and despite detailed analytical studies having been carried out within architectural research that complicate the automatic association between density and built form, these common socio-cultural conceptions still remain.[31]

Another recent study, *Perceptions of Privacy and Density* gathered residents' responses to questions about the

27 Glen Bramley and Sinéad Power, 'Urban Form and Social Sustainability: The Role of Density and Housing Type,' *Environment and Planning B: Planning and Design* 36, no. 1 (2009): 30:48.

28 Burdett et al situated interviews with residents in their homes which enabled the experiences reported, positive and negative, to be directly related to the qualities of the residential environment and its context. *"Density and Urban Neighbourhoods in London."*

29 Higher density areas sustain different co-existent lifestyles – diverse

- 'urbanites' ("people whose preferences and socio-economic conditions lead them to opt for high-density living")
- 'suburban leavers' – people with lifestyles that eventually cause them to move away
- Trapped residents – groups who have little/ no choice in where they live.

Those with greater freedom of choice over their dwelling conditions and location often report greater satisfaction. *Ibid., 174–175.* Joanne Bretherton and Nicholas Pleace, *Residents' Views of New Forms of High-density Affordable Living* (Joseph Rowntree Foundation, April 2008).

In their numbers-based analysis Bramley and Power found that the impact of density on residents

One potential breach of privacy inside the flats was being overlooked across the internal courtyard. Serried ranks of windows faced one another across each of the four courtyard walls. No one in fact found this a problem. The windows facing one another were mainly those of the kitchens; these were seen as relatively public rooms where it did not matter if you were observed. People felt quite relaxed about seeing one another in this context.

The woman that lives in that flat there, I've never spoken to her in my life. But she is there every day washing up and I'm looking for jobs on the internet and we wave to one another.

In another example, the report noted how one resident had put up blinds to give her greater privacy from overlooking by passers-by. These simple, almost mundane tactics for countering the effects of proximity between the dwelling and public space are revealing, not only of the way in which privacy in the dwelling is experienced, but also of the types of spatial conditions that the researchers have attributed to density.

Figure 4: The internal courtyard described in an interview for the Mulholland Research and Consulting, *"Perceptions of Privacy and Density in Housing"* (Design for Homes and Popular Housing Research, 2003), 33.

dissatisfaction was also reduced when income was taken into account. *"Urban Form and Social Sustainability: The Role of Density and Housing Type,"* 590.

30 The observations were responses taken from one of the case studies at Town in Hammersmith and Fulham. *Burdett et al., "Density and Urban Neighbourhoods in London,"* 150–151 and 174.

31 March and Martin, *"Speculations";* Berghauser Pont and Haupt, *Spacematrix: Space, Density and Urban Form.* These studies complicate the assumed relationship between density and built form, but have not necessarily influenced common preconceptions about signifiers of density.

32 Mulholland Research and Consulting, *"Perceptions of Privacy and Density in Housing"* (Design for Homes and Popular Housing Research, 2003), 1.

33 *Ibid.*, 3. Note that the study did not arrive at these 'characteristics' through systematic analysis and they should therefore be treated as assumptions. However, it is interesting that the study did not define the sample based on quantitative densities. Interviews were carried out with residents of ten case studies with density ratios between 30 and 176 dwellings per hectare.

34 *Ibid.,* 59. Importantly, the analysis of the residents'

experience of privacy in and around their homes. The intention of the study was to identify what physical consequences associated with density affect the experience of privacy in different housing environments of different numerical densities.[32] The schemes were chosen because they had characteristic "elements of higher density design, for example terracing, additional stories, apartments as opposed to houses, use of shared outdoor space or limited private outdoor space".[33] In contrast with the LSE study, residents were not asked about their perceptions of density per se, but the researchers used residents' responses towards questions about spatial, visual and acoustic privacy, to decipher the particular physical consequences of density relevant each interviewee's dwelling that had a specific impact on the privacy of the dwelling.[34] Figure 4 shows an example of the spatial factors that were described.

Privacy is clearly a personal and subjective perception and asking people how they feel about different aspects of privacy is perhaps the most valid way of investigating it. The perception of density on the other hand is more complicated. There are socio-cultural ideas about the relationship between density and certain built forms and architectural styles that complicate the use of residents' perceptions as a way of understanding how it is experienced and how it affects the residential environment. Arguably, the greatest difficulty lies in the problem that Tunstall identifies, which is that the conception of density as a numeric ratio is a technical concept that has little relevance to most people.[35] Meanwhile, the perception of density is affected by many factors that are perceived differently by different people. This indicates the need for a tighter definition of what is meant by density and those qualities and characteristics that are relevant to it.

Alternative models of density

The study presented by Boyko and Cooper in 2011, highlighted the lack of clarity around how density is defined and understood and sought to address it by defining a series of different types of density.[36] Their proposed 'taxonomy' of density (shown in Figure 5) is based on a review of the literature on the subject of urban density and draws out five unit types for describing density: natural form, built form, mobile material form, static form and people. Each of the types represents different types of density that are frequently measured and implicated in studies relating to urban density. They note that a search on the subject of density might refer to the density of flora, dwelling density, density of vehicle use, or density of signage, but all use the same terminology.[37] Within the different units that they set out, there are many that pertain to the physical mass and to the perception of the built environment (particularly the mobile material form, natural form and people, all of which are associated with the perception of density). The model assumes, however, that it is the ratio of these units to the defined area that is the critical factor. Arguably, these are simply representations, conceptions of density based on an abstract model, designed to simplify what is undoubtedly a complex subject of study. The strength of

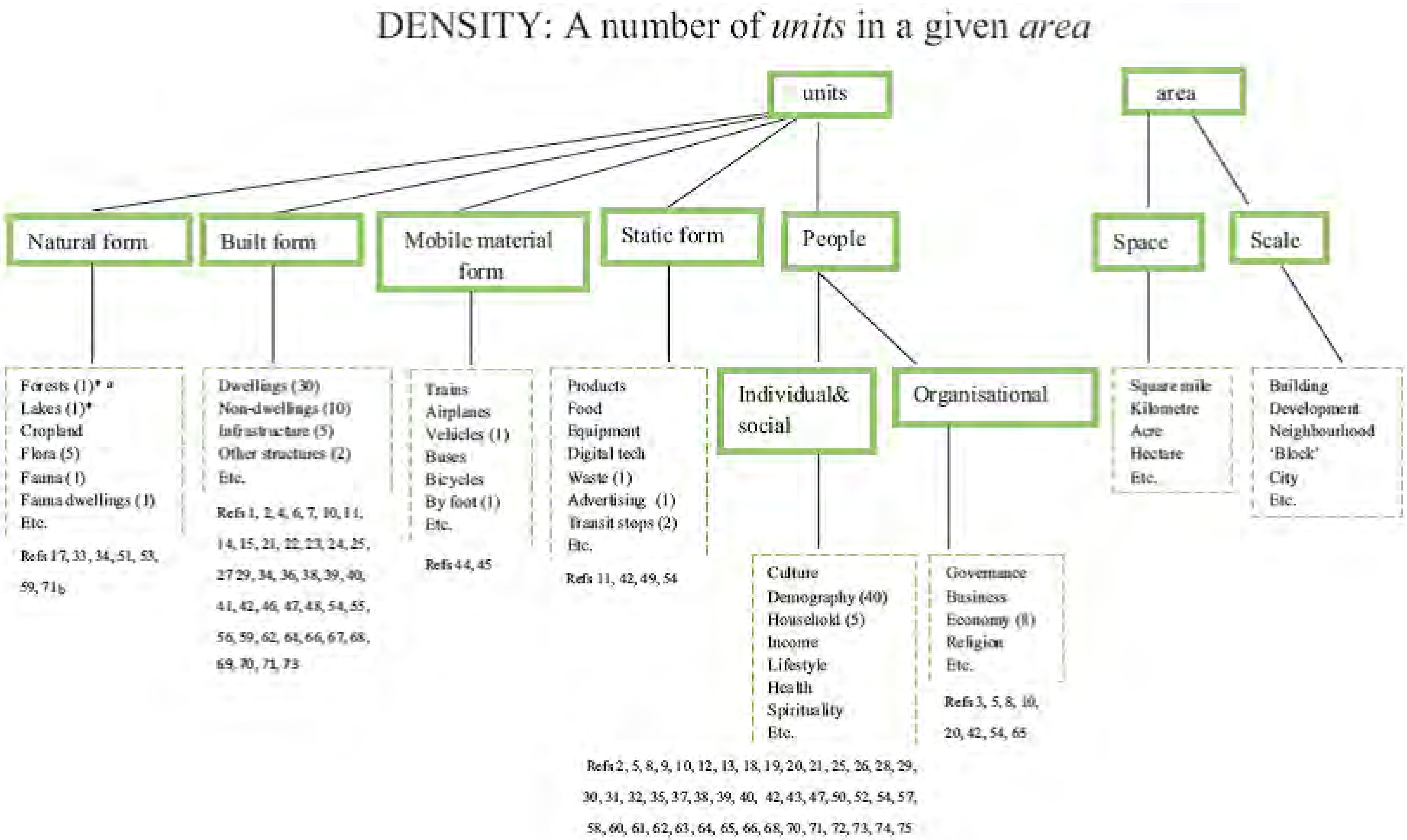


Figure 5: Taxonomy of density as set out by Boyko and Cooper in their study "Clarifying and Re-conceptualising Density," *Progress in Planning* 76 (2011): 27.

their model is in the expanse of the field of research that it captures. However, by returning to ratio measurements (albeit of an expanded variety of matter), the broader 'spatial' understanding of density is not necessarily improved. In order to begin to identify and describe the qualitative conditions of density in terms of their lived and perceived conceptions, the methods that are used must seek to capture the full, experiential and phenomenological character of density rather than to represent it.

interviews was also carried out in direct relationship to an (albeit quite simplistic) description of the case study environment, enabling the responses to be related to the actual spatial qualities, proximities, and impacts apparent to the case study.

35 Rebecca Tunstall, *"Housing Density: What Do Residents Think?"* (East Thames Housing Group, 2002).

36 Christopher Boyko and Rachel Cooper, "Clarifying and Re-conceptualising Density," Progress in Planning 76 (2011): 1–61.

37 Ibid., 3.

Setting out an alternative approach towards density

From matters of fact to matters of concern

Developing a spatial index of density requires not only an expansion of the variety of implications associated with density – as was begun with the historical analysis – but also an alternative approach towards the use of density. Bruno Latour's essay on methods of critique is a useful starting point. His essay *'Why Has Critique Run Out of Steam?'* posits that the idea of all fact as constructed has become so universally applied that there is no longer any implicit acceptance of any concept as simply known. He suggests that in 'fetishising' over certain matters and seeking to scrutinise their use, form or meaning and situate them within a context of social, economic and cultural forces so as to render them indisputable, critics have lost sight of those critical issues that are simply known. By constantly seeking to construct and at the same time, dismantle certain objects as 'fact', criticism has lost its capacity to establish certainty of understanding.[38] This recognition could easily surmise the breadth, complexity and contradiction that characterises the existing research on the subject of density. Different research interests situate themselves in opposition in the field and seek to prove or disprove each assertion that is made about the advantages of higher or lower densities for urban development, the perception of density and its implications for the experiences of the urban environment. The vast array of research and investigation dedicated to the task of proving and disproving claims about urban densities exposes what Latour describes as the 'fragility' of the current conception of density. The relentless attempt to prove the case for urban density with so-called 'hard' evidence has opened it up to continued scrutiny, allowing critics and higher-density sceptics to perpetually challenge the notion that higher urban densities can contribute to positive social benefits and desirable urbane qualities.[39] But if the debate is shifted away from the pursuit of 'hard evidence', and towards an appraisal of the softer, experiential implications of density, then the notion of density as a useful concept for thinking about the qualities of the built environment can be reclaimed. That is to say that, as long as density continues to be defined in numeric terms, its usefulness as a descriptor of the qualities, organisation and experiential aspects of density will always be compromised methodologically. Furthermore, the spatial implications of density will continue to be regarded as consequences of economic and land-use decisions based on numeric ratio measurements, rather than being explored as a potential catalyst for a considered and deliberate approach towards the design of new urban housing and the urban environment more generally.

38 Bruno Latour, 'Why Has Critique Run Out of Steam? From Matters of Fact to Matters of Concern', *Critical Inquiry,* 30 (2004), 225-248.

39 As an example, Gordon and Richardson argue that whilst there might be broad support for reducing car dependence and resource consumption, there remains a debate over whether the proposed compact city form is a desirable, achievable or even sustainable solution. Furthermore, since the claims of the compact cities movement remain unproven, it should not be adopted as a goal because it contradicts the overwhelming (consumer) preference for low-density development. "Are Compact Cities a Desirable Planning Goal?," *Journal of the American Planning Association* 63, no. 1 (Winter 1997): 98.

These challenges are seemingly unresolvable since so many factors other than density contribute to behavioural patterns such as car use. The pursuit of numbers to substantiate the case one way or another, however, undermines the importance of the issue and renders it constantly open to dispute.

Figure 6: Four types of density: the beginning of a proposed spatial index of density

A spatial index is therefore proposed as a means of giving weight to the experiential and qualitative implications of density and providing a means of appraising, comparing and describing density in terms of its spatial qualities. The literary depictions cited above presented a number of suggestions for the spatial characteristics of density. The intensity and intricacy of the urban fabric was posited as an essential condition of both Dickens and Benjamin's portrayal of the city. These were also characteristics frequently cited in the episodes considered in Chapter One and are arguably therefore key factors affecting the perception of the density (positive or negative) as a condition of the urban environment. The closeness of the buildings and inadequacies of daylight and ventilation that were apparent as a result, were both the motivation for the decongestion of the city (initially set out by the Garden Cities Movement), but also an essential part of the character of the urban environment depicted in Dickens' scene for instance.

The anonymity of the crowd was also alluded to as an experience of density, similarly the bustle of the urban environment. The proposed index of density that is set out below aims to capture these qualities within a series of indices intended to represent important spatial considerations when designing for density. They draw on the historical analysis and different interpretations of density within architectural discourse (set out in Chapter One). It also draws on the implications of density considered in the previous chapter, and finally, the perception and experience of density expanded in the first part of this chapter.

Four main categories are proposed, each representing a different way of thinking about density (Figure 6). Numeric densities are the ratios of density currently applied in planning and urban development. Physical densities represent the characteristics of built form associated with density. The theme of 'communality' is concerned with the organisation of density and the implications that has for how people live in proximity with one another. Finally, the indices of proximity are concerned with the socio-spatial implications of density, the propensity for bustle and social encounter as a result of density. Within each type of density, a series of indices are proposed to describe distinct characteristics and conditions. The indices are intended as 'guiding principles', pointers, suggesting a way of thinking about density as a design approach.[40] These indices are outlined in the discussion to follow, and in this way the diagram (Figure 6) will be 'fleshed out' to provide an index of the spatial qualities of density. The next chapter is then dedicated to testing these indices as relevant design considerations.

Numeric Densities

In spite of the limitations associated with the use of density ratios for describing the spatial qualities of density, the numeric measures of density are retained as part of this expanded spatial index of density for a number of reasons. Firstly, by virtue of their shared currency with the primary

40 Index, n: 4. a. That which serves to direct or point to a particular fact or conclusion; a guiding principle. Oxford English Dictionary, "Index, N.," *Oxford English Dictionary* (Oxford: Oxford University Press, 2013).

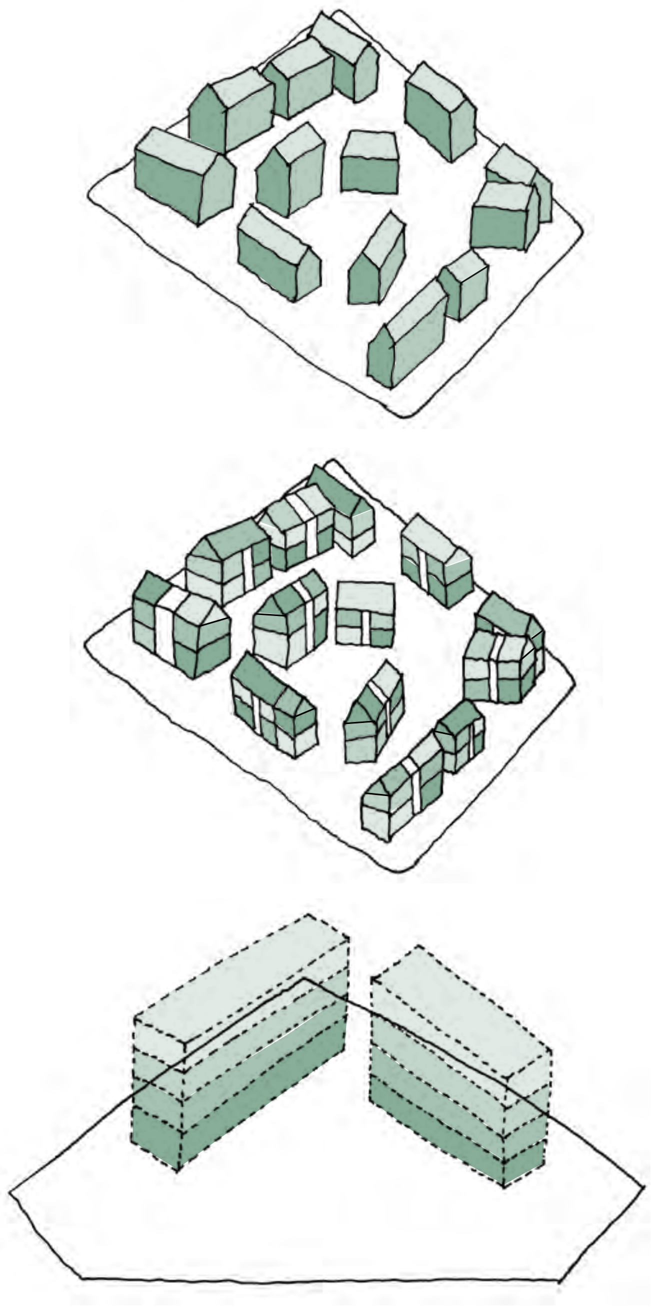


Figure 7: Three indices of numeric density

1.1 Dwelling density

1.2 Habitable room density

1.3 Bulk density

economic models on which housing development is funded and residential property is traded, they can be taken as useful indicators of the economic factors that affect site development. Secondly, numeric densities provide a scale of comparison. As an indicator of the number of units and amount of building mass on a site, they can give an insight into the pressure imposed by sheer numbers on the resulting built form and layout of the site. The Housing Density Study considered in the previous chapter suggested that different dwelling typologies have maximum dwelling or habitable room densities that they can achieve.[41] There is a suggestion therefore that numeric densities impose thresholds, above which certain compromises in the quality, daylight and organisation of dwelling units have to be made. Numeric densities therefore provide a scale against which to assess the impact that the pressure to accommodate a certain number of units has on different spatial qualities of the environment.

Three indices are proposed: dwelling densities, habitable room densities and bulk density. In the previous chapter these measurements were considered in some detail. Dwelling densities were shown to be most relevant as a measure of the effectiveness with which land is developed in light of a housing demand defined in terms of dwelling units required. Habitable rooms provide a closer representation of the occupancy of the site and are therefore referred to by planners as an indicator of the required provision of amenities such as recreation space, car parking, and infrastructure – factors which also have an impact on the amount of development that can be accommodated on the site.[42] Finally, bulk densities are included because they are more accurate than the unit-based measurements as a depiction of the amount of development on a site. Bulk densities also take into account non-residential land use and therefore in the context of an urban planning agenda that advocates mixed-use, it is apposite to use a density ratio that is able to measure the actual amount of building on the site, not only the residential component.[43]

Not only do they have a shared currency with the house building industry, but dwellings, habitable rooms, and bulk densities (albeit to a limited extent in the UK) are also the measurements used in planning. It is important to be able to consider the spatial implications explored in the other indices, in relation to policies on density. Furthermore, the assumed correlation between numeric densities and the typology and built form of housing, whilst limiting, is also part of a social and cultural conception of density and therefore inform perceptions of density. For this reason, it is important to be able to test, and challenge these formal and typological assumptions.

Physical Densities

Physical densities are proposed as means of describing the physical characteristics of density. The first two indices, building height and site coverage are drawn from the extensive analysis of the dimensions of built form presented in Berghauser Pont and Haupt's Spacematrix study.[44] The final index, built form combines readings of Martin and

41 Maccreanor Lavington Architects, Emily Greeves Architects, and Graham Harrington Planning Advice, *"Housing Density Study"* (Greater London Authority, August 30, 2012).

42 *Ibid*.

43 The Urban Task Force report cited mixed-use development as a key component of more compact urban development. *Towards an Urban Renaissance* (London: Department of the Environment, Transport and the Region, 1999). It is understood to mean the development of different types of building use in proximity to one another or as part of the same building. It is defined in opposition to the mid-twentieth century zoning approach towards city planning in which residential, industrial and commercial zones were separated from one another. Lord Richard Rogers, *Cities for a Small Planet: Reith Lectures,* ed. Philip Gumuchdijan (London: Faber and Faber, 1997), 33–35.

44 Meta Berghauser Pont and Per Haupt, *Spacematrix: Space, Density and Urban Form* (Rotterdam: NAI Publishers, 2010).

March's built form studies and the typology-based analysis in Ernest Alexander's study which posit dimensions of built form other than height as being affected by density ratios. Built form therefore considers the length, depth and connectedness of the built form on the site. The three indices of physical density are described in the diagrams shown in Figure 10.

The Spacematrix study considered the dimensions of built form in some detail and defined a mathematical model through which the bulk density and dimensions of built form could be correlated.[45] As well as the implications for the density ratio, the dimensions of built form also impact on the experiential qualities of the urban environment. The objective of this set of indices, therefore, is to explore the implications of density from the perspective of a broader understanding of the 'spatial' that includes the social use and experience of the urban fabric as valid and important conceptions.

Building height

High-rise does not necessarily mean a high density ratio.[46] Nonetheless, building height is intrinsically associated with the perception of density.[47] There are a number of reasons for this. One is the physical scale of the building. Rapoport suggests that physical height of the building and the amount of 'subtended building' in the field of vision affects the perception of high density.[48] The amount of space around the building might be a factor. Comparison between the high-rise block in the Manhattan grid and the high-rise-in-the-park urbanism that Le Corbusier, Gropius and Hilberseimer promoted makes it immediately apparent that the measurement of building height alone does not give a true depiction of the impact of the building's mass, but that context, visibility and the impact of the height on the space around it are also critical.

In Koolhaas' Delirious New York building height is posited as a product of technological possibility and economic speculation. The culture of 'maximisation' Koolhaas writes, is an urban ideology, fed from its conception on the "splendours and miseries of the metropolitan condition – hyper-density – without once losing faith in it as the basis for a desirable modern culture".[49] The vertical expansion of the city impacted on the amount of daylight and sunlight on the streets, the economics of the city and the experience of it. The higher that buildings could be built, the greater the value of the real estate. In this way, building height, and indeed density, impacted in a very real way on social and spatial equality in the city. In terms of the ideology and in terms of its consequences for the built fabric of the city, the culture of congestion was contrary to the regulated and controlled explorations with height pursued by the Modernists in their concern to decongest the city with sporadic concentrations of density. In the latter, height is off-set by the distance between the buildings, mitigating the impact of the tower blocks on the space around them.

As well as the space around the building, the perception of the building's height is also affected by the articulation

45 This is an important area of research, but the ground has been thoroughly covered by Berghauser Pont and Haupt's multi-variable analysis of the relationship between height, site coverage, open space and site dimensions and the resulting bulk density (FSI). *Ibid.* The *Spacematrix* study provides a useful resource for understanding this relationship but further emphasises the need to consider the qualitative implications of built form in order to expand the existing research in this field.

46 Lionel March and Leslie Martin, 'Speculations', in *Urban Space and Structures* (Cambridge: Cambridge University Press, 1972).

47 Burdett et al., *'Density and Urban Neighbourhoods in London"*; Rapoport, *'Toward a Redefinition of Density'*.

48 Rapoport, *'Toward a Redefinition of Density',* 140.

49 Rem Koolhaas, *Delirious New York: A Retroactive Manifesto for Manhattan,* New Edn. 1994 (New York: Monacelli Press, 1978), 10.

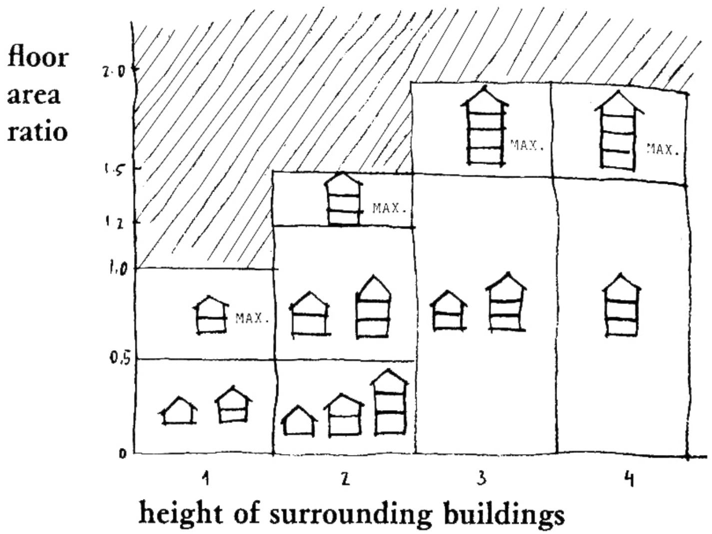


Figure 8: Rules for determining building height, as set out in Christopher Alexander, Sara Ishikawa, and Murray Silverstein, *A Pattern Language: Towns, Buildings, Construction* (Oxford University Press, 1977).

of the building's mass. Buildings that exhibit their full height boldly also impact more heavily on the spaces and buildings around them. Tall buildings take on a sort of monumentality that is a consequence of their physical scale and massiveness. Koolhaas describes the effect of the massive building as follows:

> *Beyond a certain critical mass each structure becomes a monument, or at least raises that expectation through its size alone, even if the sum or the nature of the individual activities it accommodates does not deserve a monumental expression… This category of monument presents a radical, morally traumatic break with the conventions of symbolism: its physical manifestation does not represent an abstract ideal, an institution of exceptional importance, a three-dimensional, readable articulation of a social-hierarchy, a memorial; it merely* is *itself and through sheer volume cannot avoid being a symbol.*[50]

Strategies that mitigate the perception of a building's height therefore mitigate the perception of monumentality. Christopher Alexander stated that the rule for attaining a harmonious relationship between neighbouring buildings was to ensure that a building is never more than one storey taller than its neighbours.[51] Contextualising the building height in this way makes the building a good neighbour to its adjacent sites (Figure 8). It is more convivial than the Manhattan skyscraper, show-boating its height at the expense of its neighbours. In trying to describe the different ways that buildings present their height and scale, Alison and Peter Smithson posit that density can be background and discreet, or it can be exhibited. They write:

> *The feel of density is, of course, affected by the nature of buildings. Put crudely, self-assertive buildings full of rhetoric and gesture seem to occupy more space and use up that space's absorbancy leaving less room for people. … Buildings with another concern can make the density seem lower and be more useful to people.*[52]

In the context of the discussion in Chapter One, that 'other concern' is arguably for the social propensity of housing architecture (as expounded by Neave Brown in Episode Four). Good neighbourliness, as advocated by Christopher Alexander et al and their rules for mitigating the impact of building height, is also counter to the monumentality that can result from physical massiveness. Good neighbourliness, and efforts to mitigate the impact of the building's height therefore go hand-in-hand with harnessing the social propensity of residential environments.

Building height is also associated symbolically with density as a result of the dominant dictum of post-war development, of high-density high-rise and low-density low-rise. The LSE study cited above also reported that the perception of density was affected by the visibility of 'large council estates' – housing developments of the post war era typically developed under this density rhetoric.[53] Returning to Rapoport's essay on the perception of density, he suggested that the way that density was perceived was affected by personal experience as well as social and

50 *Ibid.*, 100.

51 Christopher Alexander, Sara Ishikawa, and Murray Silverstein, *A Pattern Language: Towns, Buildings, Construction* (Oxford University Press, 1977).

52 Peter Smithson and Alison Smithson, "Density, Interval and Measure," *Architectural Design* (September 1967): 429.

53 Burdett et al refer to the visibility of large council estates as influencing residents' perceptions of whether an area is high density or not. *"Density and Urban Neighbourhoods in London"* (Enterprise LSE Cities, 2004).

54 The initially negative response towards the architecture of the first Model Dwellings built in London as accommodation for the working poor was a reaction amongst a particular social group. Severs highlights the relationship between architectural expression and its role as a signifier when he writes of the Model Dwellings: for the particular classes for whom the dwellings were intended, the monumentality of the architecture had echoes of the "coercion of the workhouse" and loss of individual freedom. Dominic Severs, "Rookeries and No-go Estates: St. Giles and Broadwater Farm, or Middle Class Fear of 'Non-street' Housing," *The Journal of Architecture* 15, no. 4 (August 2010): 19.

cultural factors (this was summarised in a diagram in Ernest Alexander's study - Figure 2). This understanding suggests that different building types and architectural styles have different significance for different people.[54] The Residential Hotel and Serviced Apartment buildings, for instance do not have the same institutional associations as the Model dwellings, despite a number of formal similarities, arguably because of the different social and economic situation of their residents.[55] Therefore the symbolic association of density with certain housing forms is not necessarily universal, but is conditioned by particular social and cultural values. The 'coercion of the workhouse' that Severs referred to as a particular social and cultural perception of the architecture of the Model Dwellings is arguably no longer a common point of reference in the UK, whereas the association between the post-war council-built housing estates - with their high-rise point and slab blocks - still retain an association with density, and also poverty.[56]

Whilst it is not possible to determine how different types of building and different forms of housing will be perceived (perception being inherently individual and subjective), it is possible to consider the symbolic role of the architectural expression as part of understanding how a building's scale and mass might affect the perception of the environment more broadly. Having developed, in the first chapter, an understanding of the context in which different models of housing have emerged and the urban strategies of which they are part, it is possible to consider the social and cultural stigma associated with certain types of built form within the fairly narrow context of London, or perhaps the English cities. However, this limits the scope of the index somewhat and it would therefore be more useful if more universal factors could be identified.

Site Coverage

The index of site coverage is concerned primarily with the strategy governing the layout of the building mass on site - the difference between congestion (as in Manhattan), and 'concentrated decongestion' (as in Le Corbusier's Plan Voisin). The Space Matrix study measured the physical dimensions of site coverage in two ways: one, as a measure of intensity of ground coverage (a simple percentage), and two, through the Open Space Ratio (OSR). The OSR comes out of Hoenig's early definition of 'Weiträumigkeit' or spaciousness. He proposed that an optimal ratio of one metre squared of open space be provided for every one metre squared of built floor area in order to achieve a harmonious built environment.[57] This balance between open space and built floor area also effectively controlled the density ratio of development the site. Any increase in density therefore would impact negatively on the spaciousness of the site.

Taking a more qualitative approach to the study of spaciousness, Rowe and Koetter used figure ground analysis to describe the difference between different types of urban fabric. Comparing St Dié, designed by Le Corbusier in 1945 and the town of Parma - the first is almost all white, the second almost all black. They write:

55 Part of the appeal of the high-class Residential Hotels was their architectural monumentality. Paul Groth, *Living Downtown: The History of Residential Hotels in the United States* (London: University of California Press, 1994). Whilst the hotel is not a ubiquitous London housing model, consideration of its type is useful for two primary reasons; first, many new urban apartment buildings, with their concierge, reception and on-site gymnasiums and other facilities share many similarities with the hotel in terms of their organisation. Secondly, the hotel presents an interesting in terms of its objectives for privacy and the relationship that it establishes between neighbours, and between the building and its surroundings.

56 Severs, 'Rookeries and No-go Estates: St. Giles and Broadwater Farm, or Middle Class Fear of "Non-Street" Housing', *The Journal of Architecture* 15, no. 4 (August 2010): 449-497.

57 Berghauser Pont and Haupt, *Spacematrix: Space, Density and Urban Form*, 88–92.

58 Colin Rowe and Fred Koetter, *Collage City,* 8th ed. (London: MIT Press, 1978), 62–63.

59 Cited in Meta Berghauser Pont and Per Haupt, “The Spacemate: Density and the Typomorphology of the Urban Fabric,” Nordic Journal of Architectural Research no. 4 (2005): 58.

60 Berghauser Pont and Haupt, Spacematrix: Space, Density and Urban Form, 67–68.

The one an accumulation of solids in a largely unmanipulated void, the other an accumulation of voids in a largely unmanipulated solid; and, in both cases, the fundamental ground promotes an entirely different category of figure – in one object, in the other space.[58]

In terms of the experience of density, the two are entirely different. In the urban plan comprising solid objects in a “void”, the visibility of the object buildings and their height and mass, can contribute to the perceived scale of the buildings and the perception of density based on monumentality and scale. However, the open space around the buildings also reduces the impact of the buildings mass on the surrounding open space. It also reduces the perceived occupancy of the site in relation to the area available - a perception that was central to the initiative to limit density ratios at the end of the nineteenth century. Indeed, Unwin reportedly used the term ‘intensity’ to describe the condition that would occur if all of the population of the buildings emptied out into the streets, and the degree of crowding that would result.[59] This suggests the idea of a balance between the size of the building mass, its height or length (and the number of inhabitants that it implies), and the expansiveness of the open space around. The use of the term intensity also connotes qualitative implications in terms of the experience of the built fabric. It is associated with that other loosely defined conception: urbanity.

Density and urbanity have both become frequently cited watch-words of the compact cities agenda. Despite a consensus on the positive effects of urbanity and spatial quality on city development in recent decades, the notion of urbanity remains difficult to define. As Berghauser Pont and Haupt observe:

What kind of vitality and intensity was actually being striven for when all parties unite around the flag of ‘urbanity’? Was it the friction and ‘accident and mess’ that seemed to be an important part of Jacobs’s urban vitality?[60]

What is clear, however, is that the representation of spaciousness or site coverage in terms of either a ratio measurement, or even a figure ground analysis, is not sufficient as a means of capturing the experience of ‘urbanity’ as Jacobs portrayed it, which seemed to be fundamentally about the use of the city’s streets. Indeed, site coverage, even where it can be explored in terms of the relative intricacy of the open spaces and compactness of the built fabric using figure ground analysis as Rowe and Koetter demonstrated, it would not be adequate to describe or capture the social aspects of the experience of urbanity. The proposed indices of proximity set out below are intended to explore the social potentiality of proximity and compactness within the urban fabric.

Built form

The index of built form overlaps with the index of building height in that it is concerned with both the physical

Figure 9: Façades

Lillington Square, Darbourne and Darke (1968 – 1972)

Dolphin Square, Gordon Jeeves (1936-38)

Robin Hood Gardens, The Smithsons (1972)

At Lillington Gardens the mass of the building is broken down so that the full height and length of the blocks is not clearly apparent. By comparison, at Dolphin Square, the repetitiveness and orderliness of the façade, and grand, double height entrances to the court emphasise both the height and length of the block. The façade manifests a 'multiplication of numbers', actually suggesting an occupancy greater than the actual through the way in which the window is made the base unit for the articulation of the façade. At Lillington Gardens the dwelling is the basic unit - they are larger and therefore there are fewer of them across the height and length of the façade.

Whether the individual units are expressed or not, the height (and length) of the building façade overwhelmingly affects the perception of numbers. Long or tall building facades that are articulated with a continuous and repetitive module contribute to a perception of numbers (perhaps a sort of 'multiplication of numbers' as Baudelaire described). Therefore, strategies that reduce the perception of the whole building mass also mitigate the perception of density.

61 Arza Churchman, "Disentangling the Concept of Density," *Journal of Planning Literature* 13, no. 4 (1999): 403.

62 Interviewees in Cope's study reported the view that in high-density housing the environment can be disorienting. The postman or pizza delivery find it difficult to find their way around and to identify your home. *"Delivering Successful Higher-Density Housing: A Toolkit- Second Edition"* (East Thames Group, 2008), 96.

63 Peter King, *The Common Place: The Ordinary Experience of Housing* (Aldershot: Ashgate, 2005), 9.

dimensions of the building mass, as well as how that mass is perceived. The notion of monumentality – that is the way in which the buildings full extent is made apparent and imposes on the space around it – is also applicable to the other dimensions of built form aside from height. The articulation of the building façade and how this contributes to the perceived capacity of the building (the number of residents) and scale of the built mass are also important factors.

Churchman's summary of the perception of density as essentially an assessment of the perception of cues in the environment that represent people and their activities,[61] suggests that the expression of the number of inhabitants in a building contributes to the perception of higher density. In this sense, the way in which the occupancy of the building is expressed in the façade affects the perception of density and many windows could feasibly represent many people.

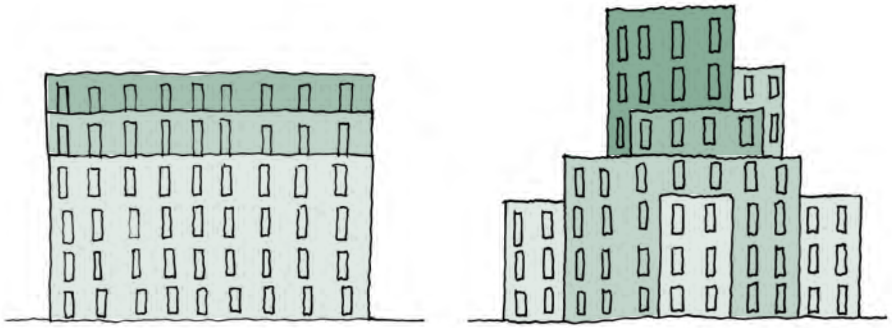
A façade that is very large, with a seemingly infinite number of windows suggests a high occupancy, and can be perceived in terms of multiplication of 'numbers' referred to by Baudelaire in the first part of this chapter. If the perceived capacity of the building is taken as an analogy for the crowd, then the repetition and uniformity of a large façade can also contribute to a perception of anonymity.

Anonymity has been posited as a consequence of density in previous studies,[62] and it is clearly an important issue when considering the residential environment, where issues of *rootedness, identity* and *meaning* are of key significance.[63]

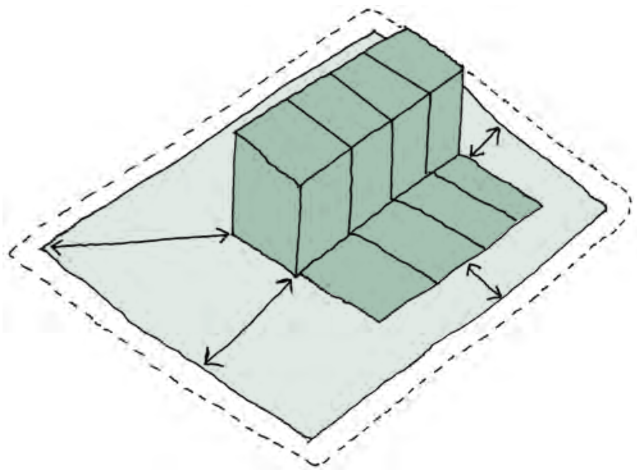
Anonymity is also the precondition for Benjamin's notion of 'Flâneurie'. It requires one to be able to disappear into the crowd in order to have the freedom to observe it. However, whilst repetitiveness and sameness provide liberation in some circumstances, the line between anonymity as liberty and anonymity as a loss of freedom to the control of the institution is a fine one and arguably one determined by individual experience and background. As such, it is possible that a building might be perceived as civic, grand and anonymous (in a liberating sense) by one person, and institutional and inhibiting by another. Nevertheless, the perception of people, and therefore, density (positive or negative) is affected by the repetitiveness and sameness that is apparent in the building façade.

In the comparison between the facades shown in Figure 9 there is a clear difference between the three in terms of how the perceived scale of the building is eroded by the definition of the individual units. In the façades of Lillington Gardens and Robin Hood Gardens each individual dwelling is articulated, either by an expressed frame defining the extent of each unit, or with balconies and steps in the building façade. Each individual dwelling is clearly delimited and the full extent of the building's height is disguised by the articulation and intricacy of the façade. By comparison, the façade of Dolphin Square does not express the extent of each individual dwelling. The building is designed as a holistic block, and derives its scale and character from the civic architecture of the city. In it, the individual dwelling is lost, and the windows are taken as the smallest unit

Figure 10: Three indices of physical density



2.1 Building Height



2.2 Site Coverage

2.3 Built Form

of division - each therefore comes to represent a room, person or dwelling and in this way contributes to an inflated perception of the scheme's capacity.

The index of built form is therefore concerned not only with the actual dimensions of the building's mass, but with the articulation of that mass and the building façade and the perception of numbers and the potential for anonymity. In setting out the three indices of physical density, anonymity, the perception of scale and intensity have been considered as ways that density is potentially perceived. These are clearly subjective qualities, and therefore necessitate discursive and qualitative assessment.

Communality

The indices of communality are concerned with describing the organisational characteristics of density. The indices are drawn from the numerous examples considered in Chapter One in which the strategy or approach towards density was premised on a way of organising (or reorganising) the housing provision on site in pursuit of some spatial or social objective such as better daylight or the separation of distinct household units for the purposes of propriety. In most cases the reorganisation involved the development of taller, bigger buildings comprising multiple dwellings, thereby attributing the control of density with implications for the communal organisation of the residential environment.

In his theory on structural hierarchies in the built environment, Habraken refers to Olynthus – the city plan cited at the very beginning of this thesis (see Chapter One, Figure 2). The structure and orderliness of the fabric of the city was, he argues, a result of there being a central authority concerned with organising the layout of the city is the best possible way for the benefit, and defence of the city as a whole.

> *Olynthus... exemplifies the large project in which a single party, in full control of the unified whole, designs and builds a large number of dwellings.*[64]

Within the set structure of narrow streets and long blocks, the inhabitants were free to configure their dwelling in whichever way they desired, but the benefits of collective organisation had been ensured by the over-arching physical structure of the city.

The redevelopment of the Jago Rookery at Boundary Street - one of the earliest examples of public housing built in England – was also an example of a collective form of organisation being used to achieve a particular social and spatial objective. It involved the reorganisation of the residential density of the site into large-scale, multi-dwelling structures. By organising the dwellings vertically it was possible to open up wider streets and create a public park at the centre of the site. Le Corbusier's Unité d'Habitation, discussed in some length in the first chapter, is probably one of the clearest examples of a 'large project' and an approach towards density based on the collective organisation of a number of dwellings. There were three main elements to Le Corbusier's organisational approach to density.

64 N. J Habraken, *Structure of the Ordinary: Form and Control in the Built Environment*, ed. Jonathan Teicher (London: MIT Press, 1998), 48.

Figure 11: Nursery School on the Rooftop of the Unité d'Habitation, Marseille, Photograph, 1952,

The Unité exemplifies the potential that Le Corbusier found in collective housing forms. By amassing the dwellings into one collective form, the rest of the site (4 hectares) was made available as an expansive, communal garden for residents. In house, domestic and other services could be provided; crèche, shops, sports facilities and a hostel for guests.

i) Collective structure: the scale and efficiency of which enabled the provision of a number of amenities and services for residents.

ii) Communal Space: by combining the individual dwellings into one structure, the dwellings were close enough together and organised in such a way that residents could share certain amenities. These communal spaces included the four hectare site that was made available as a result of the vertical organisation of the dwellings within the collective structure. At the opening of the Unité, Le Corbusier listed 26 communal facilities that were incorporated in the building, including an internal shopping center and roof-top nursery (Figure 11), gymnasium and swimming pool.[65]

iii) Communal Utility: the organisation of the building as a compact block and the use of frame construction facilitated the incorporation of advanced plumbing systems that provided hot, running water to every dwelling.

In this way the opportunities of collective organisation as a particular approach towards the design of higher density housing are embraced. It is suggested that the organisation of dwellings into collective forms is a particular spatial configuration associated with density. Furthermore, that the configuration of communal spaces and amenities can have a significant impact on the perceived and lived experience of density. These three indices are therefore taken as a starting point for thinking about a conception of density based on its organisational characteristics.

Collective Structure

The perception of density as a result of the physical scale and mass of the building was considered in the indices of physical density set out above. The physical size of the built form was one aspect of this, but another was the way in which the individual was identified within the built form. The shift from individual dwelling to collective, multi-dwelling structures not only brings about an increase in the scale of the building, but also necessitates collective control over the articulation, organisation, and inhabitation of the building.

It is assumed that above a certain density ratio, the use of some form of collective structure becomes a prerequisite as a means of organising dwellings vertically.[66] However, in a number of the case studies considered in Chapter One, collective structures were part of a deliberate strategy, motivated by the perceived social, formal and economic benefits associated with collective dwelling models. Much of the redevelopment that took place in UK cities after 1945, adopted collective housing models (many borrowed from Le Corbusier’s Unité) because they offered economic advantages and corresponded with an idealised socially-oriented model for the organisation of new urban housing.[67] As Glendinning and Muthesius convincingly reason, public housing during this period was seen as a powerful instrument of reform: reconstruction of the physical fabric

65 Alban Janson and Carsten Krohn, *Le Corbusier, Unite D’habitation, Marseille* (London: Edition Axel Menges, 2007).

66 Abercrombie and Foreshaw suggested that densities above 250 persons per hectare (80d/ha) necessitated flats for a certain proportion of the residential accommodation. Harley Sherlock suggests 150 d/ha as the limit for houses without any flats. Yet, even terraced houses share structural Party walls with neighbours.

67 Miles Glendinning and Stefan Muthesius, *Tower Block: Modern Public Housing in England, Scotland, Wales and Northern Ireland*, 1994.

Key to types:

A Domed, Nubian mud brick house
B Japanese house
C Tribal tent
D Masonry or balloon-frame house
E Detached single-family dwelling
F Condominium
G Rented apartment
H Hotel room
J Private estate

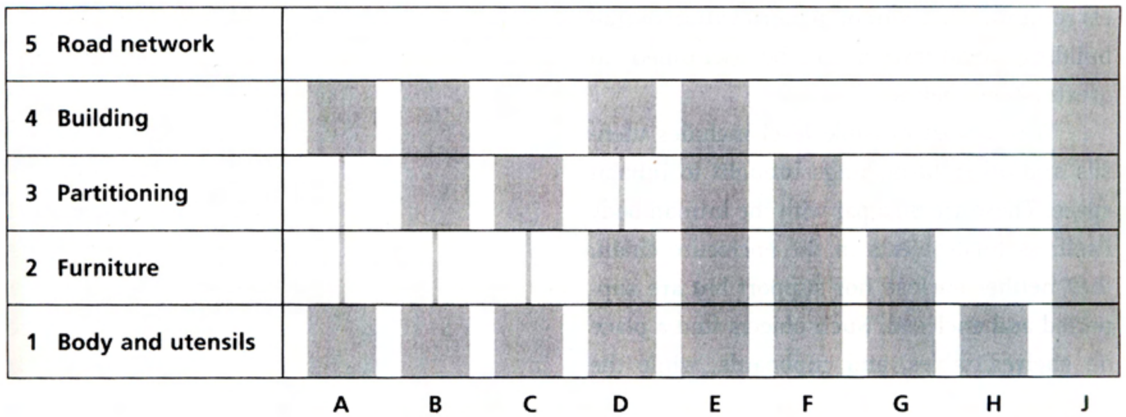


Figure 12: Habraken's hierarchies of enclosure. Source: N. J Habraken, *Structure of the Ordinary: Form and Control in the Built Environment,* ed. Jonathan Teicher (London: MIT Press, 1998), 61.

interconnected with the reconstruction of socio-political values. They suggest, further to this, that the high-rise, whilst never preeminent in terms of numbers, came to epitomise the post war "Modern Dwelling" in UK cities.[68] Indeed, the references cited in the study by Burdett et al, to 'council estates' as a symbol of apparent high-density, suggests that the index of collective structure needs to consider not only the implications for the organisation of spatial relationships, but also the potential symbolic significance of collective, multi-dwelling typologies. The discussion above noted the potential for certain collective dwelling models to be associated with a kind of institutional dominance.[69] The residential hotel is an institution in the extreme, but for its residents it was, and is, synonymous with freedom and flexibility.[70] Counter to Le Corbusier's ideal of the collective housing model as a structure for community; the hotel's organisational logic was the pursuit of the illusion of complete solitude. The ability to shut oneself off from the city was a result of the buildings inherent spatial as well as institutional organisation. The communal entrance provided an effective control; the concierge and reception could filter unwanted guests, whilst the sequence of corridors, stairwells and lobbies to be negotiated in reaching one's suite, not to mention the similarity of all of the doors, created a heightened sense of security, seclusion and privacy.[71] At the opposite end of the economic spectrum, however, the lack of security and institutional organisation can also be a source of vulnerability for the poor. The Planner and Academic, Peter Hall notes;

> *The rich, then, could always live well at high densities, because they had services. ... But for ordinary people, … the suburbs have great advantages: privacy, freedom from noise, greater freedom to make noise yourself. To get this at high-density requires expensive treatment, generally not possible in public housing.*[72]

Hall's observations are interesting on two counts. Firstly, it acknowledges the importance of the construction of the housing as an essential control affecting how people live in proximity to one another – of particular relevance in collective housing structures. That is to say that the 'freedom from noise' and privacy that Hall refers to is available at higher densities too, but only where residents can afford the quality of construction to provide an effective buffer and adequate space to contain the activities of the household without bothering the neighbours. Secondly, Hall's statement alludes to the potential restrictions that collective dwelling types can have on the way that residents use and inhabit the dwelling and its immediate environment.

In the collective structure, Habraken suggests that concern for the layout and appearance of the building as a whole takes precedence over, and dominates the layout and appearance of the individual dwelling. Habraken's theory about the dominance of elements within the urban fabric suggests that, where collective structures are used for the organisation of a group of dwellings, the spatial autonomy of the individual dwelling is curtailed by the dominance of the larger, collective structure.[73] As such, the way that density e

68 *Ibid*., 2.

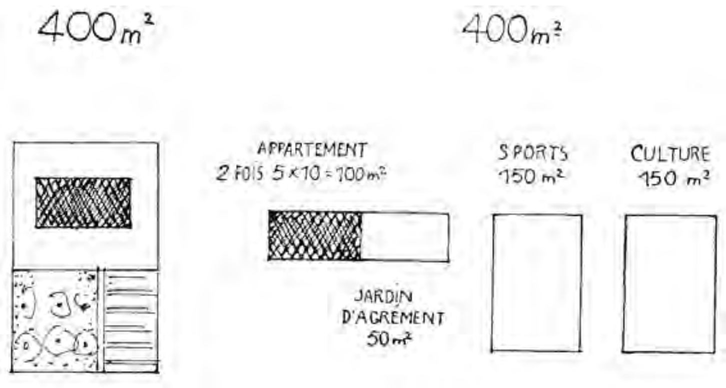
69 It was suggested by Severs that the symbolic association of collective dwelling types with an institutional is a response specific to a particular social and cultural context. *"Rookeries and No-go Estates: St. Giles and Broadwater Farm, or Middle Class Fear of 'Non-street' Housing."*

70 Groth, *Living Downtown*; Koolhaas, *Delirious New York*.

71 It has been suggested that the privacy afforded by the hotel provided residents with a sort of freedom, "virtually untouched by the social contracts and tacit supervision of life found in a family house or apartment unit shared with a group". Groth, *Living Downtown*, 7.

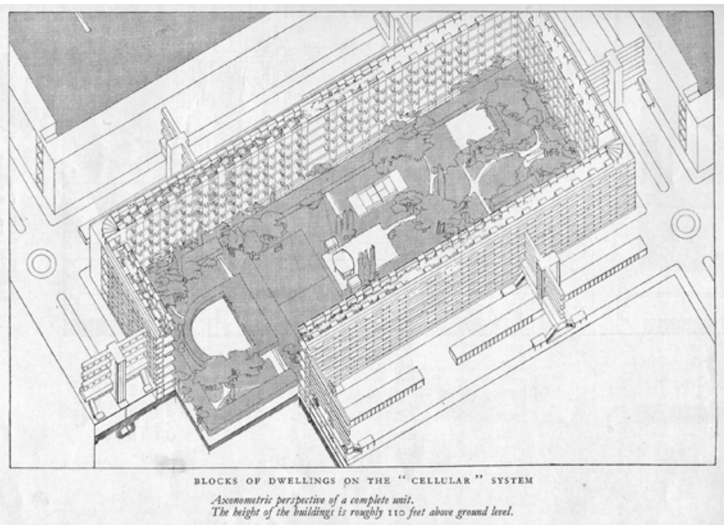
72 Peter Hall, *Cities of Tomorrow: An Intellectual History of Urban Planning and Design in the Twentieth Century* (Oxford: Basil Blackwell, 1988), 227.

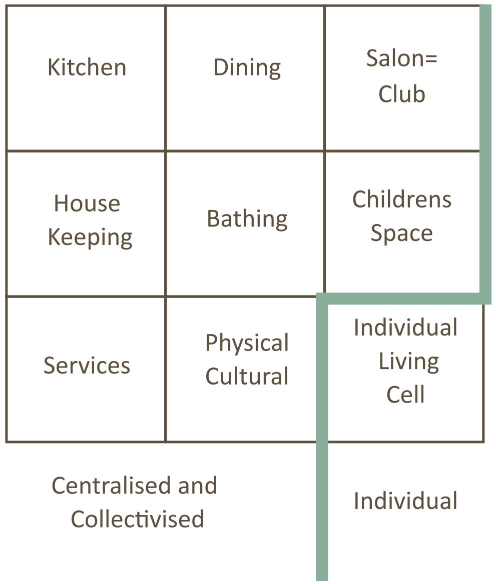
73 Habraken, *Structure of the Ordinary,* 60–61.



The family garden is carved up into areas for growing vegetables and planting flowers. Le Corbusier described this form as "stupid and ineffective". The householder and his wife, he writes, keep things tidy, weeding, watering, and killing the slugs until long after twilight. "The whole thing is ridiculous". "The children cannot play there, for they have no room to run about in, nor can the parents indulge in games or sports there".

The suggested solution is a building built over two storeys, half of the plot is built on and half provides a flower garden. The remaining part of the 400m² site is pooled together with the other dwellings to create huge sports areas and play grounds, as shown in the axonometric of a housing scheme on the 'cellular system'.





Left (above)

Figure 13: Le Corbusier's proposed alternative to the single family house with small garden.

Left (below)

Figure 14: Axonometric showing a completed housing block based on the Cellular System. It shows the private gardens overhanging the large communal garden at the centre.

Source: Le Corbusier, *The City of To-Morrow*, Translated from the 8th edn. (London: John Rodker,

Figure 15: Karel Teige's Existenz Minimum. Source: Karel Teige, *The Minimum Dwelling,* trans. Eric Dluhosch (Cambridge, Massachusetts: MIT Press, 1932).

is organised has potential implications for the freedom and expression of the individual household.

The diagram in Figure 12 demonstrates how the construction, as well as the tenure of different housing types affects the freedom that residents have to alter different parts of the dwelling environment. The hotel model, which has been referred to repeatedly as a model for achieving high numeric and physical densities, is shown in Habraken's diagram (H) as the dwelling type in which the occupants have the least capacity to alter their residential environment. In the suburban house, residents (owners at least) have more scope to adapt their dwelling to suit their individual requirements, than residents in an apartment building (owners or tenants).

This suggests that in terms of Habraken's defined hierarchies of enclosure, the initiative to achieve higher numeric densities and larger physical mass, potentially curtails the autonomy and freedom of the individual resident to use and inhabit their dwelling freely. In this way, the collective structure of the apartment building becomes an essential and defining element in the perceived and lived experience of density, and a determining factor in how the dwelling is used and individualised.

Communal Space

As with collective structure, there is a threshold above which the density of individual dwellings on site necessitates the provision of communal rather than individual private gardens. Where it is not necessitated by the density of people or dwelling space on site, it can form part of a social and spatial objective. Le Corbusier for instance, denounced what he described as the "stupid and ineffective" system of dividing the site up into individual private gardens and deemed a collective model to be far superior in terms of the amenity that it offered (see Figures 13 and 14).[74] Le Corbusier's strategy for collectivising the dwellings into large-scale, multi-dwelling structures was also extended to the site landscape – with bigger being inherently better.

Karel Teige's *The Minimum Dwelling* applied a similar theory to the designation of space inside the dwelling and is perhaps one of the most provocative theories on communality as a strategy for the organisation of higher densities, and for society itself. His text explored the notion of the minimum basic dwelling – providing the essential physiological necessities of sleeping, resting and rejuvenating – with all other functionalities provided in communal accommodation (Figure 15). The model reduced the amount of space required for each dwelling, thereby enabling higher site densities, but more than that was premised on a social and political theory based on collectivism and, by extension, collective living.[75]

Teige's model clearly offers a potential strategy for increasing the density of dwellings on the site. Minimum private dwellings, supplemented by shared amenity spaces make more effective use of the available floor area than private dwellings each equipped with individual amenity

74 Le Corbusier, *The City of To-Morrow*, Translated from the 8th edn. (London: John Rodker, 1929), 203.

75 The wages of the proletariat he argued were not substantial enough for dwelling in the fullest sense, and provided only for lodging. Karel Teige, *The Minimum Dwelling,* trans. Eric Dluhosch (Cambridge, Massachusetts: MIT Press, 1932).

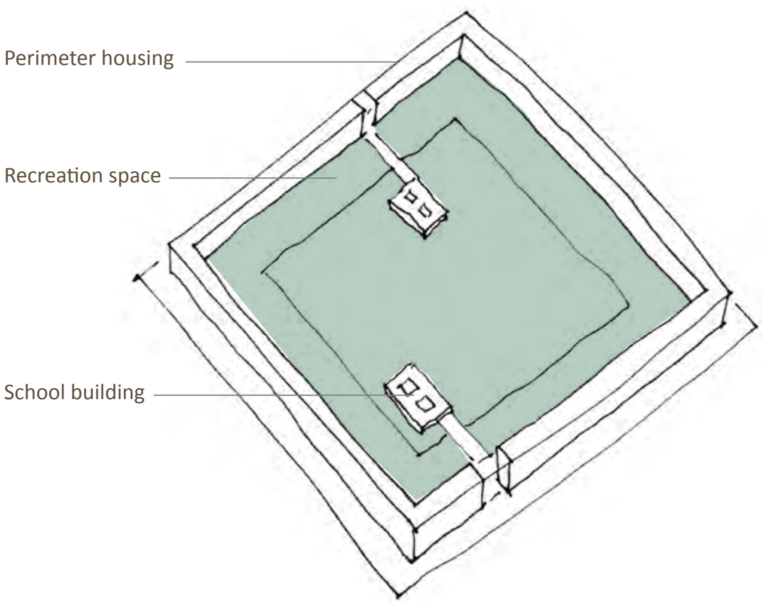
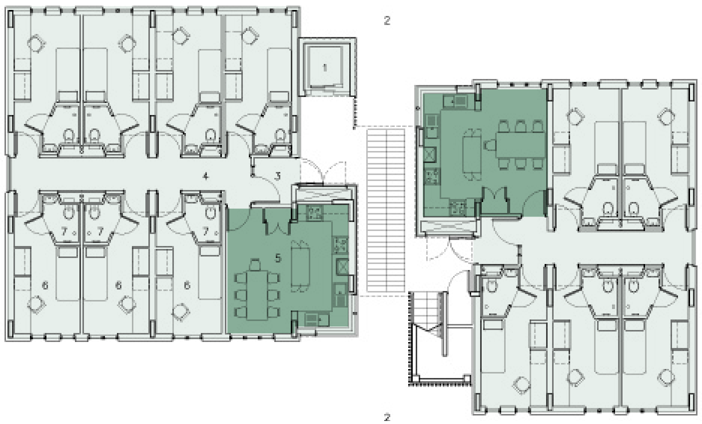


Figure 16: Leslie Martin and Lionel March's Speculations #6 and #7 on shared use of recreational land. Required recreational space per head of the population could be shared with the recreation space required by a school; one would typically be in use when the other was not, and this would enable more compact development of housing. Their work draws on a model developed by Bullock, Dickens and Steadman which explored function and use in relation to time. Source: Lionel March and Leslie Martin, "Speculations," in *Urban Space and Structures* (Cambridge: Cambridge University Press, 1972), 28–54.



KEY:

Shared kitchen and living

Residential wing

Figure 17: Newington Green Student Housing, North London. Designed by Haworth Tompkins (2004)

Floor Plan: showing five or seven individual studio rooms per shared living and kitchen space. The floor plan demonstrates the kind of efficiencies that Teige's theory was based on, but applied to a different purpose.

Source: Haworth Tompkins, "Alliance House, Newington Green," *Haworth Tompkins*, 2004

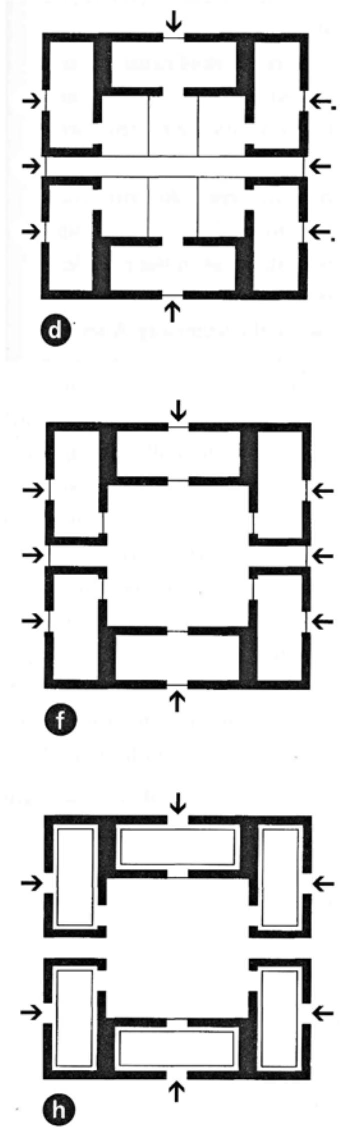


Figure 18: Territorial variations within the urban block. Source: Habraken, *Structure of the Ordinary,* 172–173.

D- Private gardens with access from a back alley that is gated. The alley is communal space for the residents

F- Private gardens are merged into a single gated communal courtyard

H- Houses are rented from a party who controls both the buildings and the communal yard spaces. An extension of the principle is that of 'cross-programming' demonstrated by Martin and March in their Speculations. Drawing on observations made by Bullock Dickens and Steadman on the infrequent use of the Dining Room within the typical family home, Martin and March suggested that the requirement for recreational space associated with new housing development could be shared with that required for schools to make more effective use of the available land (Figure 16).[76]

It is suggested therefore, that communal open space is, in itself, part of the organisational characteristic of density. Internal space is more complicated however. There is a question over how the communal space is integrated and the way in which it provides an extension of the dwelling itself. For instance, typical student accommodation (see Figure 17) is premised on the kind of space-saving efficiency that Teige considered: the rooms on their own are not self-sufficient dwellings, but are reliant on the amenities provided in the communal spaces. By comparison, an arcade of shops provided as part of a large residential development might be considered an additional extra – facilitated by the site density, but not integral to its organisation in the way that a shared kitchen would be.

Habraken's model again provides some insight in regards to the organisation of communal space and utilities. It posits that the extent to which residents are able to exercise control over, and inhabit outdoor space, is affected by access to the space outside and the implied responsibility for it. The diagrams (Figure 18) represent different configurations of space at the centre of a hypothetical urban block. In the first, the space is divided into private gardens or yards. In the second and third, the courtyard is communal. The success of these communal spaces, he suggests, is determined by the extent to which the residents living around them can contribute to them. Where the dwellings are rented and the space is owned by an external party, this 'commitment' as he terms it, is at its lowest. "Successful communal space is communally controlled and maintained", he writes.[77]

The location and integration of the communal space or spaces therefore is a significant factor in how they affect the lived experience of density. The student accommodation, for instance, has a very high dependence of communal space as part of its organisational logic and therefore this is essential to its density character. Whereas the dwellings of the apartment building are not dependent on the shopping arcade at street level, these particular communal spaces have less impact on the dwellings themselves or the organisation of the site.

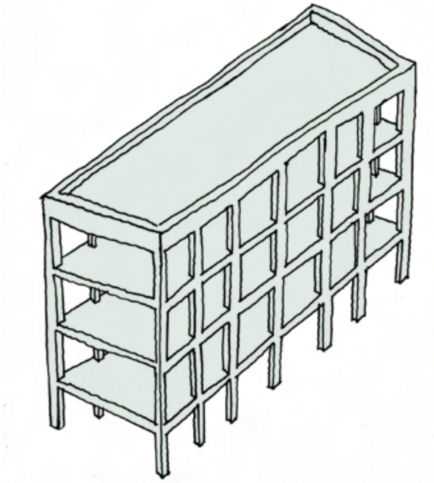
Communal Utility

The final index of communality, communal utility is proposed as an indicator of the extent to which the organisation of the site density exploits the potential to provide a range of services (utilities) and technologies for residents. Of the three indices of organisation, Utility has the least to do with the experiential impact of density, but

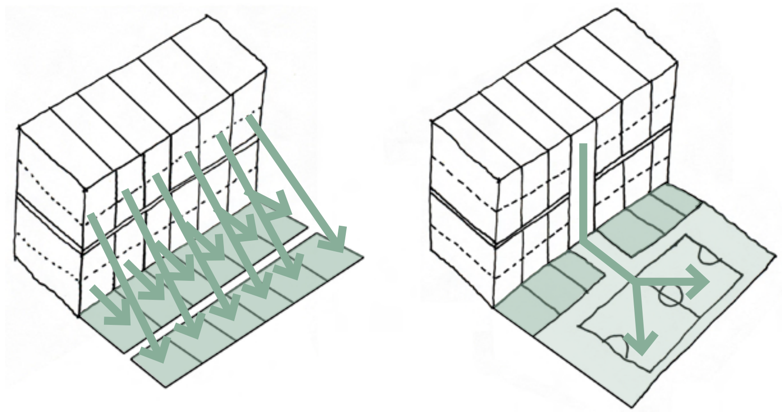
76 Lionel March and Leslie Martin, "Speculations," in U*rban Space and Structures* (Cambridge: Cambridge University Press, 1972), 28–54.

77 Habraken, *Structure of the Ordinary*, 177.

Figure 19: Three indices of communality



3.1 Collective Structure



3.2 Communal Space

3.3 Communal Utility

perhaps the most to do with revealing the economic and regulatory factors that have been brought to bear on the development.

It has been suggested by a number of studies that higher density housing potentially facilitates the development of communal utility provision such as District Combined Heat and Power (CHP) schemes; although as Churchman points out, these potential advantages are by no means guaranteed.[78] It is reasonable to suggest, however, that at higher densities, just as the need for collective structure and communal space is necessitated, the dependence on communal utility systems is also increased.

Utility provisions have been integral to the site organisation of a number of the case studies considered so far as part of the indices of organisational density. The index takes account of 'hard' technology such as district CHP schemes as well as 'soft' utilities, such a concierge service, refuse collection or car share provision. Whereas 'hard' utilities are dependent on proximity between dwellings, 'soft' utilities are affected more by proximity between people. However, the spatial organisation of the site is essential to both.

It is implicit that the provision of a concierge service for instance, is made more viable when there is one (primary) site entrance, shared by a number of dwellings that make the service economically feasible. Of course the tenure and value of dwellings can impact on what is perceived as viable, and the assumed correlation between the compactness of a scheme and the provision of certain technologies or services can be distorted by the availability of capital. A scheme where the value of the individual dwellings is significantly high might justify the incorporation of advanced energy generating technology, irrespective of the density ratio of the site. On the other hand, where the value of the dwellings is too low, it might not be possible to justify the cost of the technologies even where the density of units is high. These utilities and services also have spatial implications. Car parking is one of the most critical and can have a determining impact on the numeric density achievable on a given site.[79] In a high value development where the value of the dwellings is sufficiently high, the cost of digging out a basement beneath the site might be considered justified. On a lower value site, where the value of the dwellings or floor space is lower, the costs of the basement might not be justified financially and the parking provision is either reduced, or else it occupies a large part of the site area. In this way, car parking, or other utilities such as energy distribution centres of bicycle storage, can have a determining effect on the layout, communal organisation and the qualities of the residential environment. It can therefore become a defining spatial condition of the way that housing is organised collectively.

The design of different utility spaces and the impact that utility provision has on the layout of the site is a key consideration for the design of higher density housing.

The three indices of communality are described in the diagrams in Figure 19.

78 Churchman, *"Disentangling the Concept of Density,"* 309 and 401.

In her guide to current standards in construction and design, Sophie Pelsmakers highlights what he calls a 'paradox' between density and the move towards zero carbon standards. She notes that at densities above 35 or 40 dwellings per hectare it is very difficult to meet zero carbon standards because of the requirement for on-site energy generation that is associated that level of occupancy. *The Environmental Design Pocketbook* (London: RIBA Publishing, 2012), sec. 3.3.3.

79 The recent Housing Density study makes the same observation. It notes that car parking has a major impact on site planning and can take up between 25 per cent and 40 per cent of the area of small sites. As a rule of thumb the relative costs of providing basement car parking can be worked out as follows:

Surface parking - £x

Undercroft - 2 to 3 times £x

Basement - 5 to 6 times £x

Maccreanor Lavington Architects, Emily Greeves Architects, and Graham Harrington Planning Advice, *"Housing Density Study."*

Proximity as Density

Of all the attributes that characterise a city, there can be little doubt that proximity is the most crucial because of its generative power: building and population density, compactness of built form, concentration of people, nearness and choice of desired destinations and the constant buzz of transaction and interaction are all expressions of proximity and its outcomes[80]

The final quadrant of the four-part expansion of density draws on the discussions around physical densities and the organisation of density and considers the implications of these factors on the social experience of density. This final set of indices is concerned primarily with the impact of proximity between people and the social opportunities that might be brought about as a result of designing with this in mind.

Proximity impacts on the phenomenological experience of the city through the social conditions that it creates. Proximity was a central motivation behind the introduction of standards for minimum amounts of space introduced in the latter half of the nineteenth century. It also had an important influence over the organisation of the multi-dwelling, collective housing models developed, first of all through the philanthropic model dwellings, and later in public housing schemes such as Boundary Street (London Couunty Council, 1900). Proximity was also the essential pre-condition for the shared amenities and services propounded by Le Corbusier as an advantage of the collective dwelling models.

The Dutch architect and writer, Rudy Uytenhaak suggests that proximity between people, promoted by different types of space designed for different uses and activities promote complexity which is an essential ingredient of the bustle and 'urbanity' of the city. He writes;

Elements that are present simultaneously promote complexity and proximity, and therefore interaction between activities and events, and with it the degree of urbanity.[81]

As a means of capturing and describing the qualities of proximity in the urban environment, three indices are set out: encounter, bustle, and privacy. These are explained below.

Encounter

It is the twenty-third of June nineteen seventy-five, and it will soon be eight o'clock in the evening. Joseph Nieto and Ethel Rogers are about to go down to the Altamonts'; on the stairs, porters have come for Olivia Norvell's trunks, and a woman from an estate agency is coming to have a late look at the flat Gaspard Winckler used to occupy, and a displeased Hermann Fugger comes back from out of the Altamonts', and two similarly dressed doorstep salesmen pass by on the fourth-floor landing, and the blind tuner's grandson waits for his grandfather, sitting on the stairs reading the adventures of Carel van Loorens, and Gilbert

80 Fanis Grammenos (2011) cited in Christopher Boyko and Rachel Cooper, "Clarifying and Re-conceptualising Density," *Progress in Planning* 76 (2011): 2.

81 Rudy Uytenhaak, *Cities Full of Space: Qualities of Density,* trans. Pierre Bouvier (Rotterdam: 010 Publishers, 2008), 8–9.

82 Taken from the concluding paragraphs to Georges Perec, *Life: A User's Manual,* trans. David Bellos, Twentieth Anniversary Edition (London: Vintage Classics, 1978), 496–497.

83 Teddy Cruz, "Architecture: Participation, Process, and Negotiation," in *Verb Crisis*, Boogazine 6 (Barcelona - New York: Actar, 2008), 156.

84 Amin and Thrift (2002) cited in Ruth Fincher and Kurt Iveson, *Planning and Diversity in the City* (Basingstoke: Palgrave MacMillan, 2008), 14.

85 Fincher and Iveson, *Planning and Diversity in the City,* 13

Berger takes down the dustbins as he wonders how to solve the complicated puzzle of his serial novel; in the entrance hall Ursula Sobieski looks for Bartlebooth's name on the list of occupants, and Gertrude, who has returned to drop in on her former mistress, stops for a minute to say good day to Madame Albin and Madame de Beaumont's home help….[82]

The potential for proximity to bring about opportunities for encounter is an idea that has fascinated fictional writers for decades. Georges Perec's novel, Life: a User's Manual is constructed through a number of simultaneous events unfolding coincidently in the different rooms off the stairwell of an apartment building. They conspire to build up a complex scenario in which even the seemingly banal is situated in a detailed construct of previous and subsequent events. The encounters in the stairwell are unspectacular, but provide the pivot for the novel and for Perec's construction of the social propensity of the urban apartment building.

The architect Teddy Cruz makes a strong case for an index of encounter as an alternative way of thinking about density. He argues that by thinking of density in terms of a density of encounters per area, the social propensity of design can be measured and given weight in deliberations over density:

In Relational Aesthetics, Bourriaud suggests that form is a way of anticipating encounter, and that in this sense, we as architects can also design collaboration. By thinking of density in terms of the quantity of social relationships per acre, we suggest that to make a housing project sustainable, socially at least, we have to involve certain mediating agencies, such as these non-profit organizations.[83]

His argument is fundamental, suggesting that as long as density continues to be determined on the basis of economics and normative assumptions about housing type and desirable urban structures, housing will continue to be designed in a way that is inherently unsuitable for certain socio-economic groups, and therefore fundamentally unsustainable in the long term. An index of social encounter, he suggests, would allow the way that site development is organised to harness the potential benefits that come from social ties and community networks.

There is a body of socio-geographic research that considers the social benefits of 'encounter' of different kinds. Amin and Thrift consider the social benefits of unfamiliar encounter in large public squares, and familiar, everyday encounter in what they call the "'micro-public' sites of compulsory daily interaction", such as schools, workplaces and community spaces.[84] The urban geographers, Fincher and Iveson further situate encounter as one of the three normative social logics for the organisation of the city. The socio-political importance of 'encounter' is expanded through a reading of the city as a place of juxtaposition and necessary encounter, which is the means by which the equalising objectives of recognition (of social diversity) and redistribution (of resources and opportunities), can be achieved.[85]

Figure 20: Alexandra and Ainsworth Estate, Neave Brown for Camden Council Architects' Department (1966-72)

(Above)

Street running through the centre of the site at the Alexandra and Ainsworth Estate. The entrances to all of the flats are arranged off the open stairs that branch off the central thoroughfare.

Photograph – authors own

(Below)

The entrances to dwellings at the Alexandra and Ainsworth Estate. The landings and the front terraces overlook the street and provide an opportunity to chat with neighbours and passers-by.

Photograph – authors own

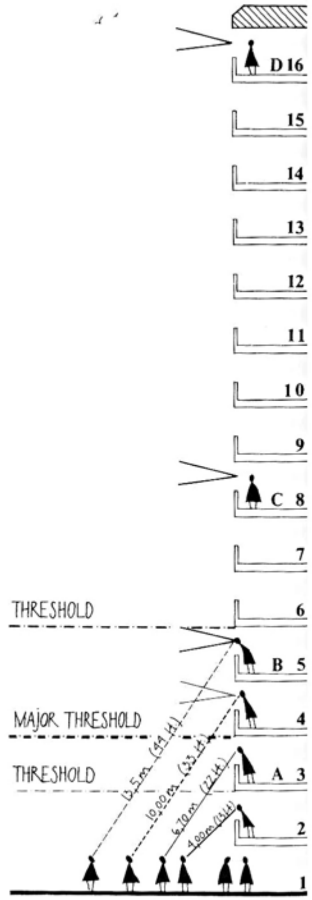


Figure 21: Contact between the floors of a building and street level. Any activity above the fifth or sixth floor, Gehl suggests, is "out of touch with ground level events."

Source: Gehl, Jan. *Life Between Buildings: Using Public Space*. 6th Edn. 2008. (Copenhagen: Danish Architectural Press, 1987), 98.

86 Andres Duany, Jeff Speck, and Elizabeth Plater-Zyberk, *Suburban Nation: The Rise of Sprawl and the Decline of the American Dream*, 5th ed. (New York: North Point Press, 2000), 41 and 59.

87 Neave Brown, "The Form of Housing," *Architectural Design* (September 1967): 432.

88 Gehl, Jan. *Life Between Buildings: Using Public Space*. 6th Edn. 2008. (Copenhagen: Danish Architectural Press, 1987), 98-99.

One of the criticisms levelled against the ubiquitous North American suburban environment is that dominance of the car in the residential environment discourages people from walking anywhere. Duany, Speck and Plater-Zyberg write:

> *Americans may have the finest private realm in the developed world, but our public realm is brutal. Confronted with repetitive subdivisions, treeless collector roads, and vast parking lots... One's role in this environment is primarily as a motorist competing for asphalt.*[86]

In the car, one does not encounter one's neighbours or bump into people from the other side of the street. The social objectives of recognition and redistribution that Fincher and Iveson suggest as part of a more equal urban society, are not possible in the absence of a spatial environment that promotes opportunities for encounter to take place. In this sense, the way that the density of dwellings and other programmes are organised on the site can either support opportunities for encounter as a positive social aspect of living in the city, or it can preclude them.

As Cruz seeks to demonstrate, opportunities for encounter are affected by the organisation and design of the built environment at a range of scales, from the fundamental organisation of the road network and the way that a site connects with the rest of the city, to the so-called 'micro-public' spaces between the entrances to two neighbouring houses for instance. In the 1960s and 1970s low-rise housing schemes such as Odham's Walk and Alexandra Road, connection to the rest of the city was one of the fundamental principles of the site layout. Neave Brown, architect of the Alexandra Road scheme in Camden wrote of the street as connecting device;

> *Even at its worst it produced a certain immediacy of relationship between house and neighbourhood, and if haphazard and deficient in public and private amenity, the virtues of contact between house and street, neighbour and neighbour, pubs, shops and backyard industry, generated cohesive street society… New housing has failed to maintain a similar immediacy of contact which seems essential to an urban culture.*[87]

Brown argued that the proximity between the dwelling and the public space of the street was critical, not only as the social space where neighbours meet and interact, but for animating the street with a density of activity, movement and interaction that defines what he calls the 'urban culture'. At the Alexandra and Ainsworth Estate (Figure 20) the pedestrian route through the site is concentrated along one central street, from which the entrances to all of the dwellings are accessed. The street therefore maximises the density of pedestrian activity and opportunity for encounter at the scale of the site. Furthermore, the entrances to the dwellings themselves are accessed from the open stairwells and arranged two dwellings per floor, creating an intimate shared space between the entrances of the two dwellings and the kind of 'micro-public' spaces that Amin and Thrift refer to. Jan Gehl, who has written extensively about the social propensity of the residential and urban environment,

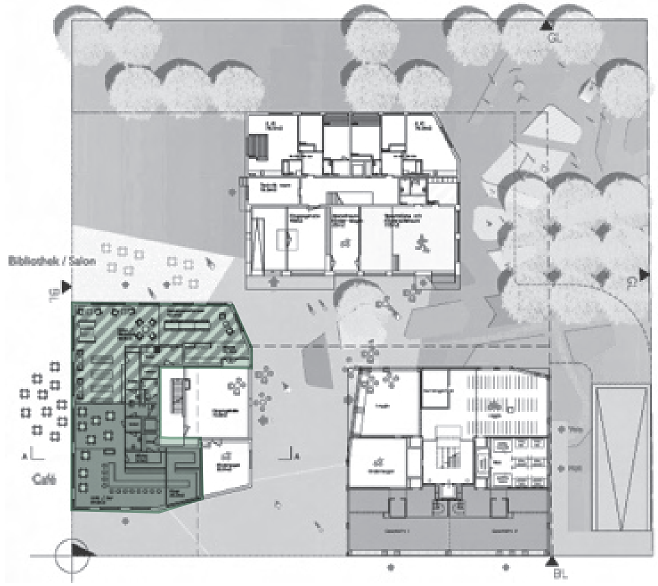


Figure 22: 122 Nordbahnhof Apartment buildings, Vienna

Sergison Bates with von Balmoos Krucker architekten and Werner Neuwirth (2010)

The communal functions on the ground floor are layed out in order to be visible from the entrance and provide tacit surveillance between the different areas.

89 Clare Cooper Marcus and Wendy Sarkissian, *Housing as If People Mattered: Site Design Guidelines for the Planning of Medium-Density Family Housing* (London: University of California Press, 1986), 187.

89 Uytenhaak, *Cities Full of Space: Qualities of Density*, 10.

90 Benjamin and Lacis, *"Naples"*. This essay was discussed in some detail above.

talks about the proximity between dwelling and street level as part of enabling activities to inter-relate. He talks about "assembling events" or activities, part of which is determined by their physical relationship to one another (see Figure 21).[88]

Marcus and Sarkissian took up the baton for low-rise medium density a decade or so after Brown, Tabori *et al* – promoting the benefits of an 'urban residential form' that provides opportunities for neighbourly interaction and fosters the benefits of proximity to other dwellings. In preparing their design guide for this 'medium-density' model they advocate clustering dwellings into identifiable, distinct groups. Casual encounters in a shared entrance are more likely to evolve into neighbourly exchanges if the number sharing the entry is relatively small – they suggest less than eight. They suggest that "proximity alone is not sufficient for friendship formation," but intelligent design of shared spaces and common routes can provide spatial opportunities for social interaction to take place.[89]

For instance, at Sergison Bates' building for the Nordbahnhof development in Vienna the ground floor contains a number of community amenities: a children's room that opens onto a secure courtyard and garden, a laundry, and a pram store (Figure 22). Each of these spaces sits adjacent to the entrance lobby and with clear views between each to harness the opportunity for supervision and surveillance, and the potential for social interaction between users of the different spaces. In the organisation of the floor plan there is an implicit acknowledgement of the tacit social benefits afforded by the density of pedestrian traffic moving through the communal entrance of an apartment building.

Inherent in Neave Brown, Marcus and Sarkissian and Sergison Bates' design proposals is the notion that the proximity that higher urban densities potentially generates can be harnessed as a positive social and spatial attribute of the urban, residential environment. The index therefore considers the way in which the site plan establishes potential for encounter, between residents and between residents and passers-by. The way that the site plan knits into the public spaces around it is therefore a critical factor. It also considers the small-scale – what might be thought of as the opportunities for 'doorstep encounter' between neighbours. Further to Marcus and Sarkissian's point noted above, proximity alone is by no means a guarantee of friendship, but the qualities of the spaces provided can make a significant difference to the propensity for social exchange between neighbours.

Bustle

A city should bustle. It should be full. Full of people, of functions, of movements. In spite of its density and fullness, it must not become oppressive. In the dense city, therefore, spaces are imperative – spaces that exude comfort, style and perfection. …As indispensable counterpoints to these grand spaces, the city also contains domains of intimacy. All of

these spaces are significant and are laden with possibilities. They speak of life; they fill the city with stories.[90]

Of the proposed indices, Bustle is perhaps the most difficult to define in spatial terms. Benjamin and Lacis' lucid depiction of the street scene in Naples is taken as the defining representation of the phenomenon of bustle. Their essay describes an experience that is the product of spaces latent with potential for use in myriad different ways, and the juxtaposition of different types of space and activity to generate the complexity and turmoil of the street scene that they depict. Uytenhaak uses the phrase 'the miracle of density' to describe cities that contain bustling spaces full of variety and diversity. They have allure, he suggests. He defines the condition of urbanity as the product of complexity and proximity. Diversity, variety and how things are mixed and the arrangement of parts, people, and activities relative to one another provide the preconditions for a bustling environment.[91]

The essential ingredients of bustle therefore are people, proximity and time. The literary depictions cited above distort the perception of how long each of scenario is played out over, but time is nonetheless an essential component, allowing for the concentration and overlap of activity that generates the bustle of the street. Inherent in Michel de Certeau's depiction of the city as a pattern generated by the uses and movements, ('practices', as he calls them) of the city's inhabitants, is bustle - a dynamic and temporally shifting quality. He writes:

The ordinary practitioners of the city live 'down below' they are walkers, Wandersmänner, whose bodies follow the thicks and thins of an urban 'text' they write without being able to read it. It is as though the practices organising a bustling city were characterised by their blindness.[92]

These 'practices' then, are the sub-conscious, unconsidered movements and activities of the everyday life of a place. They are temporal, shifting over the course of a day, a week or season. As such, the spaces that are defined by these patterns of movement are also in constant flux. For all of these reasons, bustle is both difficult to define and, to generate.

There are ways in which the layout and architecture of the urban environment can contribute to, or provide opportunities for bustle. The juxtaposition of different programmes, when and how spaces might be used, when users are likely to be coming and going? These questions can be considered as part of the process of designing with the activity and bustle of the city in mind. MVRDV use the term 'interjacency' to describe the condition of proximity and cross-over between two adjacent functions.[93] The notion of cross-programming that was considered as a device for making more efficient use of spaces through shared use (see communal space above), also holds latent possibility for social mixing and the density of activity associated with bustle.

91 Uytenhaak, *Cities Full of Space: Qualities of Density,* 8-10.

92 M De Certeau, *The Practice of Everyday Life,* New edition (2002) (London: University of California Press, 1984), 93.

93 MVRDV (Firm), *FARMAX - Excursions on Density,* ed. Winy Maas, Jacob van Rijs, and Richard Koek, 3rd ed. (Rotterdam: 010 Uitgeverij, 1998), 195.

94 Walter Benjamin and Asja Lacis, "Naples," in *Reflections: Essays, Aphorisms, Autobiographical Writings*, ed. Peter Demetz, trans. Edmund Jephcott (London: Helen and Kurt Wolff, 1925), 171.

95 Jonathan Raban, *Soft City,* 1988 edition (London: Harvill, 1974), 14.

96 Sophie Watson, *City Publics: The (dis)enchantments of Urban Encounters* (Oxon: Routledge, 2006), 60.

The porosity between the buildings and the spaces around them also contributes to the perception of activity in the spaces around them. This passage, taken from Benjamin and Lacis' Naples depiction focuses specifically on the architecture – the spatial opportunities for exchange between the dwelling and the street.

So the house is far less the refuge into which people retreat than the inexhaustible reservoir from which they flood out. Life bursts not only from doors, not only into front yards, where people on chairs do their work (for they have the faculty of making their bodies tables). Housekeeping utensils hang from balconies like potted plants. From the windows of the top floors come baskets on ropes for mail, fruit, and cabbage… Just as the living room reappears on the street, with chairs, hearth, and altar, so, only much more loudly, the street migrates into the living room.[94]

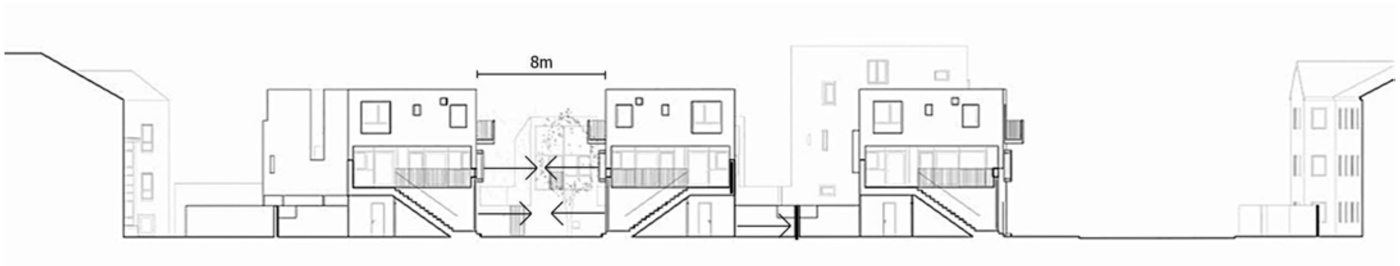
The depiction echoes Dicken's description of London's Seven Dials (cited above). In both cases, poverty and lack of space inside the home force the activities of domestic life out, into the street. However, if the perception of density is premised on the perception of people, the use of the street as an extension of the dwelling interior in this way is perhaps the most clear manifestation of density that there could be. The index of bustle therefore is concerned with functions, uses and site layout and the way that activity is harnessed to create a sense of bustle. It is also concerned, in the most basic sense, with the perception of people through sound, their visible presence in the space outside of the dwelling, or traces that reflect the inhabitation of the built fabric.

Privacy

There are strangers, not on the street, or across the square, but in the very next room. (There may even be strangers in your own room.) The house is constructed around a well- a deep rectangular column of light and air which is supposed to work like a lung through which the building breathed its own enclosed atmosphere. Now all it does is to bring strangers into eerie juxtaposition with each other. It transmits unasked-for intimacies, private sights, private sounds, which fuel suspicion and embarrassment and resentment.[95]

The final index of proximity is privacy. This citation from Jonathan Raban's Soft City highlights the potential for proximity to be a source of unease and insecurity. The unexpected and the dynamic conditions brought about by the density of people are not always compatible with the security and privacy that one desires from the home.

Social geographers have considered how notions of privacy and the physical dimensions that we associate with them come to be established. Watson proposes that the way the public-private division is understood remains a key part of how people live together in cities. She suggests that behaviour that is accepted and acceptable relates more to socio-cultural notions of privacy than to the idea of a body politic.[96] As socially and culturally defined values,



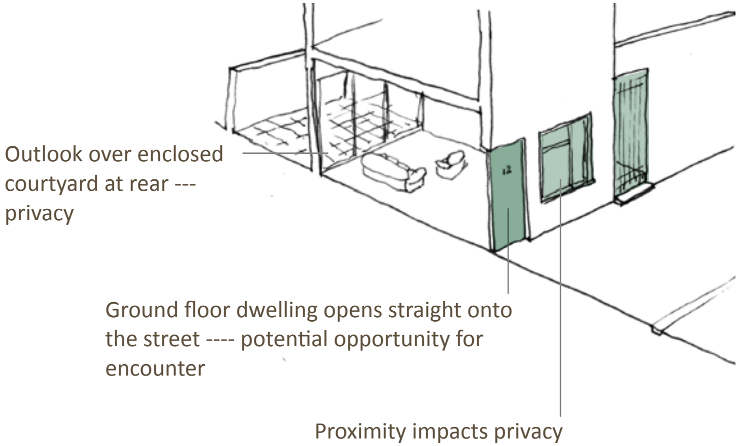


Figure 23: A sketch showing the relationship between the dwellings and the street at Donnybrook.

Peter Barber Architects (2006)

The Donnybrook scheme highlights the potential conflict between proximity, privacy and encounter. The dwellings are accessed immediately from the street, the front façade of the dwellings form the boundary of the public street, with little in the way of a threshold or semi-private domain between the two. To counter the potential feeling of exposure, each dwelling also has an outlook onto an enclosed private courtyard or terrace. This creates a perception of privacy and seclusion despite the very close proximity between the dwellings.

there is a degree of common understanding about how privacy is understood and perceived, and dimensions that are taken as indicative thresholds beyond which privacy might be encroached upon. These are not universal, but are important as part of the elaboration of the spatial consequences of density since many are defined in terms of physical dimensions between dwellings, or acceptable exposure between the dwelling and public space.

Under the demand to increase the productive use of a site there is pressure to maximise the amount of building and to minimise un-built area. This potentially impacts on privacy in a number of ways. By placing pressure on the minimum spacing distance between buildings dwellings are potentially brought into closer proximity to one another. Infill development of vacant sites within the city (part of the compact cities agenda) and pressure to make optimal use of the developable area of the site can result in proximity between buildings and the land-uses of adjacent sites, with associated impacts of noise, people and overlooking. The intensity of development on a site, the dimensions between buildings, and the organisation of dwellings in relation to one another in collective structures all incur potential consequences for the privacy of the dwellings.

The Mulholland study into the implications of density on privacy, identifies four different aspects of privacy; acoustic, visual, spatial and security. It proposes that each type, can be impacted in terms of freedoms, i.e. the freedom not to be overheard or overlooked; and protection in the sense of being protected from being overlooked or exposed to noise from outside.[97] Commonly understood dimensions of privacy; spacing distances between dwellings for example have come to represent the visual and spatial privacy freedoms that are culturally expected. However, the Mulholland study and the study by Lindsay *et al* suggest that residents of urban environments and higher density housing perceive infringement of their privacy according to different dimensions and different indicators than residents of low-density suburban environments.[98] Furthermore, because privacy is subjective and cannot be defined in terms of physical dimensions, the spatial strategies that designers use, as well as the tactics that residents deploy to improve certain aspects of privacy have a significant role to play in determining the privacy of the dwelling.

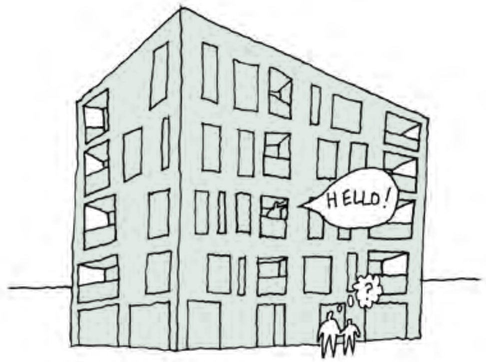
There are different ways that this can be achieved. Writing in the early 1960s, Chermayeff and Alexander commented on the need for a series of scales of privacy. They suggested a series of domains of privacy, to protect the individual from the incursion of other household members, the household from the assault of its neighbours, and the community from the incessant influence of the wider, public domain.[99] This suggests that design intervention at different scales can impact on the privacy of the residential environment. At the scale of the site plan, the privacy of the residential environment might be considered in contrast to the bustle of the spaces outside of the site. At the scale of the building, thresholds between the public space and the private interior mitigate the impact of physical proximity to these spaces

97 Mulholland Research and Consulting, *"Perceptions of Privacy and Density in Housing"* (Design for Homes and Popular Housing Research, 2003)

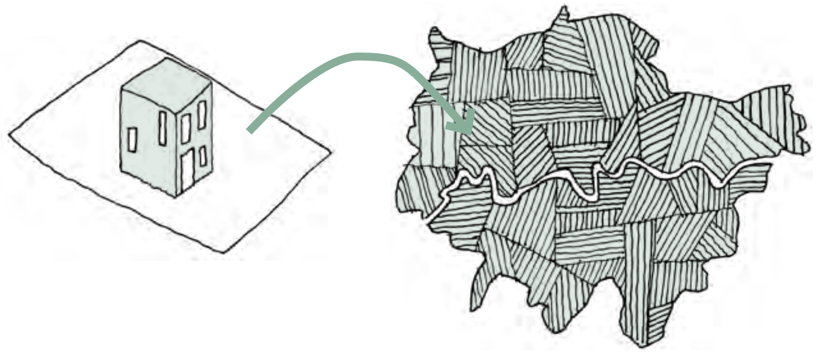
98 Residents of thirteen different case studies were asked about their comfort with the degree of overlooking, exposure to noise from neighbours, and the privacy of outdoor space. Responses were correlated against physical dimensions including; the size of private open space, setback distance between dwelling and street, distance between facing dwellings in all directions, whether dwellings are linked or detached. The study revealed that with an increase in the size of private open space in front of the dwelling, residents' comfort with the level of overlooking of their living space was reduced, suggesting that as physical separation is increased, so too residents expectations increased in regard to privacy in and around their homes. Morag Lindsay, Katie Williams, and Carol Dair, "Is There Room for Privacy in the Compact City?," *Built Environment* 36, no. 1 (2010): 36 and 43.

99 Serge Chermayeff and Christopher Alexander, *Community and Privacy : Toward a New Architecture of Humanism* (Garden City, N. Y.: Anchor Books, 1963).

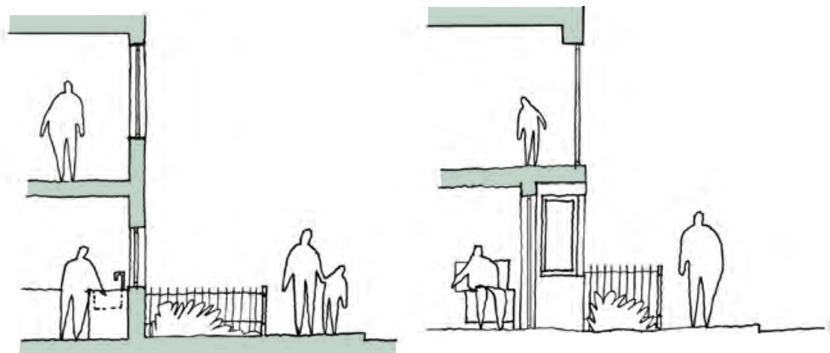
Figure 24: Three indices of proximity



4.1 Encounter



4.2 Bustle



4.3 Privacy

(see Figure 23). And finally, the privacy of dwelling itself should be considered in relation to its nearest neighbours. This might take account of the layout of rooms internally or the insulation of the building fabric.

In a large apartment building there are likely to be a series of physical thresholds that separate the dwelling from the street. The potential for strangers to knock on the front door is precluded by a series of secured doors and gateways that have the effect of separating the dwelling from the city around it. In a street of terraced houses, by comparison, the proximity between the dwelling and the street is mediated by fewer and less secure thresholds. A small garden gate and perhaps a door-step might be all that separates the private domain of the dwelling from the public thoroughfare of the street. In terms of opportunities for encounter, the immediacy of the relationship between the terraced house and the public street, has potential social benefits, but at the same time achieves less privacy than the sequences of thresholds that separate the apartment dwelling from the street.

There is also a sense in which the anonymity that comes from the scale and organisation of collective dwellings structures can contribute to a particular sort of privacy. King's theoretical proposition that housing is the commonplace, background setting for daily life, draws on the sameness and repetitiveness of a terrace of houses as his example when he suggests that:

> *The anonymity of our dwelling is a defence and we might bristle at those who try to observe us too assiduously … I seek anonymity… anonymity gives me the space to be particular, and anonymity comes from sameness.*[100]

The index of privacy is concerned with identifying how the privacy of the dwelling is affected by conditions of proximity. That is, proximity between dwellings, and between the dwelling and surrounding public spaces. As with the index of encounter, set out above, the index of privacy is concerned with how the implications of proximity are addressed through the site layout, and at the scale of the dwelling. There is a degree of overlap with the index of bustle as well. Strategies for limiting the impact of proximity for privacy can involve creating physical barriers between the two. These two indices are therefore critical points of consideration for the design of urban housing.

The three indices of proximity are represented in the diagrams in Figure 24.

100 King, *The Common Place: The Ordinary Experience of Housing,* 51.

101 The closest attempt at this was Amos Rapoport's study published in 1975, but importantly it defined the perception of density in terms of fixed formal and environmental indicators. Amos Rapoport, "Toward a Redefinition of Density," *Environment and Behavior* 7, no. 2 (June 1975): 133–158.

1. NUMERIC DENSITIES	2. PHYSICAL DENSITIES	3. COMMUNALITY	4. PROXIMITY
1.1 Dwelling Densities	2.1 Building Height	3.1 Collective Structure	4.1 Encounter
1.2 Habitable Room Densities	2.2 Site Coverage	3.2 Communal Space	4.2 Bustle
1.3 Plot Ratio	2.3 Built Form	3.3 Communal Utility	4.3 Privacy

Figure 25: Twelve indices of density

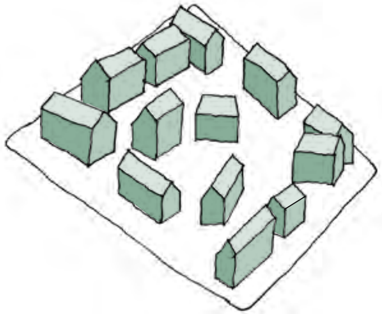
Conclusions

This chapter marks a point of departure from the existing research on the subject of density. Research on the subject of urban density (a broad summary of which has been outlined over the course of these three initial chapters), broadly falls into two categories. The first are the analytical studies that have tested the relationship between density ratios and built form, and the second are the body of socio-scientific studies dedicated to understanding the perception and cognitive impact of density. Whilst the latter has considered the perception of different qualities of density, for instance proximity to others, activity, and traces that reflect the presence of many people. However, these studies have largely sought to correlate the perception of these elements against density ratios to suggest a causal relationship. There has been little attempt at understanding the perception and experience of density in terms of its defining spatial qualities and characteristics.[101]

The previous chapter had demonstrated the limitations with the use of density ratios as the primary conception of density. It had shown how the dominance of the numeric conception of density in practice skews the perception of what constitutes an important consequence of density. Economic viability, housing production in terms of units and infrastructure provision become the critical, and defining consequences associated with density because those are the things that can be measured. Meanwhile, attempts to determine the impact of density on the qualities of the built environment or the perception of privacy, for instance, are compromised by the lack of clarity around how the numeric representation relates to the perception of density in a meaningful way.

The attempt to define a spatial conception of density therefore provides a mechanism through which those issues that are of concern for the design of the built environment can be taken into account and given due weight in deliberations over the relative benefits and compromises associated with density. The critical point of departure was in the expansion of the ‘spatial’ beyond the concern purely with representations of space and density in terms of numeric ratio measures. The acknowledgement of lived and perceived notions of space introduces other factors to the discussion of density that could not be adequately represented by the conception of density in numeric terms. The indices of communality, for instance, describe specifically the organisational possibilities that arise out of the density of people or dwellings. This has a fundamental impact on how the residential environment is lived in and perceived by its inhabitants and by others.

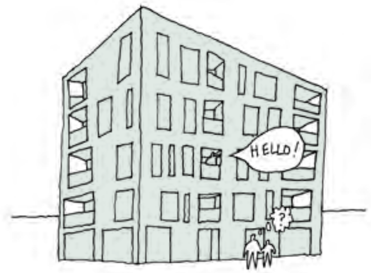
The indices of proximity, similarly, cannot be measured in numeric terms, but require a softer, more nuanced approach that considers the perception and experience of these qualities. The intention of this proposed spatial index is to highlight the experiential consequences that can arise from density and to provide a means of contemplating these qualitative factors in the design of residential



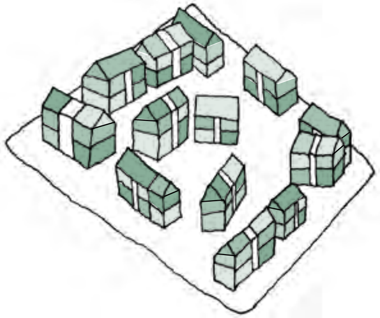
1.1 Dwelling density

2.1 Building Height

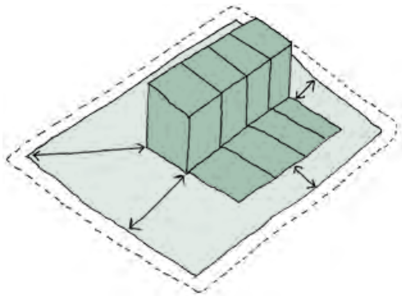
3.1 Collective Structure



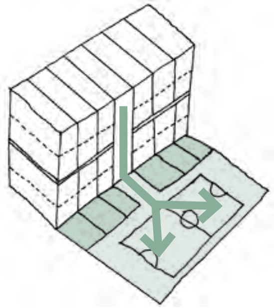
4.1 Encounter



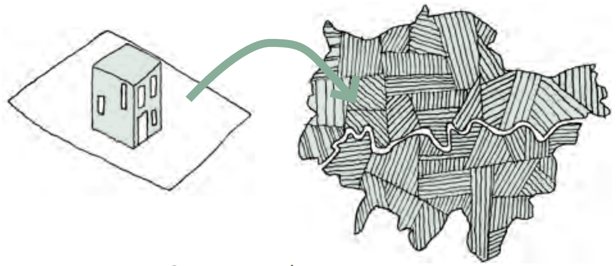
1.2 Habitable room density



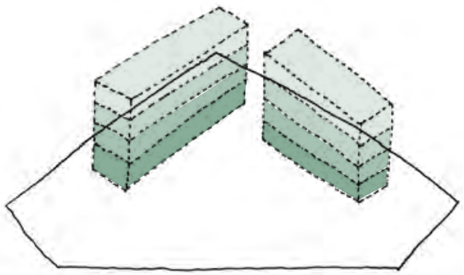
2.2 Site Coverage



3.2 Communal Space



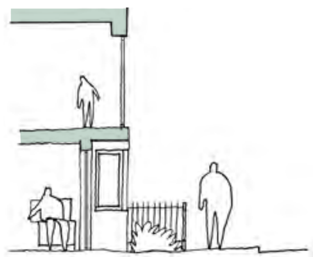
4.2 Bustle



1.3 Bulk density

2.3 Built Form

3.3 Communal Utility



4.3 Privacy

Figure 26: Diagrammatic representations of the twelve indices

environments. It is intended that these indices eventually form an alternative definition of density based on the social and experiential qualities associated with it. This is necessary in order to challenge the dominant conception of density as a ratio of dwellings per hectare, and thereby challenge the predominance of the concerns reflected by this measurement; of economic viability and site capacity. The index deliberately identifies qualities that cannot be measured. Bustle, encounter, and the organisational qualities, all require alternative, softer means of assessment and consideration. They respond to designerly concerns, and demand and promote designerly methods as a way of thinking about and harnessing the potentiality of density for urban and architectural design.

The indices are summarised in Figures 25 and 26. In the following chapter they will be tested against a series of residential case studies and appraised in terms of their veracity to describe the different physical, organisational and experiential implications of density.

Chapter IV

Testing the usefulness of a spatial index of density

Chapter IV

Testing the usefulness of a spatial index of density

1.0 Introduction

The objective of this part of the thesis is to test the proposed spatial conception of density set out in the previous chapter. It draws on design analysis and observation to explore each of the proposed indices in terms of their usefulness and relevance for describing and articulating the spatial qualities and perceptions of density that have been suggested in the preceding chapters of this thesis. The twelve spatial indices set out in the previous chapter are put forward as a framework for identifying the spatial qualities of density. They are organised into four categories, numeric, physical, communality and proximity, to reflect the main conceptions of density drawn out in the first chapter, and to correspond with the main elements that designers might consider in the design of an urban scheme.

Method

The method for testing the indices draws on three types of data and three types of analysis. First, quantitative measurements of numeric densities and built form, then a detailed design analysis based on reading of orthographic drawings, and finally, observations made on site in relation to the spatial understanding gained from the design drawings.

Data from the observations on-site at each of the ten chosen case studies was recorded in sketches, field notes, photographs and video recordings, which in conjunction with the design analysis provide what Geertz describes as a ‘thick description’ of the spatial qualities of each of the case studies (see Appendix 1).[1]

1 Clifford Geertz, cited in Linda Groat and David Wang, *Architectural Research Methods* (New York: John Wiley & Sons, 2002), 186.

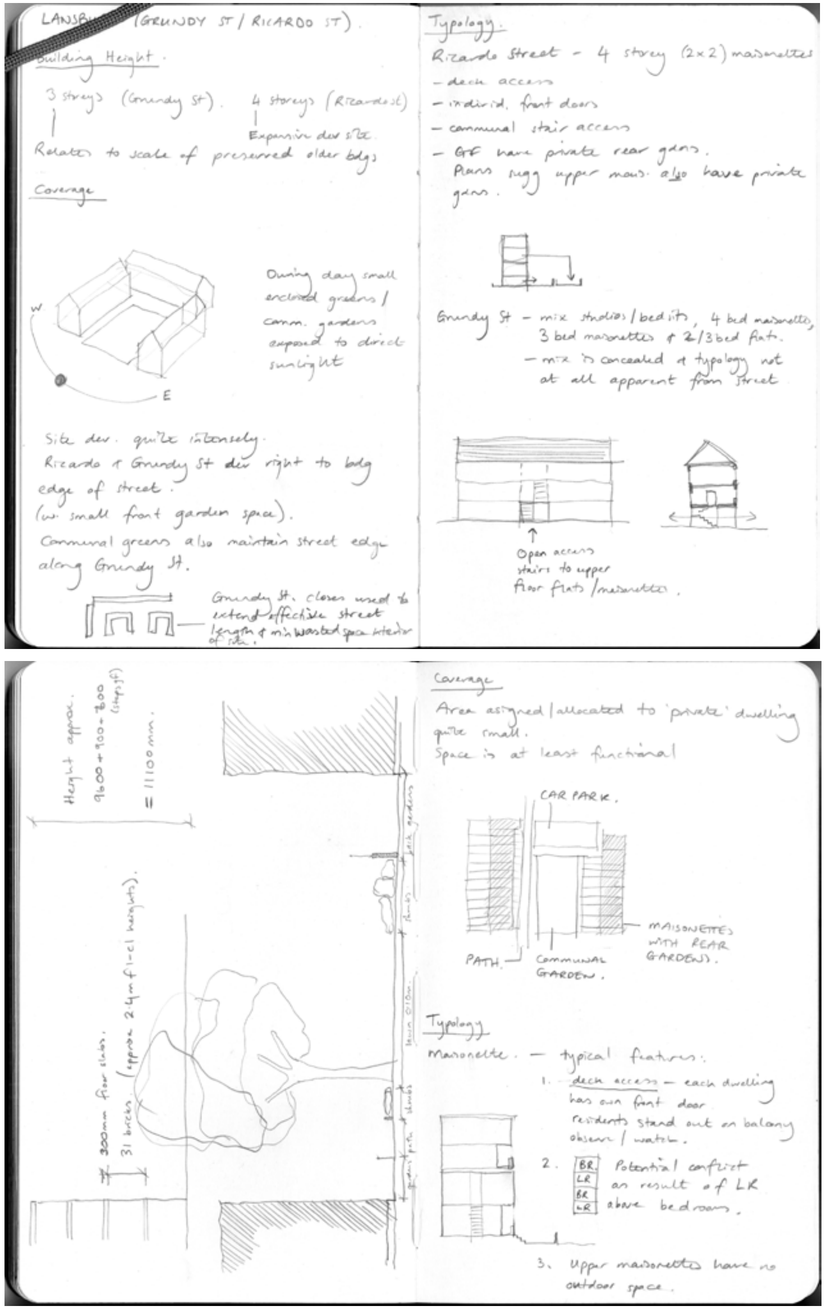


Figure 1: Example field notes

See Appendix 1 for a fuller description of the site analyses

The process of design analysis was an iterative one. Site observations informed and help to clarify the framework for analysing the design through drawings. Similarly, the analysis of the drawings raised questions to be considered during visits to the case study schemes. The two processes were therefore carried out simultaneously, with the design analysis informing what might be looked for on-site, and the observation process informing what might be looked for in the design analysis.

Design analysis and on-site observation are both qualitative methods, with much scope for freedom of interpretation. The rigour of the analysis comes from the way in which the qualities that are being considered and spatial factors that are relevant have been defined over the course of the previous three chapters. A framework of sub-questions brings a degree of control to the process and establishes a system for documentation of the case study information.[2] The sub-research questions for each theme are set out below in tables two to five.

The analysis focuses on testing the implications of density at the scale of the development site. It was established early on in this study that the perception of density inside the dwelling is a separate field of study, outside the scope of this thesis. A number of the studies into residents perceptions of density, discussed in the first part of Chapter Three, have attempted to establish the critical physical factors that contribute to residents perceptions of density in and around their home. However, as Tunstall has identified, the lack of clarity about what is meant by the term 'density' makes it difficult to ascertain residents' views on the subject.[3] It was felt that the terms proposed for the indices of density might also suffer the same lack of objective clarity which would make it difficult to gather residents' views or perceptions in relation to the different indices. Furthermore, since a large amount of research into residents' perceptions has already been undertaken, it has been possible to draw on these findings to inform the place-based analysis carried out here. The field studies therefore contribute a new methodology and new sources of data to the broader subject of the perception of density.

The process of carrying out the analyses is not completely linear. Whilst the questions have remained relatively constant, the iteration presented here, and the way that the observations and analyses are organised below, is the result of a process of evaluating and re-defining the methods and the questions of analysis. The sample field notes (Figure 1) show how initial observations were recorded against supposed indices such as 'open space', before it was determined that the area of concern was the way in which communal open space was organised as part of the social and spatial strategy for design. In this way the qualities that were relevant to the analysis were clarified, but the observations made on site were still useful. Other indices, such as 'typology' were disregarded in the course of the process because it was considered that many of the characteristics that distinguish a house from a flat or maisonette, such as the relationship to the street

2 *Tactics for generating meaning from qualitative data*, presented by Miles and Huberman, cited in Groat and Wang, p. 192.

3 Rebecca Tunstall, *"Housing Density: What Do Residents Think?"* (East Thames Housing Group, 2002). In spite of this, interviews with residents have been used repeatedly in the study of density and the methodology defined here has been developed out of the findings of many of these studies, as discussed in some detail in the previous chapter.

and physical connections to neighbouring dwellings were already being discussed within the other themes. Since it was the organisational characteristics rather than the type per se that was of interest, it proved more useful in terms of establishing the relevant spatial characteristics to remove typological distinctions from the analysis.

The design analysis is presented in a series of architectural diagrams. These diagrams combine elements of architectural drawings (plans, sections and elevations), with observations made on site and measured analyses carried out from the drawings. They form the basis of short analyses on each identified theme which is then followed up by a longer discussion on the spatial observations drawn together for each index. Photographs of the schemes are also used to describe the spatial characteristics. These were taken on site visits, during the day on both week days and weekends, as far as possible in fine weather and therefore depict the activity apparent at the case study locations.

Choice of Case Studies

In the previous chapters case studies have been used to demonstrate conceptual approaches towards density and the application of different ways of thinking about density to the design process. These case studies have generally been projects regarded as exemplars of design in one sense or another. However, in practice the initiative to 'optimise' development densities impacts on all housing, the majority of which is not exemplary. Arguably, the design of much housing is dictated by issues of capacity, economic viability and transport accessibility (PTAL) ratings, and therefore only engages with density as a ratio measure. The qualities of density; the organisational characteristics, the experiential impact of proximity, and the density of activity, are probably not an explicit part of design considerations.

The case studies that were selected were intended to represent 'normal' housing development (in the context of London). They are therefore interesting both for the things that they do well and the qualities of density that they demonstrate, as much as they are for the things that are done badly. That is to say that in order to test the usefulness of the indices as pointers for design, it is also useful to consider examples where the qualities of density have quite possibly not been considered at all.

The case studies also represent the norm in terms of their numeric densities (again, in the context of London). This provides a means of understanding the spatial implications resulting from the pressure of numeric densities and development policies. Since the discussion in the earlier chapters focussed on density policy in London, the use of case studies in this part of the study that enable some reflection on these policies is useful. The average density for new housing completions in London in 2010 was 120 dwellings per hectare.[4] Taking this as a starting point, the case studies were chosen to demonstrate a range of formal and typological characteristics within an average density range for London. Within Bromley-by-Bow there was a large amount of housing with numeric densities consistent

4 Greater London Authority, *Housing in London: The Evidence Base for the London Housing Strategy,* (London: Greater London Authority, December 2011), sec. 2.11.
In 2009 that equivalent figure was 103 d/ha. Land Use Change Statistics and Department for Communities and Local Government, *"Land Use Change: Proportion of New Dwellings on Previously Developed Land, and Density of New Dwellings 1994-97, 2006-09"* (Department for Communities and Local Government, July 30, 2010).

5 Patrick Abercrombie and John Henry Forshaw, *County of London Plan* (London: MacMillan & Co., 1943).

A01

BOW BRIDGE ESTATE

d/ha	149
hr/ha	277
plot ratio	1.27

A02

LANSBURY

d/ha	98
hr/ha	322
plot ratio	0.86

A03

GALE STREET

d/ha	146
hr/ha	510
plot ratio	1.43

A04

LINCOLN’S ESTATE

d/ha	111
hr/ha	420
plot ratio	1.02

A05

ARROW ROAD

d/ha	88
hr/ha	458
plot ratio	0.98

B01

BOW CROSS (whole site)

d/ha	234
hr/ha	777
plot ratio	2.02

B02

CASPIAN WHARF

d/ha	366
hr/ha	878
plot ratio	2.65

B03

ST. ANDREW'S

d/ha	320
hr/ha	964
plot ratio	2.76

B04

NEW FESTIVAL QUARTER

d/ha	254
hr/ha	728
plot ratio	2.61

B05

ABBOTT'S WHARF

d/ha	329
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Figure 2: Map showing the location of the case studies in and around Bromley by Bow, East London.

KEY

- - Indicates the Bromley-by-Bow ward

- A01 - Bow Bridge
- A02 - Lansbury
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with the average London densities. Much of the housing was developed in the decades after 1945 and was therefore built at the densities set out by Abercrombie and Foreshaw in their 1943 County of London Plan of approximately 100 dwellings per hectare.[5] Subsequent, infill development, for example at Lincoln's Estate and Bow Cross meant that the sites had dwelling densities equivalent with the London average.

Eight case studies were selected initially with dwelling densities of between 100 and 150 dwellings per hectare. All were located within the Bromley-by-Bow area of East London. After initial scoping visits to the sites of these schemes, however, it became apparent that the Bromley-by-Bow area where the case studies are located is undergoing significant transformation. Of the initial case studies selected, one was covered entirely by scaffold making it difficult to carry out field observation. A second; the Crossways/ Bow Cross estate, was undergoing extensive redevelopment with new housing being built around the existing tower blocks and the towers themselves being fully refurbished. There were also a number of new schemes in early stages of development, but with density ratios significantly higher than the case studies chosen to represent an 'average London density'. These new schemes represented the upper ranges of the GLA Density Matrix, with dwelling densities of between 200 and 350 dwellings per hectare. The decision was taken to include a number of higher density case studies as the physical, organisational and therefore spatial qualities of these schemes provide a

Group A	100 – 150 dwellings per hectare	A01. Bow Bridge
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Table 1: Defining the case studies by their numeric densities

good comparison with the lower density schemes and an opportunity to test the proposed indices more thoroughly.

A total of ten schemes were identified. They are listed in Table 1. Design drawings and key facts and figures for each of the schemes are documented in the Appendix at the end of this thesis.

Part of the definition of the schemes as 'typical', was that they were also exposed to the common constraints of site, development economics and management strategies that beget the majority of housing in London. In response to these issues it was decided to select a group of case studies located within similar socio-economic and socio-geographic context. The Bromley-by-Bow ward in which the case studies are broadly located (see Map of Case Studies in Figure 2) is characterised by high levels of deprivation that is relatively constant across the ward. Tenure status for the ward is almost 50 per cent socially rented (compared with 17 per cent average for London).[6] The majority of the case studies; Bow Bridge, Gale Street, Lansbury, Whitehorn Road and Bow Cross were formerly council-owned and are now owned and managed by Registered Social Landlords and Management organisations.[7]

The selection of Bromley–by-Bow as the location for identifying case study schemes was therefore justified on the following criteria:

- There are a wide variety of housing types and built forms with comparable numeric densities in the area
- Because of their geographic proximity, the schemes are exposed to similar development pressures and constraints in terms of housing development and planning policies and access to transport infrastructure – both of which impact on permitted development densities.
- The schemes have similar tenure profiles, all with a proportion of socially rented accommodation and owner-occupied (although the older schemes tend to have a higher proportion of socially rented accommodation).
- Many of the schemes were designed and built by the Greater London Council or London County Council which means that design drawings are available through the public archives.[8]

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The indices defined in the previous chapter have been drawn out of a detailed historical and theoretical analysis of the potential implications of density for the built environment. The proposal of a spatial conception of density marked a departure from the existing research on the subject, both in terms of the qualities that are identified, and in terms of the methods through which they are appraised. In moving away from the representation of density as a numeric ratio, and towards an understanding of density as a composite of different spatial conditions and experiences also requires a shift in the methods through which is it contemplated

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Left

Table 2: Framework for testing indices of numeric density

Right

Table 3: Framework for testing indices of physical density

and tested. The discussion below briefly sets out how the design analyses and observations were used in relation to the different categories of index, before each is expanded in relation to the observations drawn from the case studies.

Numeric Densities

The three indices of numeric density are set out as a scale against which to compare the case studies in terms of their spatial qualities. The case studies for testing the proposed index of density have been selected on the basis of their numeric densities, specifically the dwelling density. These are the units of density used by the Greater London Authority (GLA) to measure the density of new housing development in London, and the density measurements used most commonly in the UK. They also provide an indication of the number of households present on a site (when supplemented with a measure of site area). Habitable room densities, when used in conjunction with dwelling densities can give an indication as to the size of the dwellings on a site (albeit in terms of rooms rather than floor area). Finally, the plot ratio is used as a representation of the amount of building mass on the site. These indices therefore explain the potential pressures in terms of built mass to be accommodated on the site and enable the subsequent indices to be considered in relation to the pressures exerted by the amount of accommodation or number of people present on site. (Table 2 sets out a framework for the analysis of numeric densities).

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The index of site coverage is concerned with the way, in which site coverage and open space are affected by the density ratio of the site, and furthermore how the perceived spaciousness or intensity of the site affects the perception of density. The ‘intensity’ of the site is affected by the closeness between the buildings and the balance between the amount and size of the open spaces in relation to the built form. The discussion will rely primarily on the figure ground as a means of analysis.

Finally, the index of built form highlights the potential impact of density on the physical scale of the built form. As with building height, the discussion will consider both the physical dimensions of the built mass, and how it is articulated architecturally and the impact that has on the perception of density. These indices are primarily concerned with the perception of scale, intensity and the potential for anonymity and repetitiveness, although the latter is considered in more detail in relation to the indices

3.0 Communality Indices

3.1	How does the density ratio affect the degree to which communal space, structure and amenity are required/ are integral to the layout of the residential environment?
3.2	How does the communal structure affect the flexibility and use of the dwellings?
3.3	What is the relationship between the dwellings and communal spaces on site?
3.4	How is utility integrated and to what extent does it impact on the qualities of the site?

4.0 Physical Indices

4.1	How does site layout define opportunities for encounter and concentrate (as assemble) activity?
4.2	How does the relationship between dwellings create opportunities for ‘doorstep’ encounter?
4.3	In what ways might the architecture of the housing be described as porous?
4.4	How does the site layout affect the privacy of the dwellings?
4.5	How does proximity between dwellings and between dwellings and public space potentially affect the privacy of the dwellings?

Left

Table 4: Framework for testing indices of communality

Right

Table 5: Framework for testing indices of proximity

of communality. (Table 3 sets out the indices of physical densities, and the conditions and qualities against which they will be appraised).

Communality

The indices of communality are intended to draw attention to the organisational characteristics of density. It is assumed that higher density ratios necessitate collective structures for housing development and by extension, communal spaces, utilities and services. In this way, density has a significant socio-spatial impact, and further to Habraken's notion of hierarchies of dominance, impacts on the autonomy and capacity of individuals and groups to affect change in the urban environment in which they live.[9]

The index of collective structure is proposed as a means of identifying the implications of the building's structure on the organisation of individual dwellings relative to one another. The index of communal space considers how the site and residential accommodation is organised around communal space and how integral shared spaces are to the organisation of the building. In this way it is concerned with the effect that the communality that arises out of density has on the way the residential environment is perceived and inhabited. Two aspects of the site layout are considered: one is the organisation of the buildings around communal outdoor space. This is taken as one of the key organisational characteristics associated with density. The other is communal space within the building and how that is used to supplement the space provided within the dwelling itself.

The index of communal utility comes from the Modernist notion that the collective, multi-dwelling structure would generate the physical proximity and rationality of structure that would enable the provision of domestic technologies for every dwelling. The discussion will consider how utility is integrated into the collective structures (where they are present amongst the case studies) and how it impacts on the organisation of the site. (See Table 4 for framework questions).

Proximity

The indices of proximity consider how aspects of physical density and organisational density impact on the experience of density; characterised by the conditions of proximity it generates. The index of encounter is considered in terms of two primary factors. Firstly, it will consider the impact that the site layout has on the opportunities for social encounter, both with strangers (i.e. the rest of the city), and with nearby neighbours. Secondly, it will consider the opportunities for 'door step' encounter. Given that proximity impacts most significantly at the scale of the dwelling itself, it is concerned with the opportunities that proximity creates for social interaction between neighbours.

The index of bustle is perhaps the most difficult to examine. Bustle is dependent on the presence and activities of people, yet design cannot determine use, it can only suggest, anticipate and provide opportunities for activity to take place and harness this activity. The discussion therefore considers the opportunities for bustle, created either by the

9 N. J Habraken, *Structure of the Ordinary: Form and Control in the Built Environment*, ed. by Jonathan Teicher (London: MIT Press, 1998).

10 Mulholland Research and Consulting, *'Perceptions of Privacy and Density in Housing'* (Design for Homes and Popular Housing Research, 2003), 2. Note that the study defines four ways in which privacy is experienced or impacted: visual, acoustic, adequate space and security. The final two have been summarised into one category of spatial privacy.

Chapter IV

Testing the usefulness of a spatial index of density

diversity of activities within and around the site, or by the articulation of the buildings themselves to create the sort of porosity depicted in Benjamin and Lacis' text referred to in the definition of these indices in the previous chapter.

In many respects, the index of privacy is at odds with the index of bustle. The presence of many people, activity and noise, in the immediate vicinity of the dwelling is counter to commonly accepted notions of privacy associated with the residential environment. Taking the model set out in the study, *Perceptions of Privacy and Density in Housing* as a starting point, three types of privacy are considered: visual, acoustic, and spatial.[10] The analysis is concerned primarily with site conditions and the relationship between the dwelling and the surrounding site. The analysis will draw on measured dimensions taken from design drawings, as well as observations made on site regarding the perceived exposure of a home, or interventions by residents that suggest problems of overlooking or on-looking. Noise issues are more difficult to apprehend from design drawings and therefore site observations are particularly useful for identifying sources of noise and understanding how this affects the residential environment. (See Table 5 for the framework for the indices of proximity).

The indices will then be discussed and potentially refined in light of the observations drawn from these case studies. The next and final chapter is dedicated to expanding a reference for designers based on the indices tested below.

Chapter IV

Testing the usefulness of a spatial index of density

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1.0 Introduction

The objective of this part of the thesis is to test the proposed spatial conception of density set out in the previous chapter. It draws on design analysis and observation to explore each of the proposed indices in terms of their usefulness and relevance for describing and articulating the spatial qualities and perceptions of density that have been suggested in the preceding chapters of this thesis. The twelve spatial indices set out in the previous chapter are put forward as a framework for identifying the spatial qualities of density. They are organised into four categories, numeric, physical, communality and proximity, to reflect the main conceptions of density drawn out in the first chapter, and to correspond with the main elements that designers might consider in the design of an urban scheme.

Method

The method for testing the indices draws on three types of data and three types of analysis. First, quantitative measurements of numeric densities and built form, then a detailed design analysis based on reading of orthographic drawings, and finally, observations made on site in relation to the spatial understanding gained from the design drawings.

Data from the observations on-site at each of the ten chosen case studies was recorded in sketches, field notes, photographs and video recordings, which in conjunction with the design analysis provide what Geertz describes as a 'thick description' of the spatial qualities of each of the case studies (see Appendix 1).[1]

1 Clifford Geertz, cited in Linda Groat and David Wang, *Architectural Research Methods* (New York: John Wiley & Sons, 2002), 186.

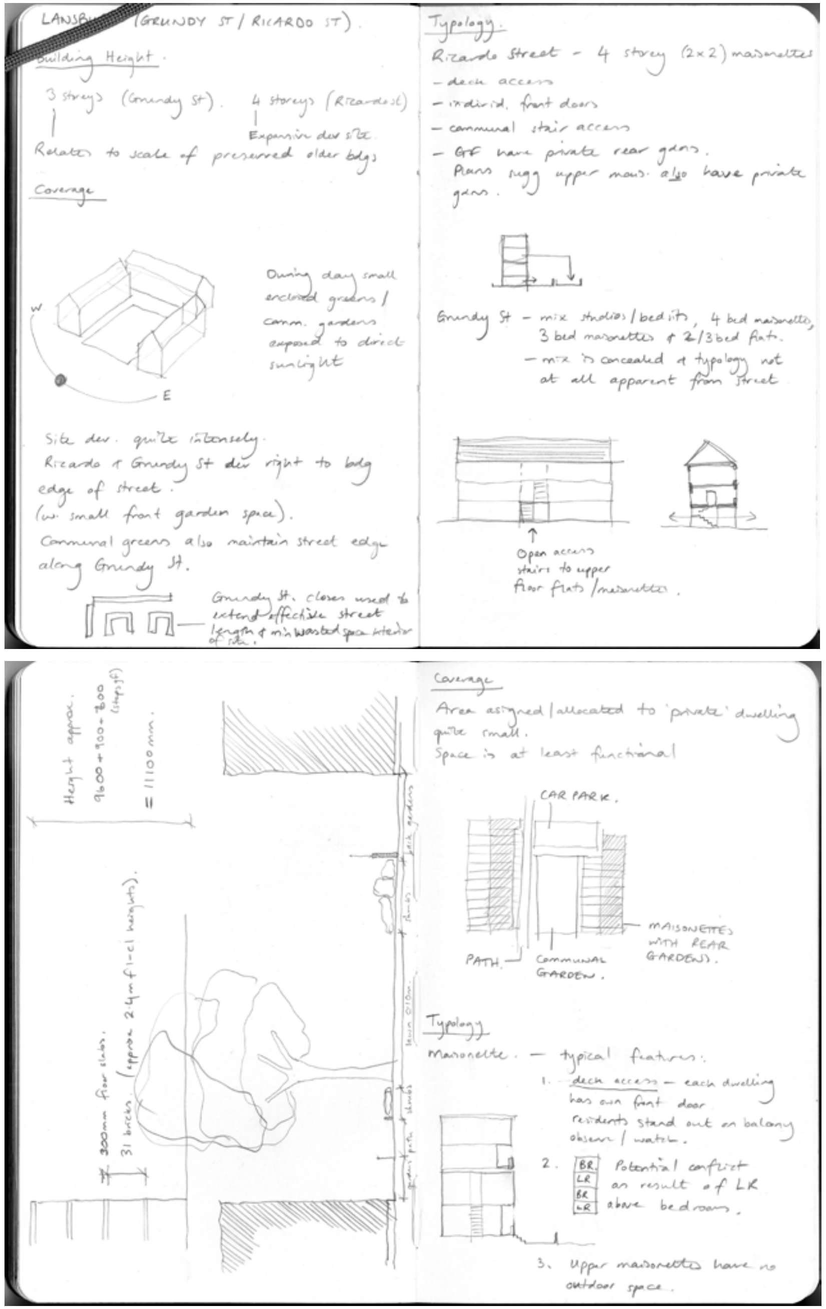

Figure 1: Example field notes

See Appendix 1 for a fuller description of the site analyses

The process of design analysis was an iterative one. Site observations informed and help to clarify the framework for analysing the design through drawings. Similarly, the analysis of the drawings raised questions to be considered during visits to the case study schemes. The two processes were therefore carried out simultaneously, with the design analysis informing what might be looked for on-site, and the observation process informing what might be looked for in the design analysis.

Design analysis and on-site observation are both qualitative methods, with much scope for freedom of interpretation. The rigour of the analysis comes from the way in which the qualities that are being considered and spatial factors that are relevant have been defined over the course of the previous three chapters. A framework of sub-questions brings a degree of control to the process and establishes a system for documentation of the case study information.[2] The sub-research questions for each theme are set out below in tables two to five.

The analysis focuses on testing the implications of density at the scale of the development site. It was established early on in this study that the perception of density inside the dwelling is a separate field of study, outside the scope of this thesis. A number of the studies into residents perceptions of density, discussed in the first part of Chapter Three, have attempted to establish the critical physical factors that contribute to residents perceptions of density in and around their home. However, as Tunstall has identified, the lack of clarity about what is meant by the term 'density' makes it difficult to ascertain residents' views on the subject.[3] It was felt that the terms proposed for the indices of density might also suffer the same lack of objective clarity which would make it difficult to gather residents' views or perceptions in relation to the different indices. Furthermore, since a large amount of research into residents' perceptions has already been undertaken, it has been possible to draw on these findings to inform the place-based analysis carried out here. The field studies therefore contribute a new methodology and new sources of data to the broader subject of the perception of density.

The process of carrying out the analyses is not completely linear. Whilst the questions have remained relatively constant, the iteration presented here, and the way that the observations and analyses are organised below, is the result of a process of evaluating and re-defining the methods and the questions of analysis. The sample field notes (Figure 1) show how initial observations were recorded against supposed indices such as 'open space', before it was determined that the area of concern was the way in which communal open space was organised as part of the social and spatial strategy for design. In this way the qualities that were relevant to the analysis were clarified, but the observations made on site were still useful. Other indices, such as 'typology' were disregarded in the course of the process because it was considered that many of the characteristics that distinguish a house from a flat or maisonette, such as the relationship to the street

2 *Tactics for generating meaning from qualitative data*, presented by Miles and Huberman, cited in Groat and Wang, p. 192.

3 Rebecca Tunstall, *"Housing Density: What Do Residents Think?"* (East Thames Housing Group, 2002). In spite of this, interviews with residents have been used repeatedly in the study of density and the methodology defined here has been developed out of the findings of many of these studies, as discussed in some detail in the previous chapter.

4 Greater London Authority, *Housing in London: The Evidence Base for the London Housing Strategy,* (London: Greater London Authority, December 2011), sec. 2.11.

In 2009 that equivalent figure was 103 d/ha. Land Use Change Statistics and Department for Communities and Local Government, *"Land Use Change: Proportion of New Dwellings on Previously Developed Land, and Density of New Dwellings 1994-97, 2006-09"* (Department for Communities and Local Government, July 30, 2010).

5 Patrick Abercrombie and John Henry Forshaw, *County of London Plan* (London: MacMillan & Co., 1943).

and physical connections to neighbouring dwellings were already being discussed within the other themes. Since it was the organisational characteristics rather than the type per se that was of interest, it proved more useful in terms of establishing the relevant spatial characteristics to remove typological distinctions from the analysis.

The design analysis is presented in a series of architectural diagrams. These diagrams combine elements of architectural drawings (plans, sections and elevations), with observations made on site and measured analyses carried out from the drawings. They form the basis of short analyses on each identified theme which is then followed up by a longer discussion on the spatial observations drawn together for each index. Photographs of the schemes are also used to describe the spatial characteristics. These were taken on site visits, during the day on both week days and weekends, as far as possible in fine weather and therefore depict the activity apparent at the case study locations.

Choice of Case Studies

In the previous chapters case studies have been used to demonstrate conceptual approaches towards density and the application of different ways of thinking about density to the design process. These case studies have generally been projects regarded as exemplars of design in one sense or another. However, in practice the initiative to 'optimise' development densities impacts on all housing, the majority of which is not exemplary. Arguably, the design of much housing is dictated by issues of capacity, economic viability and transport accessibility (PTAL) ratings, and therefore only engages with density as a ratio measure. The qualities of density; the organisational characteristics, the experiential impact of proximity, and the density of activity, are probably not an explicit part of design considerations.

The case studies that were selected were intended to represent 'normal' housing development (in the context of London). They are therefore interesting both for the things that they do well and the qualities of density that they demonstrate, as much as they are for the things that are done badly. That is to say that in order to test the usefulness of the indices as pointers for design, it is also useful to consider examples where the qualities of density have quite possibly not been considered at all.

The case studies also represent the norm in terms of their numeric densities (again, in the context of London). This provides a means of understanding the spatial implications resulting from the pressure of numeric densities and development policies. Since the discussion in the earlier chapters focussed on density policy in London, the use of case studies in this part of the study that enable some reflection on these policies is useful. The average density for new housing completions in London in 2010 was 120 dwellings per hectare.[4] Taking this as a starting point, the case studies were chosen to demonstrate a range of formal and typological characteristics within an average density range for London. Within Bromley-by-Bow there was a large amount of housing with numeric densities consistent

A01

BOW BRIDGE ESTATE

d/ha	149
hr/ha	277
plot ratio	1.27

A02

LANSBURY

d/ha	98
hr/ha	322
plot ratio	0.86

A03

GALE STREET

d/ha	146
hr/ha	510
plot ratio	1.43

A04

LINCOLN'S ESTATE

d/ha	111
hr/ha	420
plot ratio	1.02

A05

ARROW ROAD

d/ha	88
hr/ha	458
plot ratio	0.98

B01

BOW CROSS (whole site)	
d/ha	234
hr/ha	777
plot ratio	2.02

B02

CASPIAN WHARF	
d/ha	366
hr/ha	878
plot ratio	2.65

B03

ST. ANDREW'S	
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4.1	How does site layout define opportunities for encounter and concentrate (as assemble) activity?
4.2	How does the relationship between dwellings create opportunities for ‘doorstep’ encounter?
4.3	In what ways might the architecture of the housing be described as porous?
4.4	How does the site layout affect the privacy of the dwellings?
4.5	How does proximity between dwellings and between dwellings and public space potentially affect the privacy of the dwellings?

Left

Table 4: Framework for testing indices of communality

Right

Table 5: Framework for testing indices of proximity

9 N. J Habraken, *Structure of the Ordinary: Form and Control in the Built Environment*, ed. by Jonathan Teicher (London: MIT Press, 1998).

10 Mulholland Research and Consulting, *'Perceptions of Privacy and Density in Housing'* (Design for Homes and Popular Housing Research, 2003), 2. Note that the study defines four ways in which privacy is experienced or impacted: visual, acoustic, adequate space and security. The final two have been summarised into one category of spatial privacy.

of communality. (Table 3 sets out the indices of physical densities, and the conditions and qualities against which they will be appraised).

Communality

The indices of communality are intended to draw attention to the organisational characteristics of density. It is assumed that higher density ratios necessitate collective structures for housing development and by extension, communal spaces, utilities and services. In this way, density has a significant socio-spatial impact, and further to Habraken's notion of hierarchies of dominance, impacts on the autonomy and capacity of individuals and groups to affect change in the urban environment in which they live.[9]

The index of collective structure is proposed as a means of identifying the implications of the building's structure on the organisation of individual dwellings relative to one another. The index of communal space considers how the site and residential accommodation is organised around communal space and how integral shared spaces are to the organisation of the building. In this way it is concerned with the effect that the communality that arises out of density has on the way the residential environment is perceived and inhabited. Two aspects of the site layout are considered: one is the organisation of the buildings around communal outdoor space. This is taken as one of the key organisational characteristics associated with density. The other is communal space within the building and how that is used to supplement the space provided within the dwelling itself.

The index of communal utility comes from the Modernist notion that the collective, multi-dwelling structure would generate the physical proximity and rationality of structure that would enable the provision of domestic technologies for every dwelling. The discussion will consider how utility is integrated into the collective structures (where they are present amongst the case studies) and how it impacts on the organisation of the site. (See Table 4 for framework questions).

Proximity

The indices of proximity consider how aspects of physical density and organisational density impact on the experience of density; characterised by the conditions of proximity it generates. The index of encounter is considered in terms of two primary factors. Firstly, it will consider the impact that the site layout has on the opportunities for social encounter, both with strangers (i.e. the rest of the city), and with nearby neighbours. Secondly, it will consider the opportunities for 'door step' encounter. Given that proximity impacts most significantly at the scale of the dwelling itself, it is concerned with the opportunities that proximity creates for social interaction between neighbours.

The index of bustle is perhaps the most difficult to examine. Bustle is dependent on the presence and activities of people, yet design cannot determine use, it can only suggest, anticipate and provide opportunities for activity to take place and harness this activity. The discussion therefore considers the opportunities for bustle, created either by the

Chapter IV
Testing the usefulness of a spatial index of density

diversity of activities within and around the site, or by the articulation of the buildings themselves to create the sort of porosity depicted in Benjamin and Lacis' text referred to in the definition of these indices in the previous chapter.

In many respects, the index of privacy is at odds with the index of bustle. The presence of many people, activity and noise, in the immediate vicinity of the dwelling is counter to commonly accepted notions of privacy associated with the residential environment. Taking the model set out in the study, *Perceptions of Privacy and Density in Housing* as a starting point, three types of privacy are considered: visual, acoustic, and spatial.[10] The analysis is concerned primarily with site conditions and the relationship between the dwelling and the surrounding site. The analysis will draw on measured dimensions taken from design drawings, as well as observations made on site regarding the perceived exposure of a home, or interventions by residents that suggest problems of overlooking or on-looking. Noise issues are more difficult to apprehend from design drawings and therefore site observations are particularly useful for identifying sources of noise and understanding how this affects the residential environment. (See Table 5 for the framework for the indices of proximity).

The indices will then be discussed and potentially refined in light of the observations drawn from these case studies. The next and final chapter is dedicated to expanding a reference for designers based on the indices tested below.





A01 BOW BRIDGE	A02 LANSBURY	A03 GALE STREET	A04 LINCOLN'S ESTATE	A05 ARROW ROAD
149	98	146	111	88
277	322	510	420	458
1.27	0.86	1.43	1.02	0.98

KEY

- Dwellings per hectare
- Habitable Rooms Per Hectare
- Plot Ratio





B01 BOW CROSS	B02 CASPIAN WHARF	B03 ST. ANDREW'S	B04 NEW FESTIVAL QUARTER	B05 ABBOTT'S WHARF
234	366	320	254	329
777	878	964	728	881
2.02	2.65	2.76	2.61	2.99

Figure 1.1: Numeric densities for the case study schemes

Testing the indices

Numeric Densities

	Bow Bridge	Lansbury	Gale Street	Lincoln's Estate	Arrow Road	Bow Cross	Caspian wharf	St. Andrews	New Festival Quarter	Abbotts Wharf
	A01	A02	A03	A04	A05	B01	B02	B03	B04	B05
Plot ratio	1.27	0.86	1.43	1.02	0.97	2.02	2.65	2.76	2.61	2.99
Dwellings d/ha	149	98.4	146	111	88	234	366	320	254	329
Habitable rooms hr/ha	454	323	510	379	458	777	878	964	728	881
Site Area (ha)	2.35	1.23	0.56	1.5	0.91	1.83	1.14	3.01	1.93	0.61

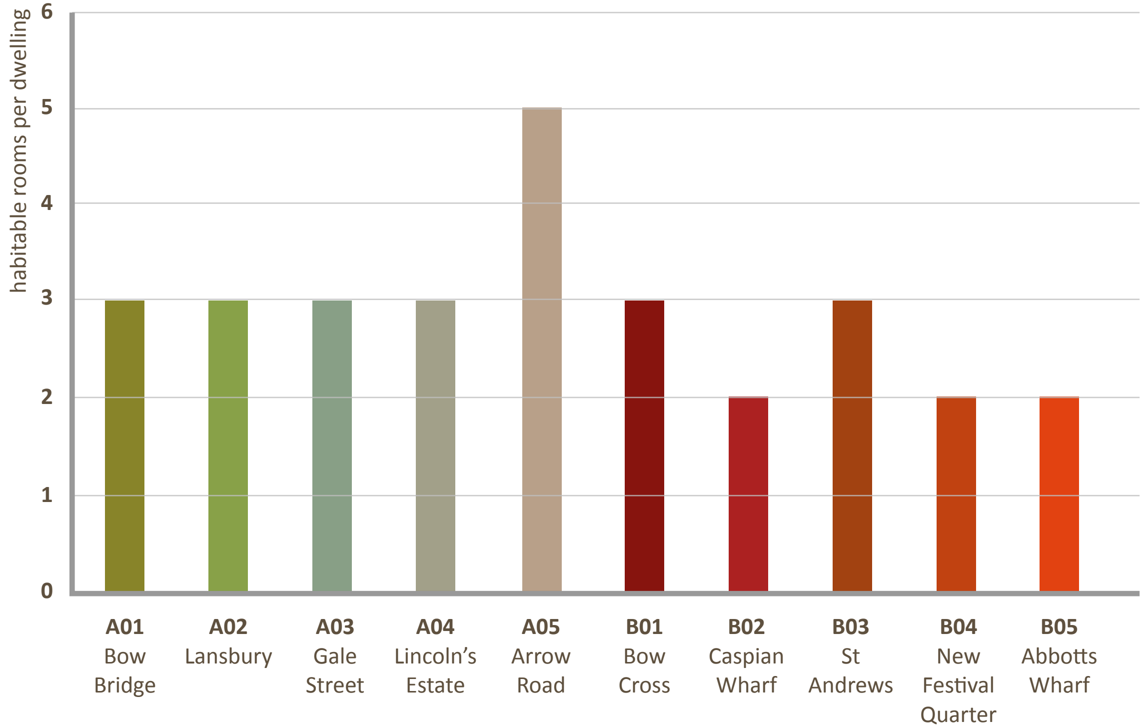
Numeric densities for the case study schemes

1.1

The two groups of case studies were selected to represent average and higher numeric densities in relation to new urban housing development in London.

In terms of their dwelling densities, habitable room densities, and plot ratios the higher density schemes are between two and three times higher than the lower density schemes. It is anticipated therefore that the higher density schemes might be more affected by the compromises and limitations associated with the typologies that can generate these densities, and also the open space and car parking provision.[11]

11 Maccreanor Lavington Architects, Emily Greeves Architects and Graham Harrington Planning Advice, *'Housing Density Study'* (Greater London Authority, 2012).



1.2

The case studies do ratify the trend observed by Bowie and Collins and Clarke, for smaller dwellings in terms of number of rooms at higher habitable room and dwelling densities. The difference in the size of the dwellings (in terms of number of rooms) between the case studies potentially has implications for the way that the dwellings are organised on the site and will therefore be considered in terms of the densities 2.3: built form and 3.1: collective structure.

Figure 1.2: Graph showing the average number of habitable rooms per dwelling in the case study schemes

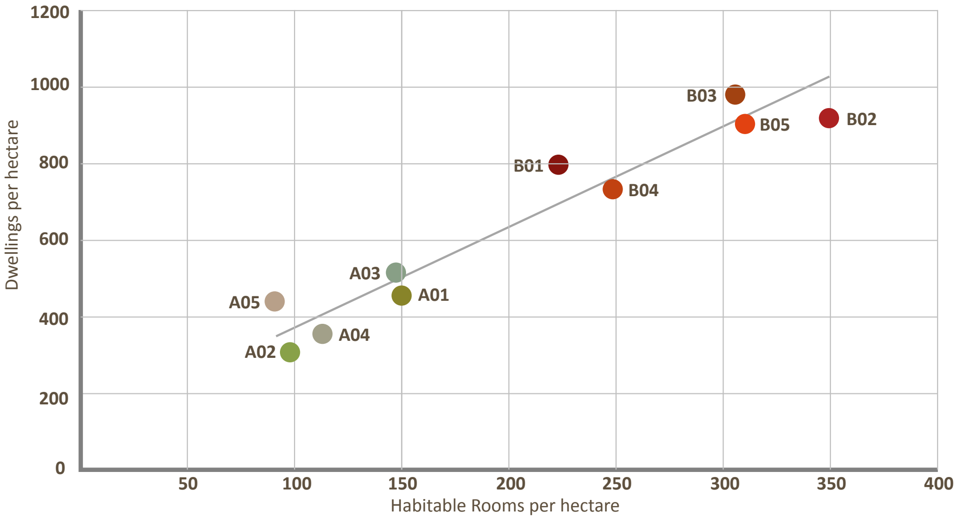


Figure 1.3a: Dwelling densities in relation to habitable room densities

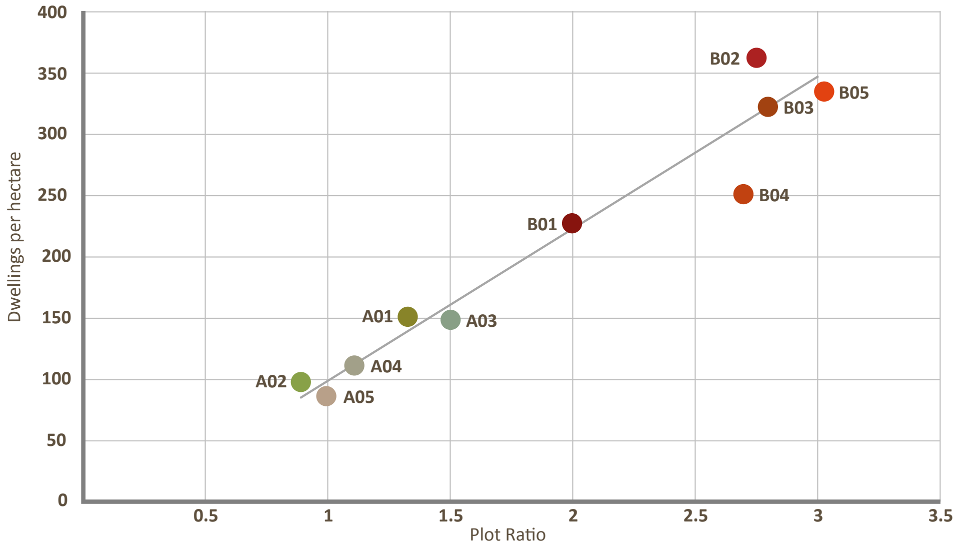


Figure 1.3b: Dwelling densities in relation to plot ratios

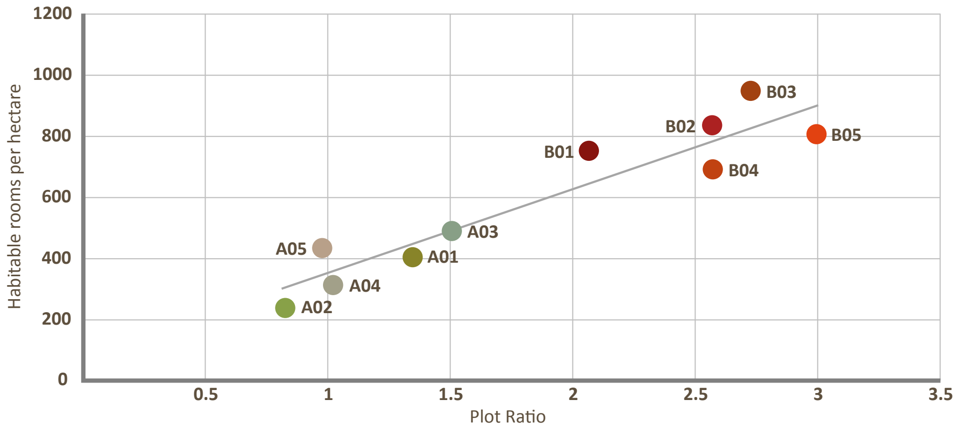


Figure 1.3c: Habitable room densities in relation to plot ratios

1.3

Figure 1.3a shows the dwelling densities plotted against the habitable room densities for each of the case studies. The graph shows a strong general correlation between dwelling and habitable room densities across the schemes. Figure 1.3b and Figure 1.3c further show a correlation between dwelling and habitable room densities and plot ratio. In all cases, in as much as these figures can be used to demonstrate a trend, the trend is stronger amongst the lower density schemes. Regarding the relationship between dwelling and habitable room densities and plot ratios, this is more reliable in the lower density schemes since none of the lower density scheme includes any non-residential floor space. Amongst the higher density schemes, there are gymnasiums (St. Andrew's B03), community facilities (Bow Cross B01) and shops (Caspian Wharf B02 and New Festival Quarter B04). At NFQ (B04) a significant amount of the site area is occupied by car parking podiums that contribute to the plot ratio, but not to the habitable room or dwelling densities. These alternative land-uses occupy part of the measured built mass of the scheme, without contributing additional dwelling units and would therefore tend to create a higher than expected plot ratio or lower than expected density of dwelling units. Caspian Wharf (B02) has a higher density of dwellings than would be suggested by the plot ratio, in spite of a large area of commercial floor space and parking and this indicates that the average size of the dwellings within the scheme is small which increases the density of dwellings relative to the plot ratio.

For the lower density case studies, however, these charts seems to show that dwelling densities and habitable room densities can be taken as a reasonable guide of the plot ratio and therefore the amount of development on a given site. It does not however, suggest that they can be used as an indicator of the built form. Amongst the lower density schemes there is significant variation in the built form of schemes with very similar plot ratios.

KEY

- A01 - Bow Bridge
- A02 - Lansbury
- A03 - Gale Street
- A04 - Lincoln's Estate
- A05 - Arrow Road
- B01 - Bow Cross
- B02 - Caspian Wharf
- B03 - St Andrews
- B04 - New Festival Quarter
- B05 - Abbotts Wharf

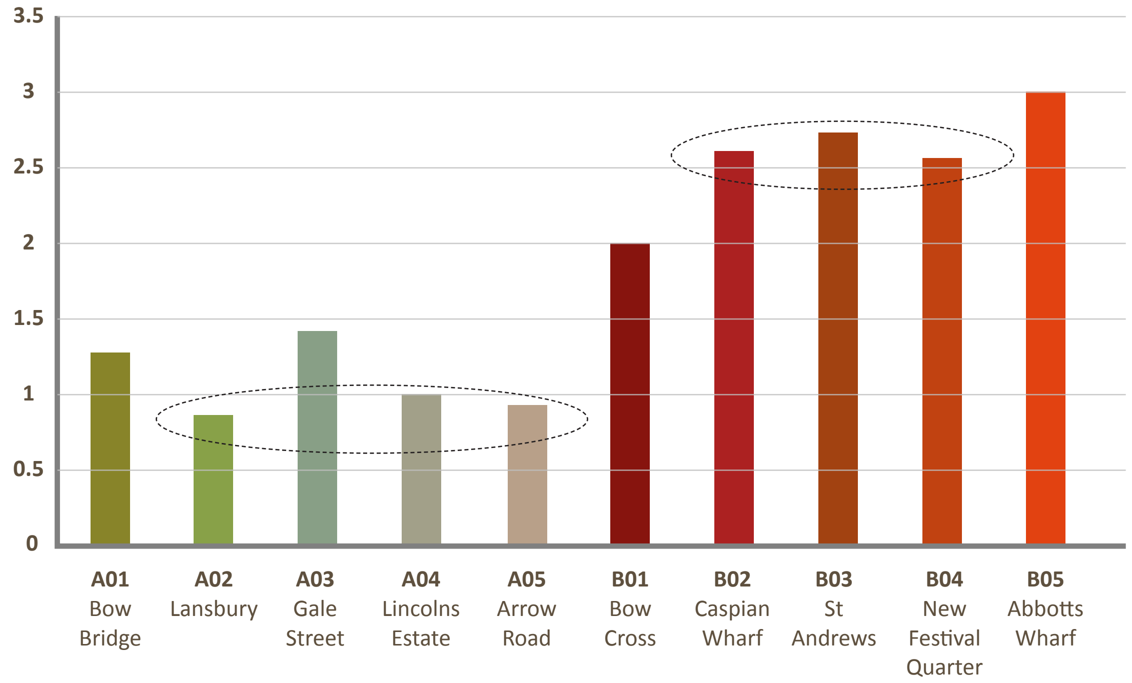


Figure 1.4: Plot Ratios of the case studies

Group 1: Plot ratio c.0.8


A02 Lansbury


A04 Lincoln's Estate


A05 Arrow Road

Group 2: Plot Ratio c.2.6


B02 Caspian Wharf


B03 St. Andrew's


B04 New Festival Quarter

KEY

- A01 - Bow Bridge
- A02 - Lansbury
- A03 - Gale Street
- A04 - Lincoln's Estate
- A05 - Arrow Road
- B01 - Bow Cross
- B02 - Caspian Wharf
- B03 - St Andrews
- B04 - New Festival Quarter
- B05 - Abbotts Wharf

1.4

The bar chart shown in Figure 1.4 demonstrates:

a) that grouping the case studies by plot ratios creates different groups than by dwelling or habitable room density.

b) amongst the lower densities the grouped schemes share few physical characteristics, however, the higher density schemes, B02, B03 and B04, that have very similar plot ratios are also similar in terms of the building height, site massing and organisation of the building and dwelling floor plans.

Whilst it is not possible to use these charts for quantitative analysis – there are neither enough case studies, nor a rigorous enough determination of anomalies within the sample of case studies- they do make some interesting suggestions. The principle that plot ratio could indeed become more accurate as a descriptor of built form at higher plot ratio densities is an interesting one and the analysis of the remaining nine indices of density will be used to challenge and further elaborate on this proposition.

Discussion

The numeric indices of dwelling density, habitable room density and plot ratio are intended to provide a representation of the economic factors underpinning the development of the site, as well as a scale against which to consider the other proposed indices.

There are suggested trends that can be taken from the numbers themselves, but this discussion will be much more insightful once the other indices have been considered.

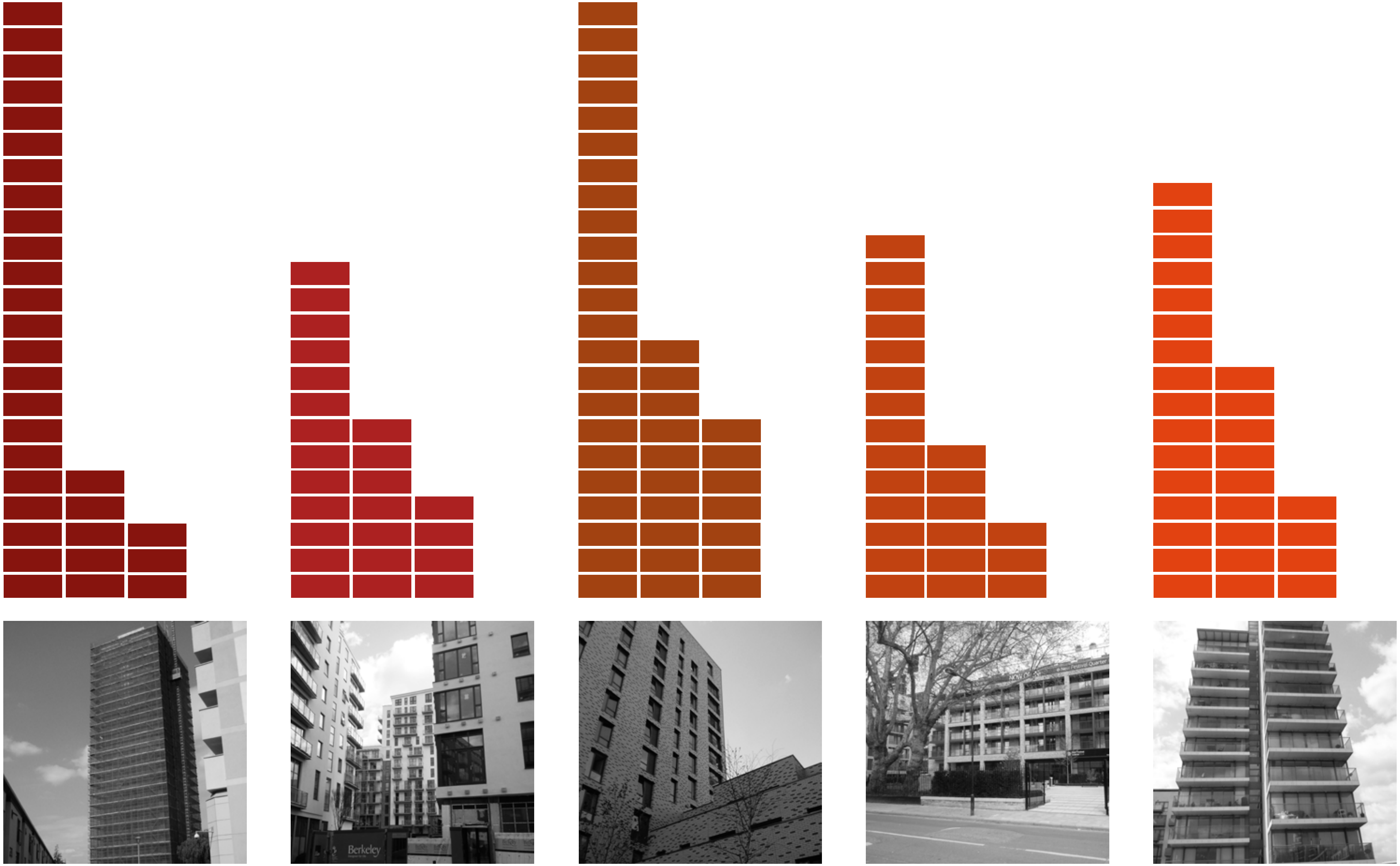
A01 - Bow Bridge

A02 - Lansbury

A03 - Gale Street

A04 - Lincoln’s Estate

A05 - Arrow Road



B01 - Bow Cross

B02 - Caspian Wharf

B03 - St Andrews

B04 - New Festival Quarter

B05 - Abbotts Wharf

Figure 2.1.1: The building heights of the case studies

	Bow Bridge	Lansbury	Gale Street	Lincoln's Estate	Arrow Road	Bow Cross	Caspian wharf	St. Andrews	New Festival Quarter	Abbotts Wharf
	A01	A02	A03	A04	A05	B01	B02	B03	B04	B05
Site Coverage (%)	24.4	26.6	23.7	25.4	48.1	23.7	29	44.4	49.4	34
Building Height (storeys)	4-6	3-4	6	4	2-3	3-25	7-13	7-25	3-14	4-13
Floor Plan Depth (m)	7.5 – 8.5	9.4 & 10.1	7.4	9.2	10	9 & 17	23.7	15	10 & 16	15

Figure 1.1.0: The building heights, site coverage and plan depth dimensions for the case studies

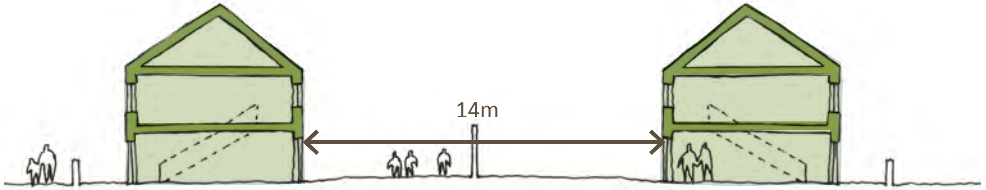
2. Physical Densities

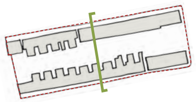
2.1 Building Height

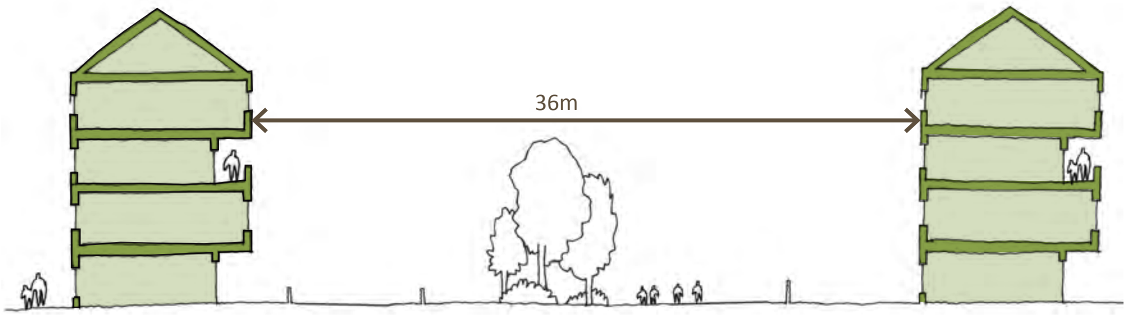
2.1.1 Building height and numeric densities

There is a clear difference between the heights of the buildings in the two groups of case studies. The lower density case studies have building heights between two and six storeys. Amongst the higher density case studies the average building height was more than eight storeys, demonstrating an apparent correlation between the height of the buildings and the density ratio.

There is also more variation in the height of the buildings in the higher density schemes. All of the higher-density schemes had at least one building or part of a building that is significantly taller than the other buildings on the site (i.e. a tower element). At Caspian Wharf (B02) and Abbott's Wharf (B05) the maximum height is 13 storeys, at Bow Cross (B01) and St. Andrew's (B03) the tallest building is 25 storeys which contributes significantly to the numeric density of the site. Since Bow Cross (B01) has the lowest density ratio of the higher density schemes, it also demonstrates that height is not per se a direct cause of density, but as suggested in the analysis in the previous chapters, can be part of an urban strategy. Therefore it is important to consider the heights of the buildings in relation to how the heights of the buildings are perceived, and design strategies that might have been used to break down the scale of the building mass.







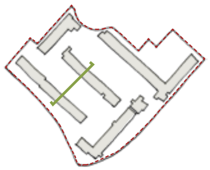
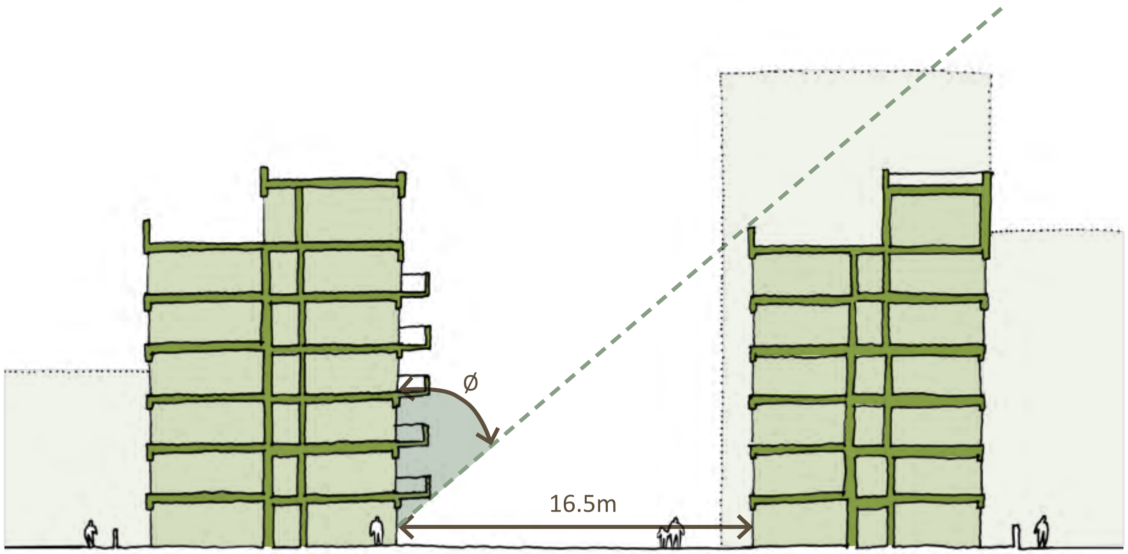


Figure 2.1.2: A05 Arrow Road and A04 Lincoln's Estate – building height versus separation

At Lincoln's Estate, the buildings are separated by a distance of 35 metres, compared with 15m at Arrow Road.

2.1.2 Building height and massing

In the lower-density and lower-rise case studies there was more evidence of building height being a product of design intent rather than a necessity of numbers. In massing terms, the increase in height from two storeys at Arrow Road to four at Lincoln's Estate for instance is off-set by a doubling of the distance between opposite-facing buildings and a significant increase in the set-back of the buildings from the street. The numeric density of Lincoln's Estate could have been achieved with lower-rise buildings. Therefore the height is considered to be part of the spatial strategy for the site.



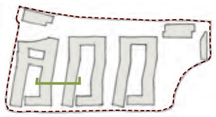


Figure 2.1.3: St Andrews (B03) Building height, Separation distance and Vertical Sky Component (VSC)

The Vertical Sky Component is the index generally used to determine adequate daylight levels for new residential developments.

Ø > 65°	conventional window design will normally provide adequate daylight
45 ° < Ø < 65°	larger windows or special design consideration will be needed
Ø < 45°	difficult to obtain adequate daylight levels

At St. Andrew's Ø is between 41° and 45°, suggesting that the height of the buildings is the maximum that it could be without allowing greater distances between the buildings. *Source for VSC calculations: Paul Littlefair, Site Layout Planning for Daylight (Bracknell: BRE, October 2012), IHSTI.*

2.1.3 Building height, daylight and privacy

At St. Andrew's (B03), the distance between the buildings would appear to have been determined by the minimum separation distances required for privacy between the facing buildings. As the sketch shows the building height is the maximum that it can be, with a separation distance of approximately 16.5m which ensures the minimum required daylight for the ground floor dwellings. However, meeting the required daylight levels at ground floor does require larger windows to be used which potentially impacts on the privacy - particularly of the ground floor dwellings and begins to suggest that the pressure to achieve a high density ratio can affect the experiential qualities of the dwelling environment.

Figure 2.1.4: Site strategy and the perception of height.

Bow Bridge (A01)

Gale Street (A03)

Caspian Wharf (B02)

New Festival Quarter (B04)

2.1.4 Reducing perceived building height

Gale Street (A03) demonstrates the impact that site strategy can have in alleviating the impact of building height. The impact of the relatively tall buildings (six storeys) on the narrow street in front of the buildings is mitigated by the set back between the buildings and the road. The rear façade is also shown, with the buildings seen from across the park. When compared with the elevation at Bow Bridge (A01), it shows that the perception of height is much greater where the buildings are closer to the site edge.

Amongst the higher density schemes, however, there were fewer instances of the buildings being significantly set back from the site edge. Where the buildings are set back, as at New Festival Quarter, it can be seen that the impact of the six storey height is again, less than at Bow Bridge (A01) where the buildings are closer to the edge of the street. At Caspian Wharf (B02) although the tallest parts of the site have been set back away from the street, the buildings along the street edge are between four and nine storeys. The designers have set back the upper two floors, however, lessening the perceived height of the buildings to five storeys in these places, but the height impacts on the intensity of the street itself far more than at Gale Street where the buildings are set back.

2.1.5 Mitigating perceived height

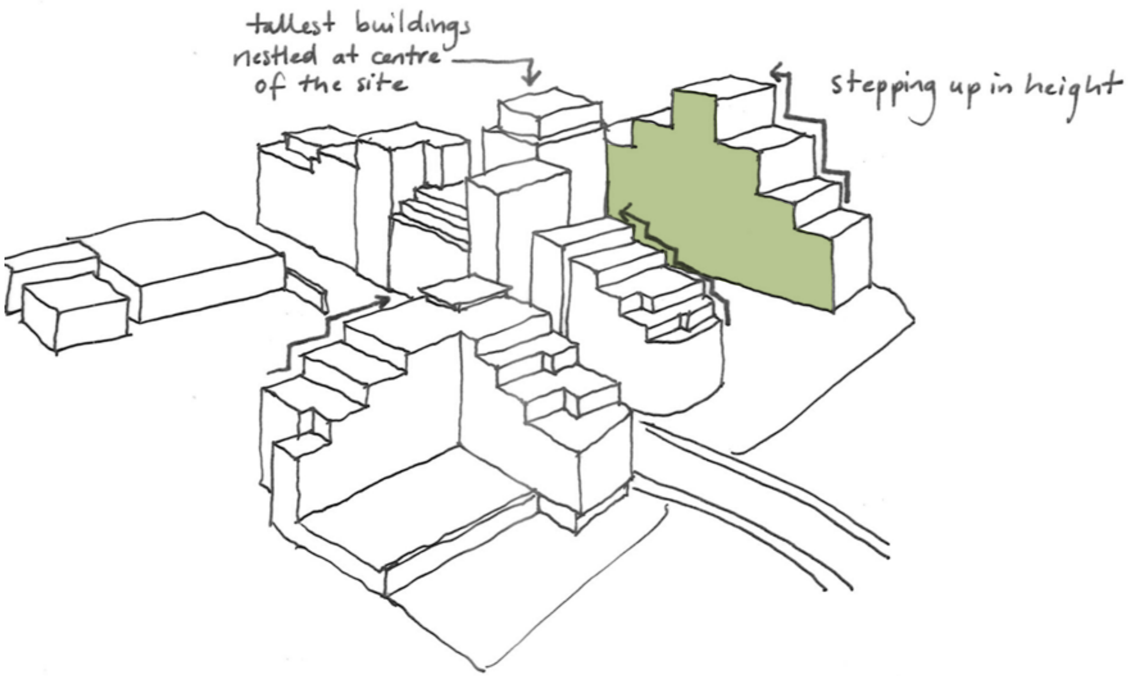


Figure 2.1.5: Caspian Wharf (B02) Sketch showing stepping of building height to reduce perceived scale of buildings

There are a couple of interesting points to note about the massing strategy at Caspian Wharf (B02). The precedent for the height of the buildings is taken from the existing warehouses and Wharfs along the canal edge. The height of the buildings is then stepped up from four storeys at the canal edge, to a maximum of nine storeys along the street. The height is stepped up again away from the street and away from the canal to a maximum of 13 storeys at the centre of the site. Although it exceeds the maximum limits that he prescribed, the massing reflects the rules set by Alexander *et al* for mitigating the perception of height, by never allowing a building to exceed the height of its neighbour by more than one storey.[12]

The building façade is also articulated to suggest that the site might comprise a terrace of separate buildings as opposed to one continuous mass which helps to reduce the perceived scale of the site overall. The stepped heights also reduced the impact of overshadowing, allowing it to fall over the rooftops of the adjacent, lower parts of the block.[13] However, as the view into the site (second photograph Caspian Wharf Figure 2.1.4) shows, where the full height of the building is visible it is very difficult to affect the perception of scale and density through design.

12 Christopher Alexander, Sara Ishikawa and Murray Silverstein, *A Pattern Language: Towns, Buildings, Construction* (Oxford University Press, 1977).

13 Stepping up the height of the building mass towards the centre of the site whilst maintaining heights equivalent to the surrounding buildings at the edge of the site is described as 'Place Shielding' –. Maccreanor Lavington Architects et al., *'Housing Density Study'.*

2.1.6 Concealing upper floors

In regards to the perceived height of the buildings, the attic storey of the houses at Arrow Road (A05) and Bow Bridge (B01) suggest a strategy for providing additional floor area of the building without increasing the perceived height of the buildings. It is also useful since, as was noted in chapter two, attic space that is not part of the designed floor area of the building (as at Arrow Road) is not counted as part of the plot ratio as an additional storey would be.

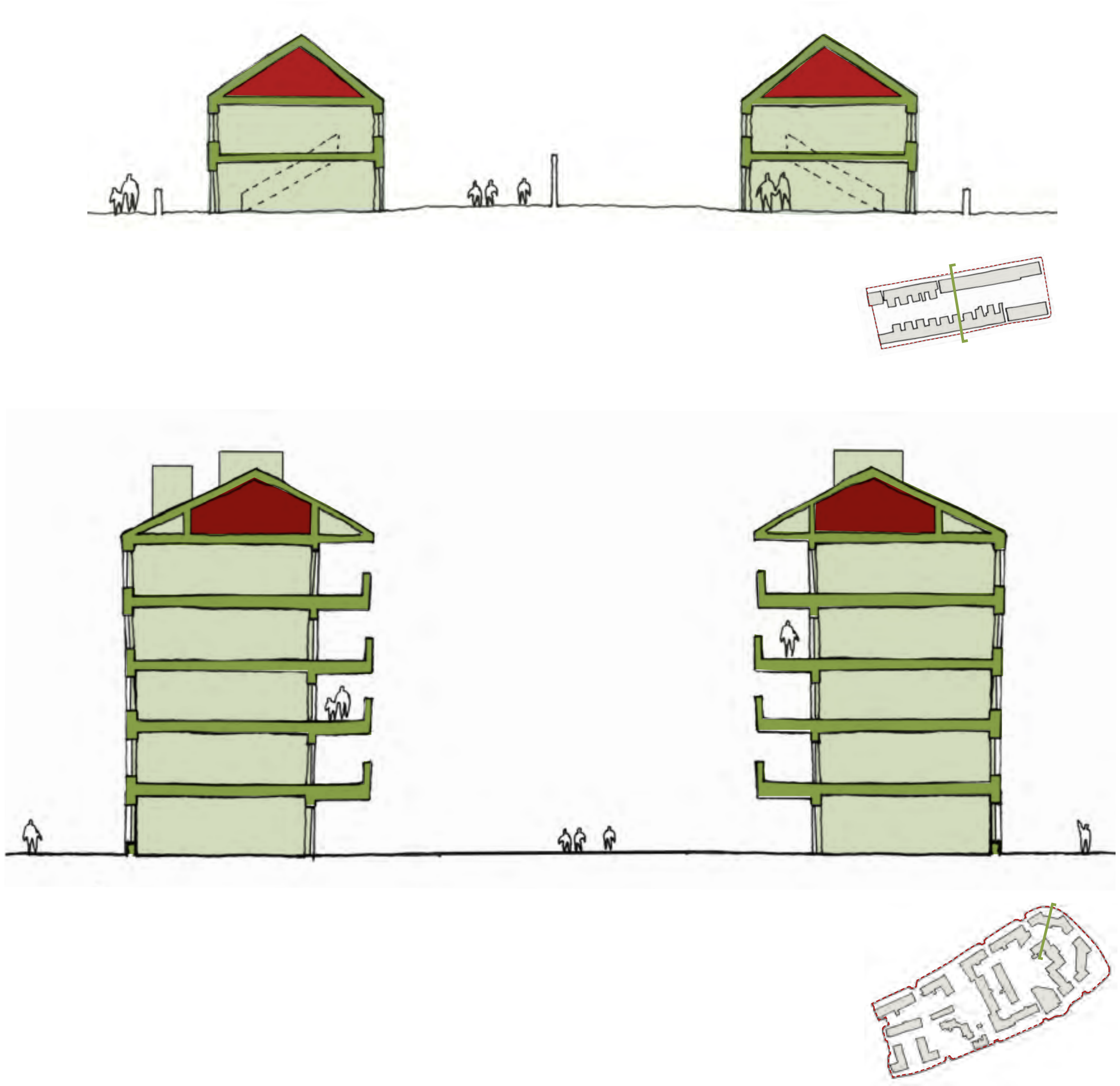


Figure 2.1.6: Arrow Road (A05) and Bow Bridge (A01): Attic Space – additional space without the increased impact of height

KEY:

- Attic space

Building Height: discussion

The increase in plot ratio between the two groups of case studies coincided with a shift both in the physical height of the case study buildings and the impact of the height on the perception of scale and capacity.

As far as the relationship between site strategy and the perception of height was concerned, the case studies demonstrate that distance between the building and the street or between facing buildings does mitigate the impact of the building height. However, other design strategies were also demonstrated to have an impact on the perceived scale of the buildings.

The discussion in the previous chapter situated the perception of scale in terms of ideas about monumentality, which, as Koolhaas proposed, attaches itself to a building as soon as it reaches a certain physical size. There is no cut and dry rule about what that size is, but the case studies do seem to support the idea that the perception of it might be helpfully affected by site massing strategies, such as stepping building heights and limiting views of the building in its full extent, except where there is a adequate distance in front (the park at Gale Street, for instance) to mitigate the effect of the building's physical height.

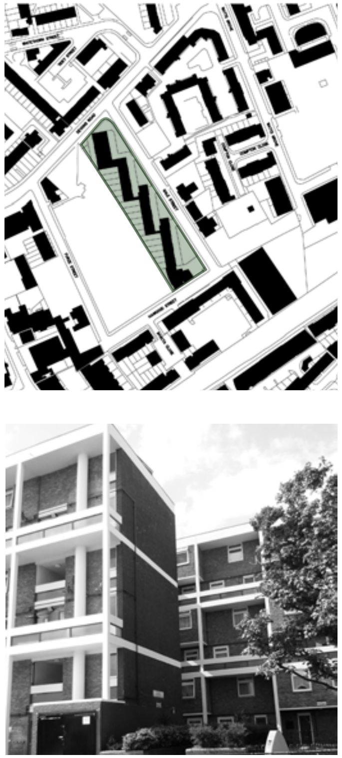
2.2 Site Coverage

2.2.1 Figure ground analyses

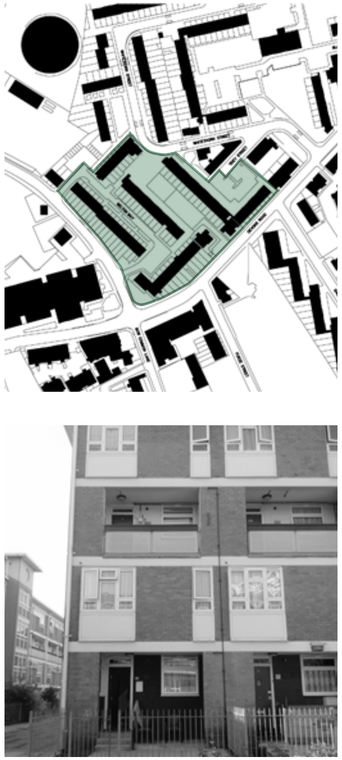
None of the figure ground plans for any of the case study schemes reflect the intensity of the built fabric of Parma that Rowe and Koetter used as their exemplar. However, when considered in relation to the reality of the spaces they represent, they do begin to suggest some factors that add to or mitigate the perceived intensity of the built fabric. One is the relationship between the height of the buildings and the width of the streets and spaces in between. This was considered above in relation to the impact that it has for the perception of the height of the buildings. Another factor is the continuity of the building and the extent to which open spaces are enclosed.

A01 - Bow Bridge

A02 - Lansbury



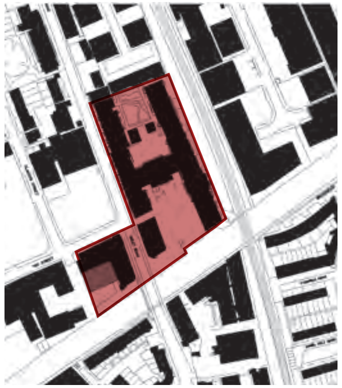
A03 - Gale Street



A04 - Lincoln’s Estate

A05 - Arrow Road

B01 - Bow Cross



B02 - Caspian Wharf

B03 - St Andrews

B04 - New Festival Quarter

B05 - Abbotts Wharf

Figure 2.2.1 : Figure Ground plans for the case study schemes

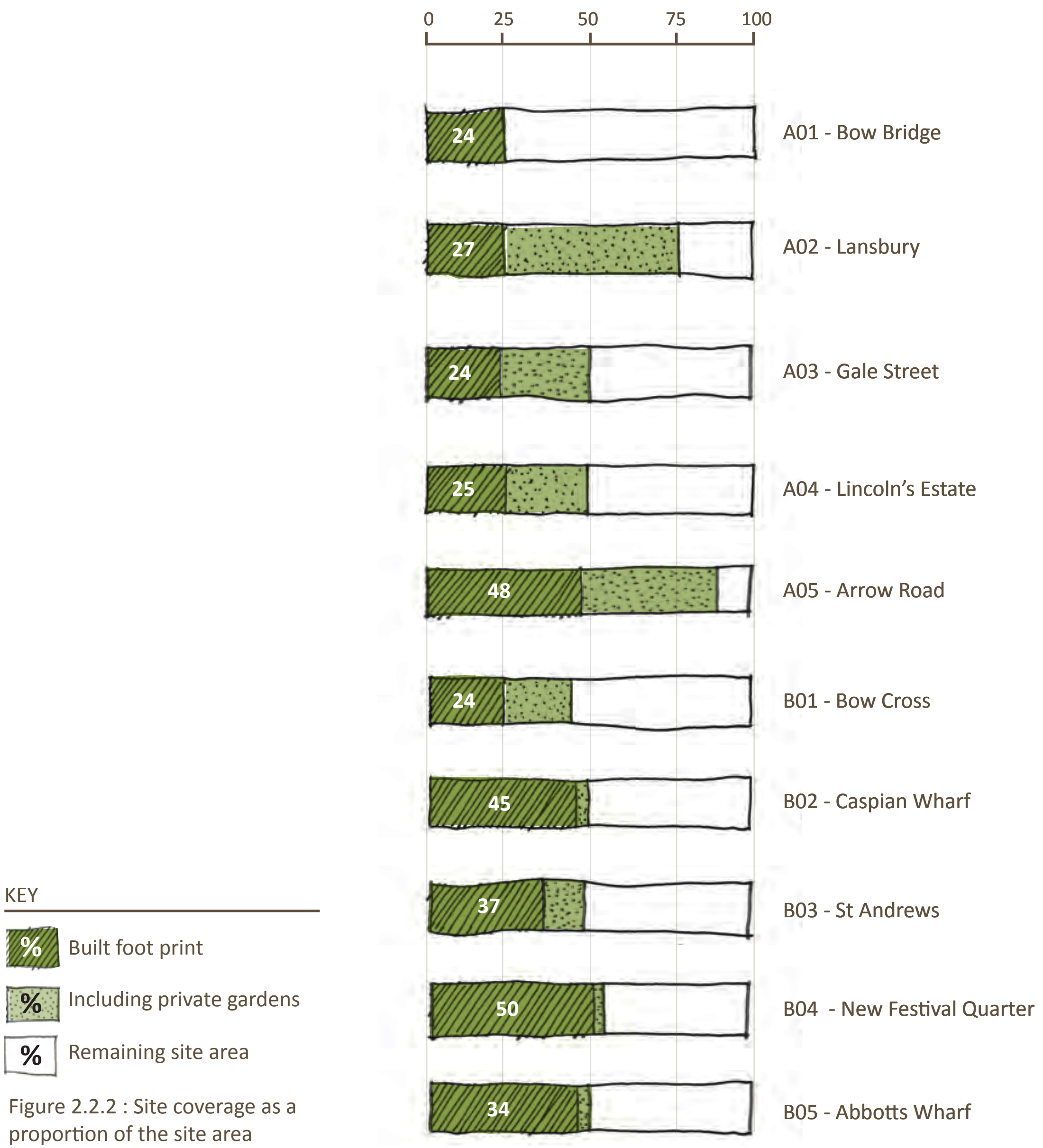


Figure 2.2.2 : Site coverage as a proportion of the site area

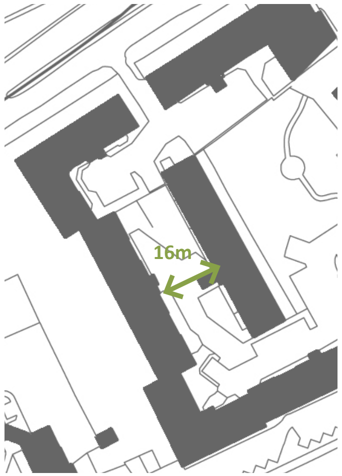
2.2.2 Site coverage ratios: what they show

In terms of the measure of site coverage, the higher density schemes generally have a higher proportion of site coverage than the lower density schemes. However, the schemes (from both groups of case studies) with high site coverage ratios warrant specific consideration.

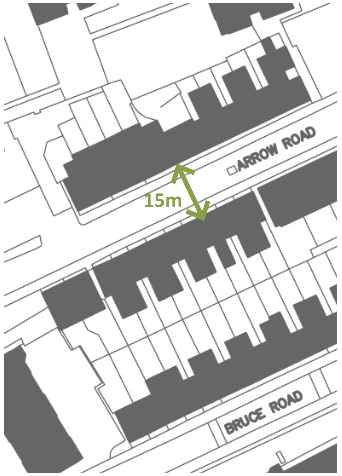
Arrow Road [A05] showed almost 50 per cent site coverage compared with around 25 per cent in the other case studies in that group. When private gardens are taken into account, the site coverage at Arrow Road is almost 90 per cent. In part this reflects the way in which the site area is defined. In the terraced street layout, the primary circulation spaces are public and therefore do not constitute part of the site area, whereas in the estate layout at Lincoln's Estate large parts of the site area (50 per cent) is dedicated to footpaths, car parks and open space.

Amongst the higher density schemes, Caspian Wharf and New Festival Quarter both had very high site coverage ratios. In both cases, this can be attributed in part to the semi-basement car parks that occupy the centre of a number of the blocks on the site, with residents' gardens above. These are shown in grey on the figure ground plans (Figure 18) as they do not contribute to the perceived intensity of the urban fabric as they would if their footprint was extruded to the height of the buildings around it.

2.2.3 Height, width, enclosure and intensity



Bow Bridge (A01) – 16m



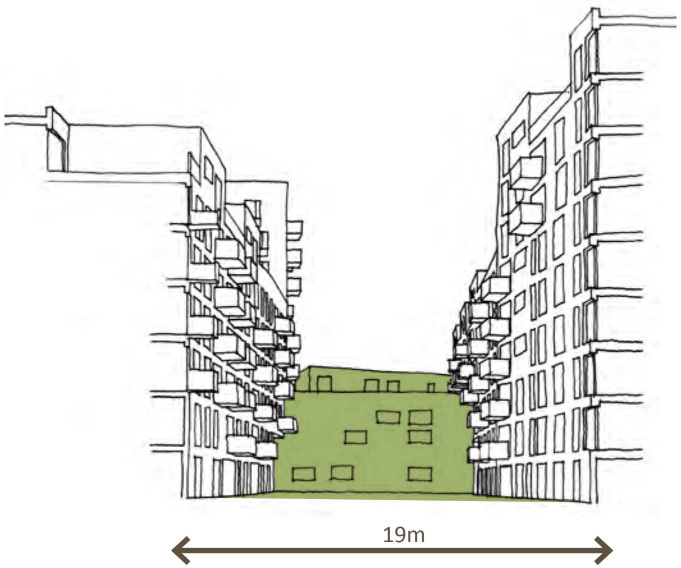
Arrow Road (A05) – 15m

St. Andrew's (B03) – 16.5m

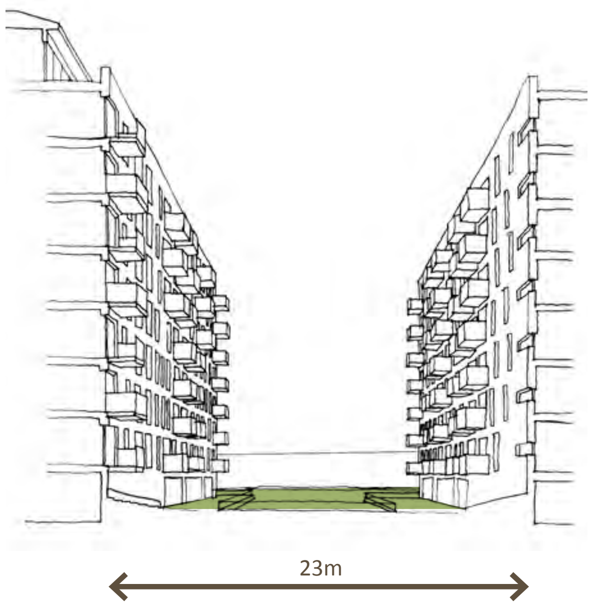
Figure 2.2.3: Three spaces with equivalent distance but different qualities of density: figure ground plans and photographs of the space dimensioned.

Comparison between these three spaces highlights the impact of building height. The increase in the height of the buildings from two storeys at Arrow Road to five storeys at Bow Bridge and seven storeys at St. Andrew's significantly changes the experience of the street at 16 metres wide. However, the spaces at Bow Bridge and at St. Andrew's also differ in the way that the space is enclosed in the first example and open in the second one. The open-ended street layout at St Andrew's creates a view out, whilst at Bow Bridge, the space is enclosed. The suggested relationship between 'intensity' as Unwin defined it – as the condition that would occur if all of the people emptied out of the buildings all at once – and the experience of density was premised on the relationship between the perceived amount of building, and the area of open space available. In the Bow Bridge and St. Andrew's schemes the ratio is relatively comparable, yet the enclosure of the space at Bow Bridge exacerbates the sense that the scenario that Unwin depicts would be more intense in this space than in the street. In the street there is at least the possibility that the people might spill out, around the corner.

Figure 2.2.4: The courtyards at St. Andrew's (B03) and Abbott's Wharf (A05)



St. Andrew's (B03) – 19m



The wharf at Abbott's Wharf (A05) – 23m

2.2.4 Enclosure and overlooking

The effect of enclosure on the perceived intensity is also apparent in the comparison between these two higher density schemes. In both examples the ratio between the building height and the distance between them is approximately 1:1. In both cases there are many windows along each façade suggestive of the capacity of the buildings. However, in the St. Andrew's example the space is enclosed, whilst in the Abbott's Wharf scheme the space is open to the canal running along the edge of the site. The openness of the site appears to have a significant effect on the perceived intensity of the site and suggests that the layout of the massing on the site to create long views out of and through the site can alleviate the sense of enclosure and perceived intensity of the site.

Site coverage: discussion

The analysis of the amount of ground coverage [Figure 2.2.2] highlighted the need for qualitative analysis for understanding the impact of site coverage on the perceived intensity and capacity of the site. The numbers suggested that Arrow Road would have an intensely built-up urban fabric, yet the perception of intensity in the streets at Arrow Road tell a different story. The relationship between the width of the streets and the heights of the buildings limited the perception of intensity compared with the sites where the ratio of building height to street width was greater.

In addition, the visibility of the mass of built form and the open space around the building potentially impacts on the perceived scale of the buildings.

The enclosure of the spaces between the buildings was also apparent as a factor affecting the perception of intensity. Whilst the theoretical discussion in the previous chapter had suggested that the relationship between building height and street width might affect the perception of the site intensity, the experience of different spaces within the case study schemes suggested that the openness of the spaces in between the buildings also impacts on the perception of how densely built up the space it. This suggests that the connectivity of the built form, but more importantly, views through the site are an important design consideration for mitigating the perception of density.

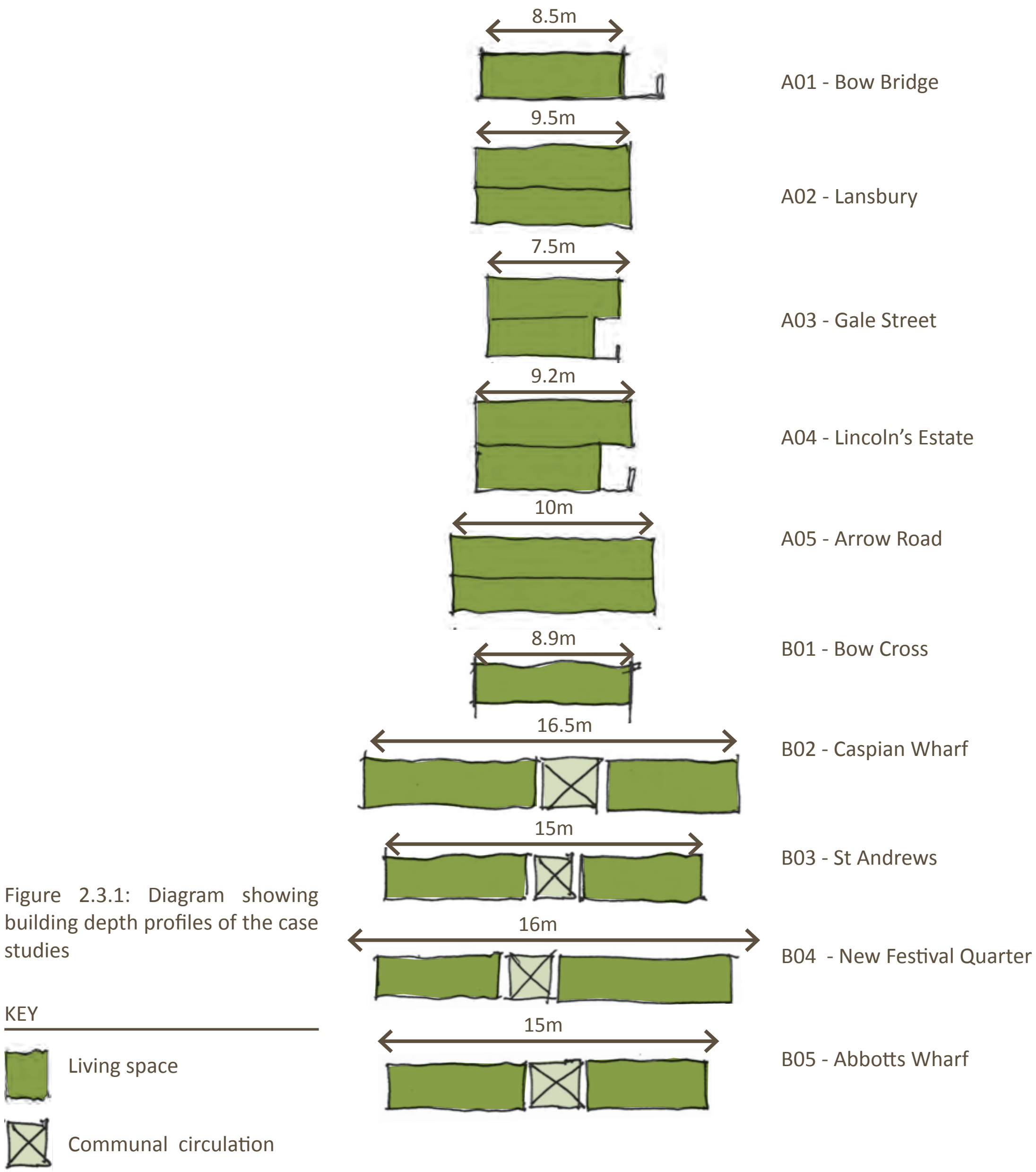


Figure 2.3.1: Diagram showing building depth profiles of the case studies

2.3 Built Form

2.3.1 Physical dimensions of building bulk

The physical dimensions of the building bulk, particularly the plan depth are generally larger amongst the higher density case studies. This affects the density ratio of the site as well as the perceived scale of the buildings. Between the two groups of case studies, there is an increase in the depth of the building plan from around eight metres in the lower density case studies, to 15 or 16 metres in the higher density case studies. The difference is the increase from one dwelling in depth, to two.

The deeper floor plans of the higher density schemes is comprised of two dwellings, either single aspect or corner aspect, with an internal access corridor between the two apartments - as indicated in the sketch sections Figure 2.3.1.[14]

14 'Single aspect' refers to dwellings that have windows in only one elevation. 'Corner aspect' dwellings have windows on two elevations at right angles to another. These are distinguished from 'dual aspect' dwellings that have windows on two facades opposite (normally parallel) to one another. It should also be noted that the recently published Housing SPG states that single-aspect dwellings should generally be avoided where possible and north-facing single-aspect dwellings should not be permitted at all. Greater London Authority, *'Housing Supplementary Planning Guidance'* (Greater London Authority, 2012)

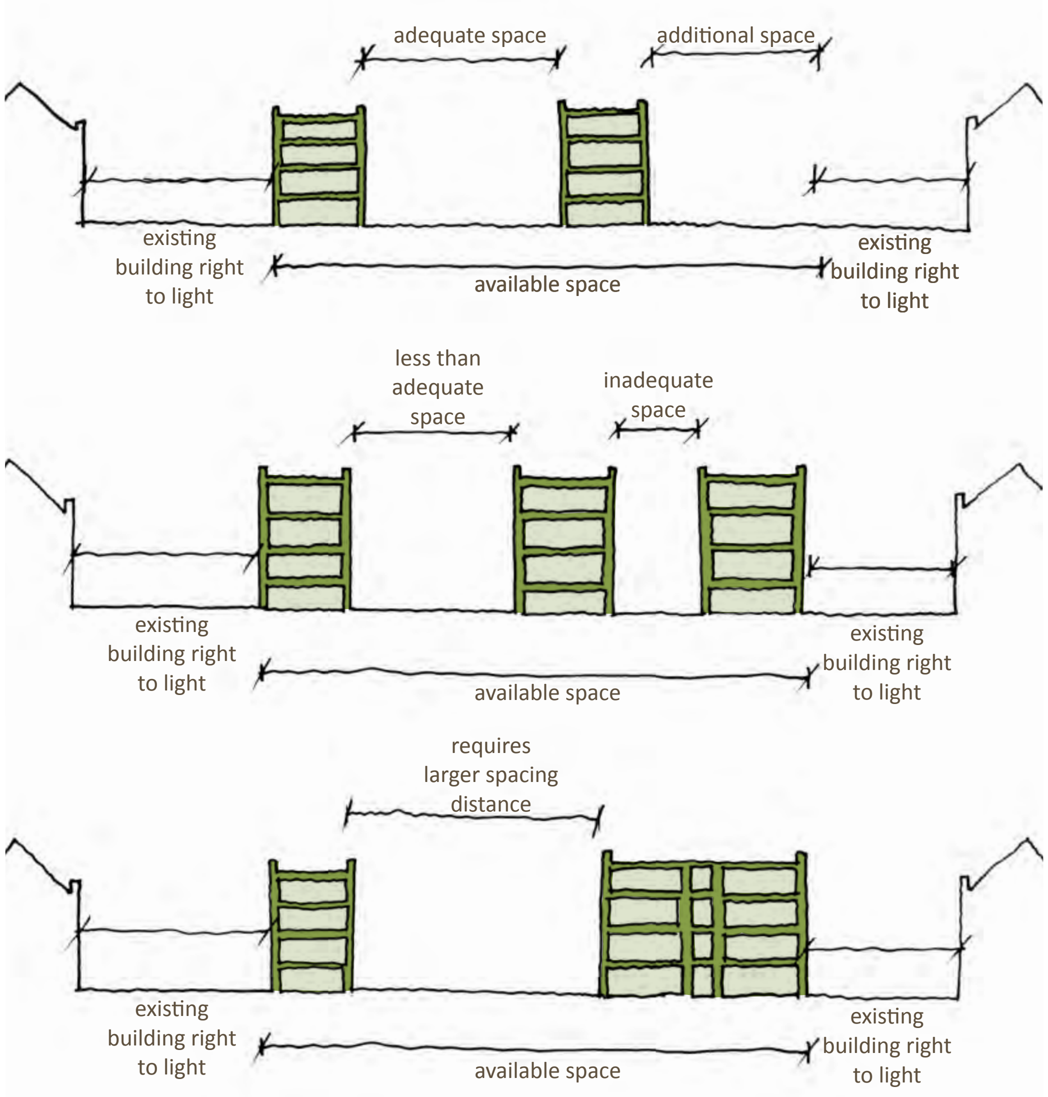


Figure 2.3.2: Diagram showing the principle of dual-aspect as a means of making more effective use of the site area

2.3.2 Dwelling layout and dimensions of built form

The single-aspect-with-internal-access layout eliminates the in-between distance that would be needed between two blocks of dual aspect dwellings. Whilst this generates efficiencies in terms of the use of the site area, it also has implications for the building mass, articulation of the façade, the privacy of the dwelling and the relationship between the dwellings themselves (although these final two matters will be considered in relation to the later indices of proximity).

The notion that built form affects the perception of density is based on how visible the building mass and how it impacts on the space around it. Amongst the case studies with the deepest plans, the extent of the building plan depth was rarely apparent.[15] However, the deeper plan does impact on the articulation of the building facade. Single-aspect layouts as in B02, B03, B04 and B05 (see Figure 2.3.1) have no rear elevations, only fronts.

15 At Caspian Wharf, a gable end has been left adjacent to an vacant site – presumably there is an expectation that this site will be developed, therefore outlook onto the site was not permitted.

Figure 2.3.3: Built form and connectivity

Bow Bridge (A01)

Gale Street (A03)

Bow Cross (B02)

2.3.3 Outlook and visibility of the building's mass

When these indices were set out, in the previous chapter, it was suggested that the impact of the scale of the buildings was affected by the visibility of their mass.

It is also apparent that the aspect of the buildings impacts on the way buildings adjoin and therefore how they sit within the surrounding site.

At Bow Cross the tower blocks, which have aspect in four directions, are by necessity disconnected from the site around them. At Bow Bridge, the buildings are dual aspect but have their primary outlook out-over from the site. At Gale Street, the dwellings have primary aspect in both directions. The direction of outlook limits the way that the space in front of the buildings is used. One implication of this has already been considered above, which is the visibility the buildings bulk. At Bow Cross, the multi-directional outlook limits any development adjacent to the towers that would enable their height to be contextualised to some degree, for instance by using a stepped site-massing strategy as at Caspian Wharf.

Figure 2.3.4: The length of the façade and the perception of the buildings capacity.

Arrow Road (A05)

At Arrow Road each individual house can be identified by the front doors and bay windows, changes in the condition of the brick, colour of the paintwork or height of the parapet which demarcate the extent of each f

St Andrew's (B03)

Caspian Wharf (B02)

At Caspian Wharf, the length of the façade is divided into tall, narrow panels one or two dwellings wide, and each articulated with a different cladding material; brick, render or a curtain wall panel system. As a result the façade is never read as a whole, but as a series of distinct elements that could almost belong to a series of distinct buildings.

Abbott's Wharf (B05)

Ricardo Street, Lansbury (A02)

2.3.4 Physical length and perceived capacity

Both the lower density and the higher density schemes had examples of long building facades that provided a reasonable testing ground for the index of built form based on scale. The articulation of individual units within the facade or the division of the overall length, reduces the perceived scale of the buildings.

Arrow Road and Ricardo Street at Lansbury are equivalent in length (each around 135 metres). However, comparison between the two highlights the impact that the dividing elements (garden walls, cross wall parapets and chimney stacks) at Arrow Road make in mitigating the perception of the overall length of the street.

Amongst the higher density schemes, where the building facades are taller, although not necessarily longer (the Abbott's Wharf building is approximately 55 metres in length), the perception of scale is exacerbated by the size of the façade and the repetitiveness of the windows and balconies across it. Whereas at Arrow Road the length of the façade is broken up by changes in the condition of the brick, colour of the paintwork or breaks in the height of the parapet which demarcate the extent of each individual dwelling, in the higher density schemes there is no such variation. At Abbott's Wharf there is one balcony per dwelling, but this does not make the façade easy to read in terms of numbers. This might be because the extent of each dwelling is not clear from the façade so it cannot be easily 'broken down'. Similarly at St Andrew's, dwellings are articulated with projecting balconies, but are too many and the building façade is too high and too long for the number of units to be apprehended at once.

At Caspian Wharf, the length of the street façade is broken by projected elements and changes in the façade treatment. Comparison between this example and the St Andrew's and Abbott's Wharf buildings suggest that design strategies such as these, for reducing the perceived length of the façade (and therefore the scale of the building) have a significant effect in reducing the perceived capacity and potential anonymity that can be associated with density.

Bow Bridge (A01) facade towards the interior of the estate

Bow Bridge (A01) facade towards perimeter roads (main outlook from flats)

Gale Street (A03) facade towards the park (main outlook from dwellings)

Gale Street (A03) facade Gale Street

Figure 2.3.5: Bow Bridge (A01) nd Gale Street (A03): front and rear facades

2.3.5 Articulation versus anonymity

Comparison between the front and rear facades of the buildings at Bow Bridge (A01) and Gale Street (A03) further suggests that the perceived scale, and therefore density, of the site can be affected by the articulation of individual units within the physical mass of the building. At Bow Bridge (A01), the interior-facing façade is divided up into units of two dwellings per floor on either side of the stair core, clearly delimited in the building façade. This gives the building a recognisable scale and an idea of its capacity. In comparison, the outer facades are relatively unarticulated. They portray the kind of repetitiveness that the discussion in the previous chapter attributed with the disorientation and anonymity as a result of the perception of myriad duplications of the same window across a sizeable building façade.[16] At Gale Street the frame on the street elevation describes the extent of each dwelling, and acts to break up the facade into a series of smaller elements - limiting the perception of the overall height or length of each block. (Note that the staggered blocks act in the same way, reducing the perceived length of the building).

16 In the previous chapter Dolphin Square in Pimlico was suggested as an example of this kind of anonymity.

Built form: discussion

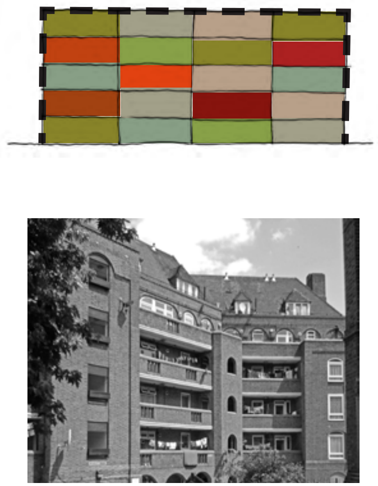
Built form is concerned with the perception of density in two ways. One is the perception of scale, and the other is the potential for anonymity. The issue of the connectivity of the built fabric was found to have some implications for the perception of the scale of the building. The case studies seemed to demonstrate that contextualisation of a buildings height as part of a massing strategy can also contribute to limiting the visibility of the building in its full extent. The tower at Bow Cross has aspect in four directions, and therefore could not be built up to in a way that would contextualise its height, as at Caspian Wharf for instance. In this way, the aspect of the building contributes to it's full mass being visible - not mitigated.

In this sense, the continuity and connectivity of the built form which was found to have relevance in terms of enclosure and openness considered as part of the index of site coverage above, also has implications for the perception of scale.

In regards to the potential for anonymity, the scale of the building was clearly a factor, but comparison between the case studies demonstrated that there are design strategies that mitigate the perception of a continuous (and potentially anonymous façade). Introducing vertical breaks, for instance appeared to have some impact on reducing the perception of the façade as a whole. Similarly, articulating individual units and smaller groupings within the facade (as at Bow Bridge for instance), potentially impacts on the perceived capacity and anonymity of the buildings. It it counter to the 'multiplication of numbers' that was associated with the anonymity of the crowd in the discussion in the previous chapter.

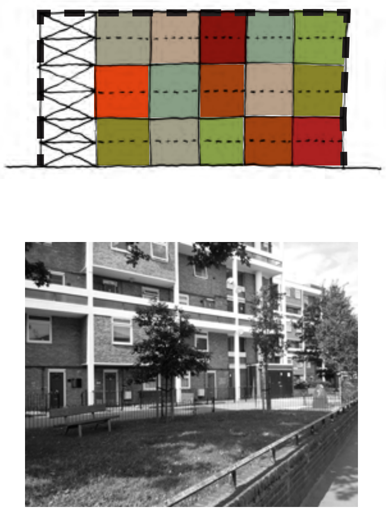
It is clear that there is some overlap between the three indices of physical density and there is scope therefore for better clarification of how each is defined. This will be considered in more detail at the end of the chapter, however, in light of the other indices still to be tested.

Figure 3.1.1: Diagrams showing individual dwelling units within collective structures - as in one of the buildings in each of the case study schemes.



A01 - Bow Bridge

A02 - Lansbury



A03 - Gale Street

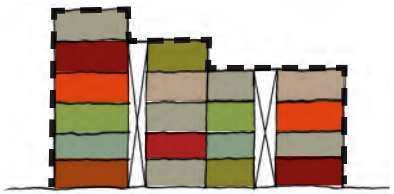
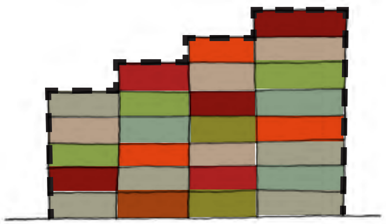
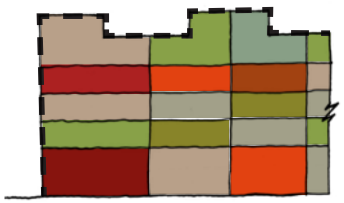
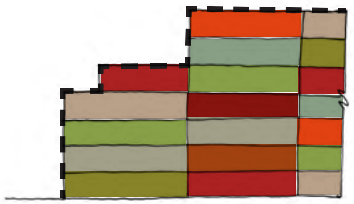
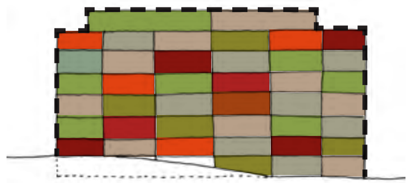
A04 - Lincoln's Estate

A05 - Arrow Road

KEY

Individual dwellings

Enclosing Collective structure


B01 - Bow Cross


B02 - Caspian Wharf


B03 - St Andrew’s


B04 - New Festival Quarter


B05 - Abbotts Wharf

3. Communality

3.1 Collective Structure

3.1.1 Shared structure

The dwellings in all of the case studies share some element of their building fabric with their neighbours. The diagrams in Figure 3.1.1 show the physical arrangement of individual dwellings in each of the case studies. At Arrow Road, houses share party walls. In all of the other case studies, dwellings share party walls and floors with their neighbours. These elements enable the dwellings to be built side by side and one on top of the other as part of a collective structure. Therefore in all of the case study schemes the collective structure is an essential factor affecting the layout and relationship of dwellings on the site. In the lower density schemes, particularly Lansbury (A02) and Lincoln's Estate (A04) the scale of the buildings does not demand frame construction, but it is a defining characteristic of the architecture of these two schemes. Both are characteristic of the style of post-war council-built housing, and the collective structure is integral to this, defining the typology, organisation and architectural character of the buildings. It was suggested in the previous chapter that communality was part of the architectural rhetoric of the Modernist housing agenda. However, it is aside from the stylistic tropes and their symbolic association with density, collective structures also have a determining effect on many aspects of the dwelling and its environment.

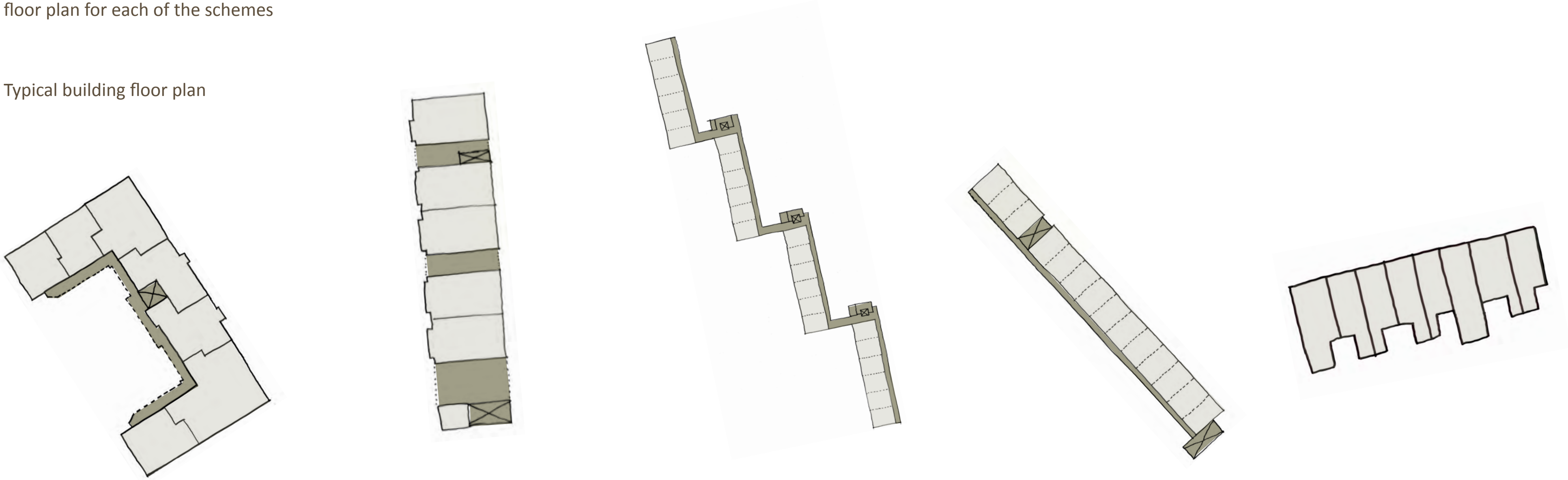
3.1.2 Communal circulation

With the exception of the houses at Arrow Road and Bow Cross, all of the schemes have dwellings organised in 'stacked' typologies of some description. This requires communal circulation in the form of stairs, lifts and landings, and common entrances which fundamentally impact on how the residential environment is organised and used. The degree to which these integral, communal spaces determine the way that the dwelling is accessed, its relationship to the street and to neighbouring dwellings differs between the sites.

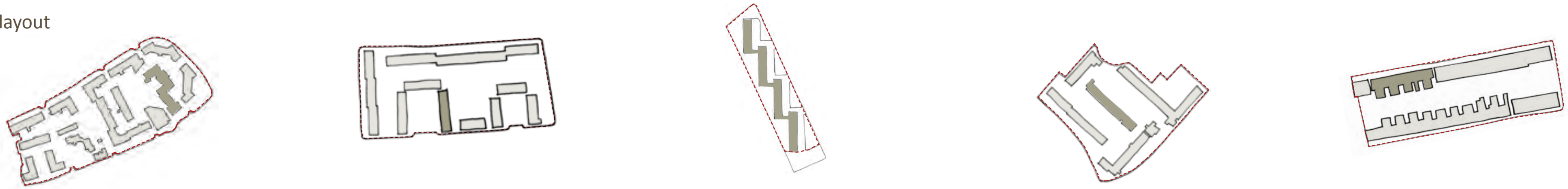
The layout and qualities of the communal spaces is considered as part of the index of encounter (4.1). It is apparent that the layout of communal circulation within the schemes impacts on the organisational as well as the architectural expression of the buildings. Internal access - as in the higher density schemes, B02, B03, B04 and B05, affect how the building mass is articulated and the perception of individual units within it. In the lower density schemes, A01, A03 and A04, the circulation is external and forms part of the architectural expression of the scheme. The qualities of the space (and its conviviality as a social space are affected), but so too, the perceived scale of the building.

Figure 3.1.2: Diagrams showing communal space circulation in a typical floor plan for each of the schemes

Typical building floor plan



Site layout



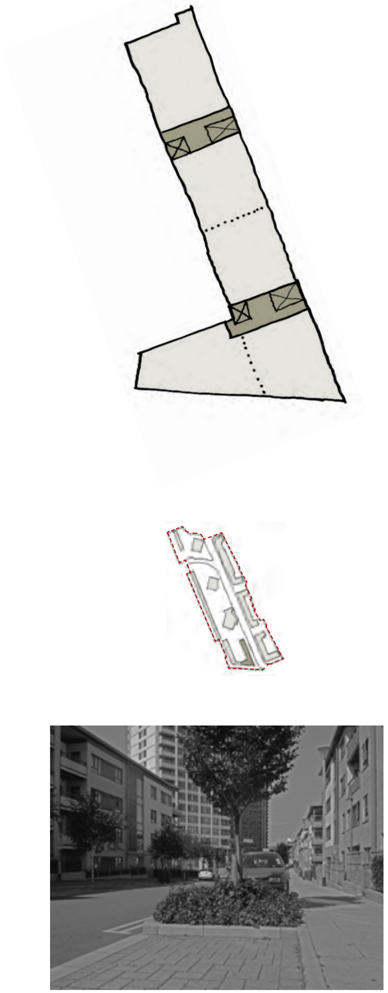
A01 - Bow Bridge

A02 - Lansbury

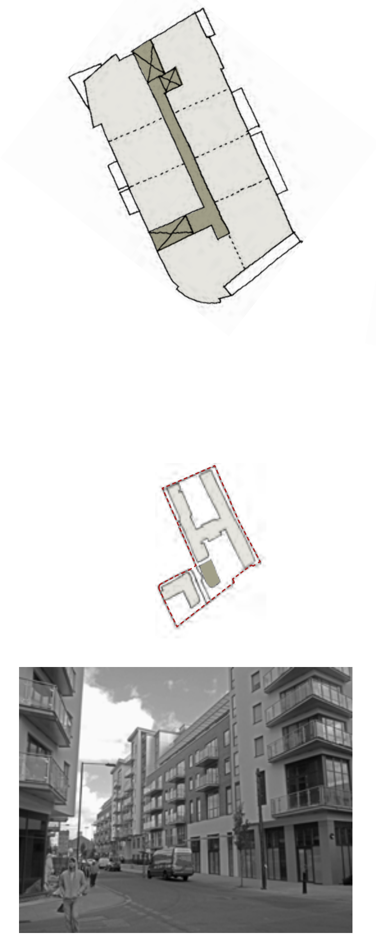
A03 - Gale Street

A04 - Lincoln's Estate

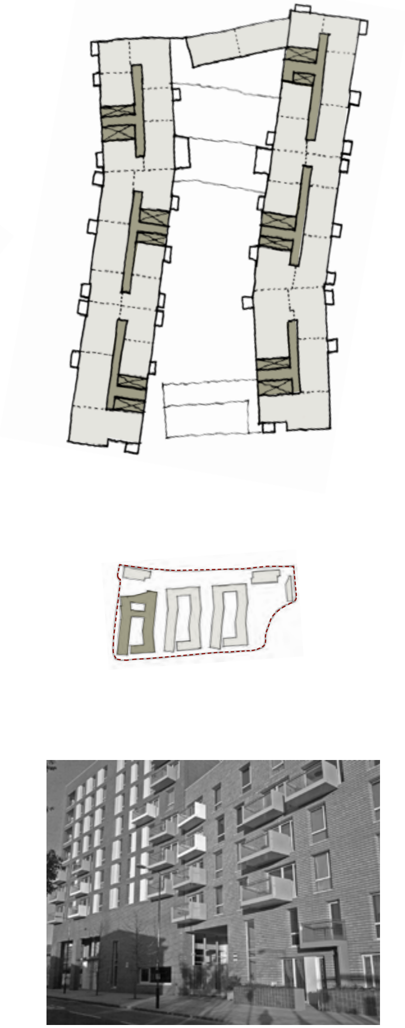
A05 - Arrow Road



B01 - Bow Cross

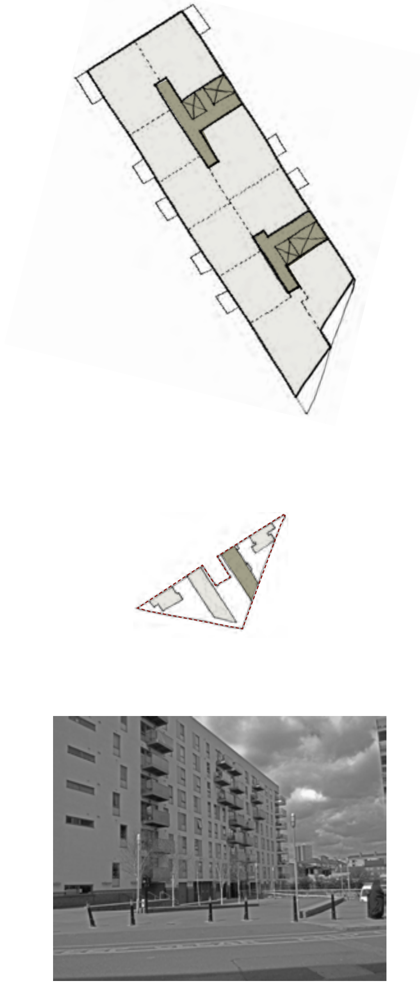


B02 - Caspian Wharf



B03 - St Andrew's

B04 - New Festival Quarter



B05 - Abbotts Wharf

Key to symbols

*	Subject to tenure
o/s	Not applicable to open space/ gardens

Figure 3.1.3: Diagrams based on N.J. Habraken's proposed hierarchies of enclosure.

Arrow Road (A05): The residents are able to exercise control over the front and rear facades and all internal partitions (subject to tenure).

At Bow Cross the houses would potentially allow the same control as the Arrow Road houses, but all are rented therefore limiting residents freedom to alter the building externally.

In all of the case studies, residents have the freedom to alter the internal configuration of the dwelling (*subject to tenure).

In the higher density schemes, residents have autonomy only over the interior of the dwelling. The balcony remains under the ownership of the Leaseholder and residents have access to it, but are not able to alter it. There may also be conditions on the tenancy of the building as to how the balcony can be used, prohibiting the storage of bikes, for instance, or drying laundry.

3.1.3 Autonomy and collective structures

In all of the case studies in which dwellings were incorporated into collective structures (i.e. in all except the houses at Arrow Road and Bow Cross), the structural logic and architectural expression of the collective building arguably subsumed that of the individual dwellings. This is apparent in the degree of freedom that the residents (specifically owners) have over the spatial configuration and appearance of their dwelling (see Figure 3.1.3). Whereas at Arrow Road it is feasible that one of the houses could be demolished with its neighbours still standing, this would not be the case in any of the other case studies. Few of the Arrow Road houses have been altered significantly (externally at least), but garden walls had been painted, front doors varied between the houses and even the state of maintenance even, was an indicator of the distinct occupancy of the separate houses. The composite effect of these small interventions contributes to an impression overall of a number of individuals. That is in contrast to the uniformity of the expansive façades of some of the other schemes (and not only the higher density ones). Abbott's Wharf and at Ricardo Street, for instance have both been designed at the scale of the collective and there is relatively little opportunity for individualisation.

These examples are suggestive of a different type, or condition, of density. There is a notion that the diversity in the dwelling fronts at Arrow Road suggests a density of activity, a composition of the endeavours of different households. The other, the collective dwelling schemes are more indicative of a collectively organised density, in which the site, urban block or building is organised as a model of collective dwelling.

Arrow Road (A05): The older part of the street

In this part of the street each front garden has a slightly different wall type, height or colour or a different gate – it shows evidence of different uses and activities

Arrow Road (A05): A relatively new extension to the street

In the newer part of the street all of the garden fences and gates are the same. The terrace has a continuous façade without the breaks of a cross wall or change in paint colour. These houses, as well as the houses at Bow Cross were designed for social rent and, as they are relatively newly built, this is still the case.

Bow Cross (B01): New houses (initially for rent rather than sale)

Bow Cross (B01): The apartment buildings, also for rent rather than sale, have large balconies, the use of which impacts on the appearance of the building façade as a whole. Furniture, plants, laundry and toys animate the building façade and begin to construct a façade that is a composite of the different dwellings.

3.1.4 Individual identity and collective structures

These examples occupy a middle ground, in between the collectively organised density of Ricardo Street, and the composite of individuals apparent in the Arrow Road houses (shown here in the first image). Comparison between the different parts of the street at Arrow Road indicates that the dominance of the collective identity is not only a product of the structural logic of the buildings, but that design also plays an important role.

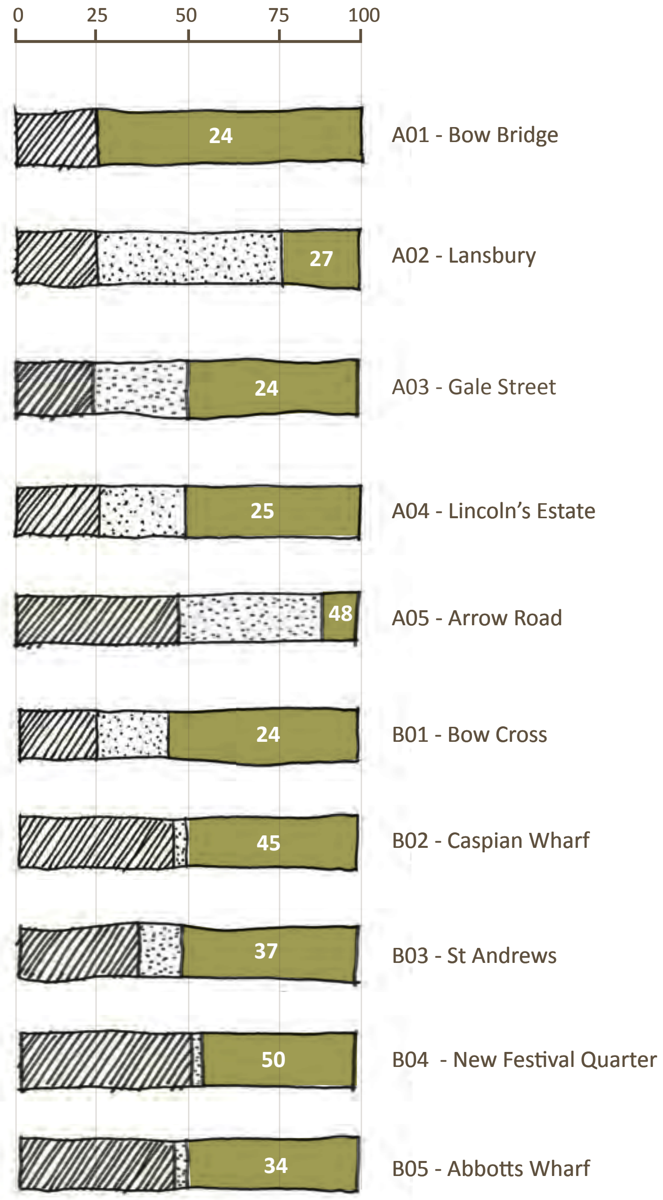
In Habraken's models (cited in the previous chapter), he suggests that tenure affects the capacity that residents have to intervene and to alter their dwelling or the space around it. There is a sense that the tenure of the new houses at Arrow Road (top right) and Bow Cross (bottom left) limit the scope for physical alterations to the buildings. However, the apartments at Bow Cross (which are also rented) pose some suggestions for how design might mitigate the perception of the collective organisation and enable the intervention of the residents to contribute to the appearance of the buildings. This is particularly relevant where the collective structure and the order imposed is associated with the dominance of the institution in a negative way. It suggests that design strategies that recognise how residents' capacity to alter and personalise their dwellings is affected by tenure, and furthermore, enable residents to alter their dwellings and mitigate the perception of a collectively organised density are potentially very useful.

Collective Structure: discussion

The index of collective structure was intended to capture the perception of density based on consequences of collective dwelling structures for the scale of the buildings, organisation and layout of the site and the potential anonymity associated with collective dwelling types.

In regards to the scale and organisation of the site, collective structure proved to have most effect where the vertical organisation of the dwellings necessitated the use of communal entrances and circulation. The case studies indicated that communal entrances and stairwells and the organisational logic that they denote are inherent characteristics of density. But whereas the Housing Density Study outlined the limits in terms of density ratio associated with different circulation types (see Figure 10 Chapter Two), it is also apparent that the organisation of circulation within the building has an effect on the qualities - the phenomenology of the site. It potentially affects the perceived scale of the buildings, the perception of individuals, and the relationship between neighbours (although this will be considered further in relation to the indices of proximity).

Further to this, the consideration of the appearance of collective structure and dominance of the collective structure over the individual in the appearance of the building lead to the consideration of two different readings of density. One, a density based on a composite of individuals. The index of bustle, considered below, will also draw on the individualisation of the façade as a trace of the occupancy of the built fabric, suggesting some overlap between the two indices. The second type was that of collectively organised density. Following Habraken's theoretical model, the case studies seemed to support the principle that in the collective structure, the identity and appearance of the individual dwelling is determined by the collective identity of the whole.



KEY

Built foot print

Including private gardens

Communal space

Figure 3.2.1: The area of the site designated for communal use in each of the case studies.

3.2 Communal Space

3.2.1 Communal area as a percentage of the site area

It was anticipated that the higher density case studies would have less private outdoor space on site and more emphasis on shared gardens as part of the site planning strategy on the basis that as the density of units on the site increases, the feasibility of providing private individual gardens for each dwelling decreases. To an extent this was evident, although there was great variation in the amount of site area that was designated specifically for amenity use as opposed to thoroughfares or car parking or other utility uses. There was also great variation in the way that the communal spaces were shared which revealed different approaches towards design and integration of communal space specifically as a strategy for designing higher density housing.

Amongst the lower density case studies there was the most variation in the amount of communal outdoor space and some consideration of two schemes in particular, Bow Bridge and Arrow Road seem to demonstrate that the principle of using communal space as an indicator of the organisational characteristics of site density is probably a valid one.

Figure 3.2.2: Site Plan Bow Bridge (A01) and Arrow Road (A05) showing areas of communal open space on site.

At Bow Bridge none of the dwellings have private outdoor space leaving the whole site allocated for communal use. Different parts of the site are designated for specific uses - parking, refuse storage, play areas for different types of play and sitting gardens for relaxation - are all allocated within the site masterplan.

At Arrow Road the only communal space on site is a car park for residents.

3.2.2 Collective amenity versus private amenity

Bow Bridge exemplifies the Modernist notion of collectivised amenity which was that bigger space is better amenity. What is not apparent however, is the relationship between the buildings and the communal spaces that are provided. Habraken suggested that the use of communal space is determined by access to it.[17] At Bow Bridge, however, because the communal amenities are distributed across the whole site for all residents there is not a manifest relationship between the buildings and their residents, and the communal spaces that are provided.

Nonetheless, it is apparent that the site strategy is premised on communal rather than privately allocated space and in this regard there is a perceptible difference between the character of the sites at Bow Bridge and Arrow Road.

17 N. J Habraken, *Structure of the Ordinary: Form and Control in the Built Environment,* ed. by Jonathan Teicher (London: MIT Press, 1998).

Figure 3.2.3: Site plan showing the areas of private and communal outdoor space

KEY

Communal gardens

Private gardens

Lansbury (A02)

At Lansbury, each of the dwellings (even the upper floor maisonettes) has a private garden accessed via shared footpaths to the rear of the buildings. There are also two communal gardens that occupy a central position on the Grundy Street side of the site.

Photograph showing communal gardens at Grundy Street

3.2.3 Aesthetics of communality

This distinction is complicated, however, when schemes such as Lansbury are taken into consideration. The discussion above suggested that the buildings at Lansbury are defined by the appearance of the dominant collective structure. However, the site plan is carved up into individual garden spaces for every dwelling, suggesting an organisational logic based on individual, rather than communal space. However, small communal gardens on the Grundy street side of the site have a prime location and a defining impact on the appearance of the site. This example suggests that, rather than the amount of communal space provided, the role that it plays as part of the organisation of the site is perhaps more critical.

Figure 3.3.4: St. Andrew's (B03)

A quick measure of the site area at St. Andrew's shows that for Block A, the area required simply to provide the minimum garden space required for each dwelling – excluding the area that would be consumed by access routes to the gardens and dividing walls between them – is around 1300m², whereas the site area available for garden space is c. 1100m².

[Calculations based on private outdoor space requirements for dwellings as set out in the Greater London Authority, 'Housing Supplementary Planning Guidance' (Greater London Authority, 2012)]

Photograph showing communal gardens and private balconies

KEY

Communal gardens

Private gardens

Public park

Elsewhere on the site:

children's play area

public lawn

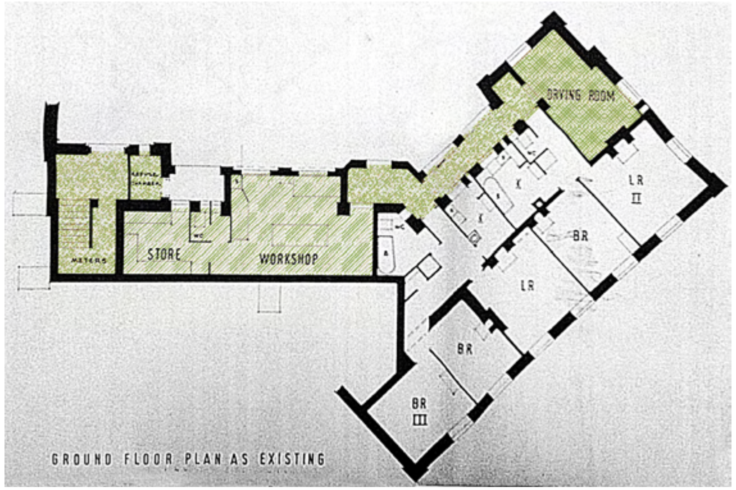
3.2.4 Communal space as necessity

Amongst the higher density case studies, all are organised around a communal open space of some kind. This further supports the proposal that the prominence of communal open spaces as part of the site plan is a key organisational characteristic of density. Furthermore, the absence of private gardens for most dwellings (the ground floor dwellings have small private gardens around the edge of the communal garden in the photograph) affects the way that the dwellings and outdoor space is used as part of the daily practices of living in the apartment buildings. The private balconies do not, for instance provide space for a substantial vegetable plot, os space to repair a bicycle. In this way, it affects daily activities and the way that public and private space is used.

Figure 3.2.5 Types of communal space and the implications for density

Bradley House, Bow Bridge (A01) – the ground floor plan as designed in the late 1920s

The buildings were originally designed with communal laundries, drying rooms, workshops, coal bunkers and pram stores to provide additional space outside of the limits of the dwelling itself. Many are now closed or have been converted to other uses but the original designation of these spaces was indicative of the kind of organisational logic that was proposed in the previous chapter as a characteristic of density.



3.2.5 Communal space as an extension of the private domain

The case studies did not really demonstrate examples of communal space being used to extend the effective area or to provide part of the essential amenity required from the dwelling (as in the example of the student accommodation discussed in the previous chapter). The communal spaces at Bradley House, Bow Bridge arguably represent (in as much as any of these examples do), communal space forming an integral part of the building's organisation. The communal workshops, coal and pram stores supplement the individual dwellings by reducing the need for storage provision in each of the dwellings themselves. The communal bike and bin stores in the more recent schemes might be thought of in the same way.

Figure 3.2.6: Bow Cross Community Centre – designed as an extension of the original Priestman Point tower block, PRP (2010).

The Community Centre includes and IT centre, Housing Office run by the Housing Association that manage the premises, a community hall for classes and meetings and a ball court and play area outside.

3.2.6 Communal spaces for social use

A number of the case studies had communal amenities on site, however, these were mainly utility spaces such as refuse stores and bike stores, or else functional spaces such as entrance lobbies and stairwells. These utility spaces will be discussed in relation to the index of communal utility, below. The community centre and facilities at Bow Cross (B01) was the sole example of communal space being provided in addition to the basic utility and storage space (as in the other higher density schemes). It is not necessarily an integral component of the spatial organisation of the dwellings or the buildings since the centre has its own entrance and operates autonomously from the residential buildings. It is not clear, therefore, how facilities such as this contribute to an idea of density based on communality. It does, however, act as a focal point for activity around the site and is considered below in relation to the indices of proximity.

Communal Space: discussion

The hypothesis developed in the previous chapter proposed that the communal space index is a means of considering the organisational characteristics of the site density. It was suggested that the way that communal space was used as an integral part of the site layout and organisation of the building was an essential characteristic of density. However, it was not known to what extent this would be apparent. Comparison between the communal spaces in the case study sites provided a means of exploring how the index could be better clarified and to what extent it is useful for describing a particular characteristic of density.

The case studies raised some issues that had not be anticipated and challenged the usefulness of the index as a means of describing the organisational characteristics of density on the site. The Lansbury site demonstrated that it was not only the presence of communal space, but its location and significance as part of the spatial qualities of the site that contribute to the perception of communality. The communal gardens at Lansbury were more suggestive of a communally oriented approach towards density than the hidden-away gardens at Bow Bridge. The orientation of the buildings around the gardens makes them integral to the organisation of the site and has potential for collective ownership and authority over the space.

In relation to internal communal space, the integrated-ness of the space became a critical factor in differentiating between communal spaces that impact on the layout and residential environment and those that do not. However, using this as the main criteria seemed to point to the presence of communal bin stores and bike stores as an indicator of the site's organisational logic. These factors are considered in more detail as part of the index of communal utility and so the discussion at the end of this chapter will be used to clarify both of these indices and consider their relevance as indicators of the spatial qualities of density.

Communal Provision on-site	Bow Bridge	Gale Street	Lansbury	Whitehorn Street	Arrow Road	Bow Cross	St Andrew's	New Festival Quarter	Caspian Wharf	Abbott's Wharf
District CHP							On-site	On-site		
Biomass boiler							On-site			
Electric Car Charge Point							On-site			
URS	On-site	On-site				On-site				On-site
Bin stores	On-site	On-site	On-site	On-site		Off-site	On-site	On-site	On-site	On-site
Bicycle store			Off-site			Off-site	On-site	On-site	On-site	On-site
Laundry/ drying room	On-site									
Car Club							Off-site	On-site		
Concierge								On-site		On-site
Grounds Maintenance	Off-site	Off-site	Off-site	Off-site		On-site	On-site	On-site	On-site	On-site
Building Maintenance	Off-site	Off-site	Off-site	Off-site	Off-site	On-site	On-site	On-site	On-site	On-site
Housing Office						On-site				
Health Surgery	On-site		Off-site				Off-site			
Gym							On-site	On-site		
Convenience store		Off-site	Off-site	Off-site	Off-site		Off-site	On-site	On-site	Off-site
Community Space	On-site		Off-site			On-site	Off-site	On-site		

Figure 3.3.1: Diagram showing the different services and utilities on site in each of the case studies.

The diagram ranges from 'hard' technological utilities at the top, to 'softer' service provisions at the bottom of the list

KEY

On-site

Off-site

3.3 Communal Utility

3.3.1

The hypothesis for testing communal utility as an index of density was that higher density should facilitate a greater number of technological and other services to be provided, collectively, for the benefit of residents. The provision of utility collectively can also have a determining impact on the layout and spatial qualities of a site. Furthermore, at higher densities, there was expected be a greater reliance on communal services as part of the basic functionality of the dwelling. In broad terms, the case studies did reflect this general principle. Some of the higher density schemes have advanced technological services on site, such as district CHP schemes whilst none of the lower density schemes have these systems. However, that should not be taken as a universal trend since the tenure and age of the schemes in question limit the likelihood of such provisions being afforded. Not all of the higher density schemes have CHP or on-site energy generation, indicating that, as Churchman suggested, there are factors other than density that determine the viability of these services.[18]

The diagram [Figure 3.3.1] does seem to suggest that amongst the higher density schemes there are a greater number of 'softer' services provided on site, such as building maintenance personnel, or a concierge service. These factors may be affected by tenure, but they also have a potential impact on the organisation and layout of the site and therefore warrant further consideration as part of the communal utility index.

The discussion on the index of communal space above also highlighted storage space as a significant factor and something that appears to be both effected by, and affect the organisation of the site. This seemed also to be relevant to this index since storage space (of different types) form the most common communal provisions amongst the case studies.

18 Arza Churchman, 'Disentangling the Concept of Density', *Journal of Planning Literature,* 13 (1999), 389–411.

Figure 3.3.2: Site Plan at New Festival Quarter (B04) and St. Andrew's (B03) showing the area of the building footprint that is taken up by different types of utility provision. It includes:

- Car parking
- Cycle storage
- Building Services Plant
- Energy centre
- Substation
- Bin store
- Sprinkler system unit
- Three different meter rooms

KEY

Storage Space

Building Services

Building Footprint

At New Festival Quarter the energy centre is located at street level on the ground floor of block B, but it takes up only 2.5 per cent of the overall footprint of buildings on the site and therefore has a relatively small impact on the organisation of the site.

St. Andrew's (B03)

At St. Andrew's the energy centre for the biomass boiler and CHP distribution is located in the basement beneath the Health Club in Block A. It is not visible from the street and has minimal impact on the organisation of the site.

3.3.2 Utility space and site layout

Comparison between the New Festival Quarter and St. Andrew's site plan demonstrates:

- The amount of utility space (particularly storage), and building services required for the density of dwelling units on the site and the significant impact that it can have on the site plan.
- The location of the utility space underground, or at the centre of a deep building footprint, with a podium-level communal garden above enabled much of the utility space on site to be concealed and an active frontage around the perimeter of the site to be maintained (potentially contributing to the activity and bustle around the site).

Figure 3.3.3: Refuse storage at St. Andrew's (B03) and Abbott's Wharf (B05)

The Underground Refuse Storage (URS) systems represent an example of a utility technology being used to minimise the amount of built floor area dedicated to refuse storage. Comparison between the two schemes show that the size of the areas allocated for refuse storage potentially has a significant impact on the productive density of the site (each of the bin stores at St Andrew's is approximately half the area of a one-bedroom flat).

St. Andrew's (B03)

KEY

Refuse store / URS

Abbott's Wharf (B05)

3.3.3 Visibility and presence of utility provision

Comparison between the ground floor plans for St Andrews and Abbotts Wharf further highlights the significance that utility provision can have on site planning. The Underground Refuse Storage (URS) system reduces the ground floor space dedicated to refuse storage and the storage is located below ground instead.

The two examples, Abbott's Wharf and New Festival Quarter, raise a question over whether the visibility of the communal utility systems has any impact on the organisation of the site.

Figure 3.3.4: Communal bin stores as part of a functional aesthetic

Lansbury (A02) – The original bin stores were located next to the entrance to the buildings. Recently, new bin stores have been built in front of the buildings on Ricardo Street. Still, the utility provision is a dominant presence in the street.

Gale Street (A03) – The original bin stores at the entrances to the buildings (the refuse shoot above a key sculptural element in the façade) emphasis the visibility of utility provision and its presence on site.

Bow Bridge (A01) – A URS system in place on the site. Comparison between Bow Bridge and the other two demonstrates the effect that this has on how the appearance of the utility services.

3.3.4 Utility and functionality as architectural aesthetic

The photographs of Gale Street, Bow Bridge and Lansbury demonstrate, firstly that communal refuse storage is common to both the higher and lower density case studies and is inherent where collective structures and shared circulation are part of the organisational logic. More significantly though, they suggest that communal utility might be part of a particular architectural expression. At Gale Street the building's refuse system is expressed as an architectural element in the façade. The bin store is given pride of place next to the main entrance- projected slightly for emphasis.

This raises similar questions to those around the visibility of communal space, considered above. Both instances point to a symbolic reading, in which communal space, or in this case, communal utility provision signify a particular spatial and social agenda in housing design, characteristic of the post-war period (considered at some length in chapter one). However, it is not clear whether this reading is universal and therefore how useful it is as an index of the spatial characteristics of density.

Figure 3.3.5: St. Andrew's has concierge services on site, grounds and building maintenance on site.

3.3.5

Comparison between the two groups of case studies indicates that the provision of utility services on site is greater in the higher density schemes. The services are distinguished from building technologies, or space provided for storage in that they are not part of the built fabric of the scheme, but are services provided as part of the management and running of the site. At both St. Andrew's and New Festival Quarter, a car club is provided on site (or nearby), for residents. Strategies such as this reduce the amount of parking required on site and therefore the area that it consumes.

Services such as car clubs (with their distinctively branded cars) might therefore be taken as a more modern version of the refuse shoot expressed in the façade of the buildings at Gale Street as an index of the utility advantages associated with density.

Communal utility: discussion

The apparent correlation between site density and the presence of communal utilities, including building services technologies such as CHP, storage space, and 'soft' services such as on-site maintenance personnel seems to support the notion of communal utility as an index of density. However, as was the case with the previous indices of communality, the case studies also raised questions as to how the organisational characteristics of density are experienced and therefore what factors are actually effective in terms of the perception of density.

On one hand, there were a number of examples of utility provision being hidden within the mass of the building. This represented a designed response to the pressures of accommodating the required storage and technologies on site, especially at higher densities.[19] However, in regards to the perception of density based on its organisational characteristics, these apparently 'hidden services' are not immediately apparent as part of the experience of density. It was reported that in the original design of the Dolphin Square scheme in Pimlico, refuse cupboards were incorporated next to the front door of each dwelling and would be emptied daily by the building's service personnel. This kind of provision might be taken as an indicator of the organisational characteristics of density since it has a daily (albeit relatively minor) impact on the lives of the building's inhabitants. In the case study schemes, the location of the bicycle store might have a similar impact, affecting the everyday habits of the building's residents. Communal provision of refuse stores, bin stores and car clubs also impact in a small way on the daily routines of the building's residents. In this way, communal bike stores are more than merely a bike store - a utilitarian facility. They are inherent features associated with density. The communal store makes more efficient use of space (contributing to the 'productive density' of the site). They also have a determining effect on the organisation of the site, and potentially act as a social space. In this way, the design of communal utilities such as bike stores is an important design consideration.

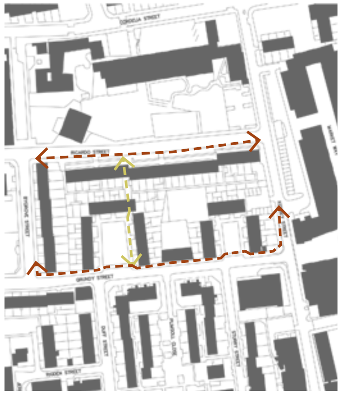
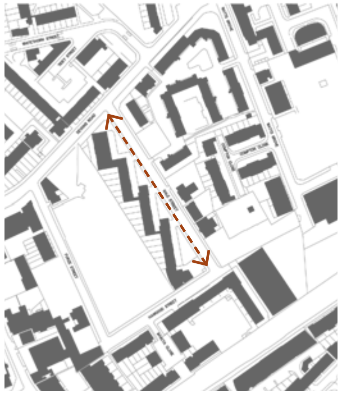
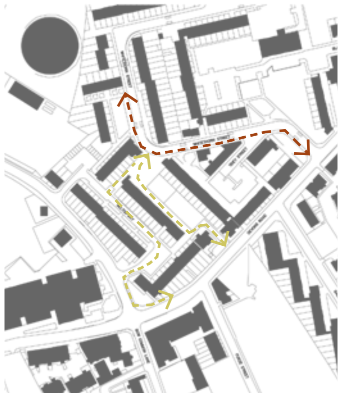
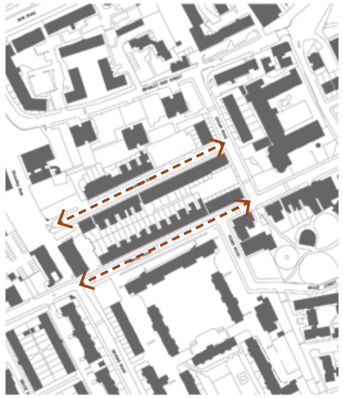
19 As noted in Macreannor Lavington et al., *'Housing Density Study'.*

Figure 4.1.1: Site Plans showing primary routes through and around.

KEY

Routes along the edge of the site

Routes through the site

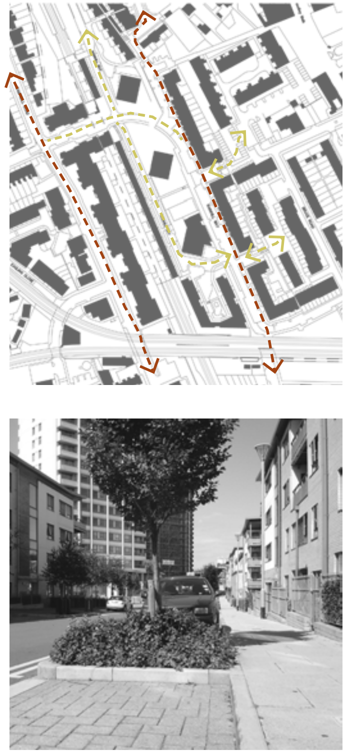

A01 - Bow Bridge


A02 - Lansbury


A03 - Gale Street


A04 - Lincoln's Estate

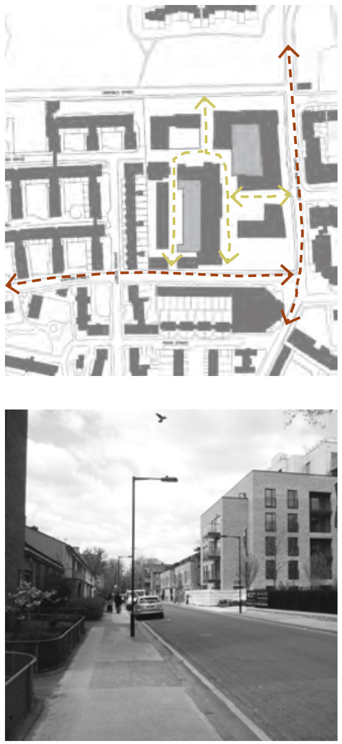

A05 - Arrow Road



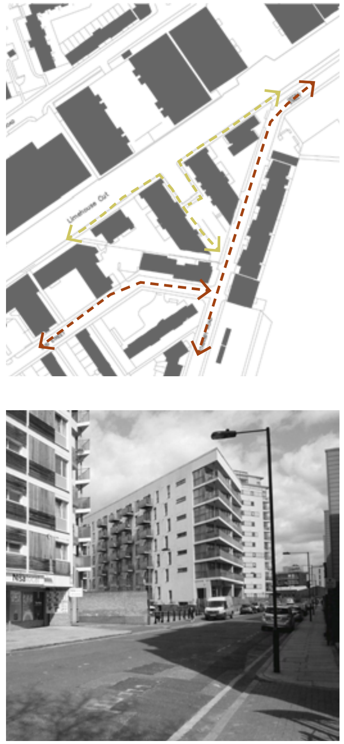
B01 - Bow Cross

B02 - Caspian Wharf

B03 - St Andrews



B04 - New Festival Quarter



B05 - Abbotts Wharf

4. Proximity

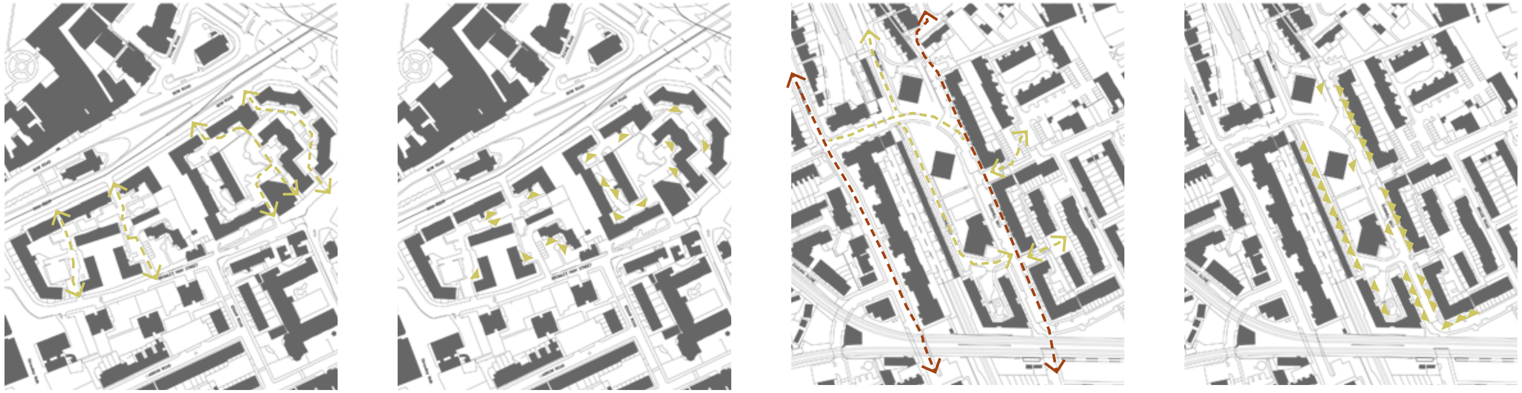
4.1 Encounter

4.1.1 Site layout and opportunities for encounter

The proposed index of encounter set out in Chapter Three posited the opportunity for social encounter as a positive attribute of density and the proximity that it can generate. The propensity for social encounter is considered in terms of the site layout, and the relationship between dwellings.

The routes through each of the case study sites on their own [Fig 4.1.1] do not provide a very useful impression of the social propensity of the routes, although a couple of key factors do emerge as having some impact on the opportunities for encounter generated by the site plan. One is the number of routes and where they lead to, and the other is proximity between the buildings and the identified thoroughfares.

Figure 4.1.2: Site Plans showing routes through the sites and location of entrances



Bow Bridge (A01)

There are a number of different pedestrian routes running through the site which dilutes the intensity of movement and activity in any one space. The entrances to the buildings are generally separated from the public thoroughfare by a car park.

In terms of encounter the site plan and the proximity between the building entrances and public thoroughfares does not make the most of the opportunities for encounter with passers-by.

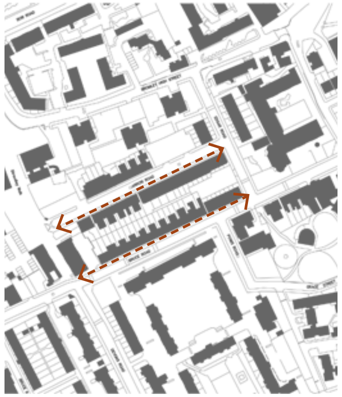
Bow Cross (B01)

The new houses and flats at Bow Cross define two main streets. The buildings are accessed primarily from one main street running north-to-south across the site and proving a thoroughfare from the Bow Road Underground station at the north to the residential areas on the south side of the railway line. The proximity between the buildings and the public thoroughfare provides an opportunity for encounter between residents in front of their houses and passers-by.

4.1.2 Site layout and street activity

The site layout at Bow Cross (B01) concentrates activity along one primary route – maximising the opportunity for encounter. The Bow Bridge (A01) site plan, by comparison, creates multiple routes through, dispersing activity. This has implications for the 'bustle' of the environment on site (it is low), but in terms of encounter, reduces the potential opportunities for encounter between residents and people passing through the site.

The way that the site layout connects with the street network around it also has an impact. At Arrow Road, the street is a primary route used by residents and non-residents which generates opportunities for encounter and the potential for recognition between different groups of people which Fincher and Iveson argue is an essential part of the social functioning of a diverse urban environment.[20] By comparison, at Bow Bridge, routes through the site are not direct and therefore not frequently used by people passing through the site, which limits the opportunity for encounter with people other than neighbours - it limits the social pool.



Arrow Road (A05)

Arrow Road itself provides a link between the main shopping street at one end and the school at the other. There pedestrian activity along the street creates opportunities for encounter between residents and passers-by.

20 Fincher and Iveson, *Planning and Diversity in the City*. (Basingstoke: Palgrave MacMillan), 2008.

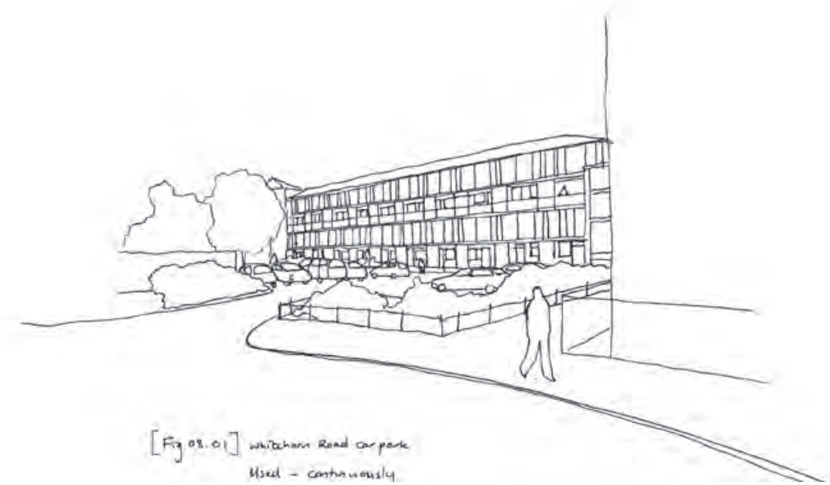
Figure 4.1.3: Immediacy between the dwelling and the street (sketches)

Arrow Road (A05)

At Arrow Road the front doors of the houses open directly onto the public street which itself acts as a thoroughfare between the shopping arcade at one end and the school at the other.

Bow Cross (B01)

At Bow Cross the balconies of the new flats are within 'hollering distance' of the street. The large balconies have different uses and therefore provide an opportunity for spending time outside of the dwelling which increases opportunities for passing the time of day with neighbours and passers-by in the street below.



Lincoln's Estate (A04)

The fronts of the buildings are set back from the road – although there is some pedestrian movement through the estate, opportunities for encounter are broadly limited to residents of the estate.

4.1.3 Proximity and external space

The immediacy between the buildings and the main public spaces on site is one way in proximity is exploited through site layout. The example of the new housing at Bow Cross suggests two factors that are potentially significant:

i) Further to Marcus and Sarkissian's suggestion, space that provide an opportunity to spend time outside of the dwelling (in this case balconies) increase the potential for encounter.[21]

ii) Further to Gehl's observation, the physical distance between dwellings and public spaces affects the possibility for social exchange.[22]

At Lincoln's Estate and Bow Bridge, the access galleries overlook the car parks and evidently allow for exchange between the dwellings and the street below. In these cases, the frequency of encounter is limited by the relatively infrequent use of the car park spaces compared with the public street at Bow Cross. During site visits, exchanges between residents on the balconies and passers-by were regularly observed.

21 Marcus and Sarkissian, *'Housing as If People Mattered: Site Design Guidelines for the Planning of Medium-Density Family Housing'.* (London: University of California Press), 1986.

22 Gehl, *'Life Between Buildings: Using Public Space.'* (Copenhagen: Danish Architectural Press) 1987.

Figure 4.1.4: Shared spaces as social spaces: the propensity for social encounter in communal entrances

St Andrew’s (B03)

At St Andrew’s, the communal garden that is shared by all of the residents within the block (potentially 587 people), has a much lower frequency of people passing through than the individual entrance lobbies (of which there are six in Block A, each shared by less than 100 people). The frequency of use makes these more significant for their potential social role.

The entrances at St. Andrew’s are large enough to allow a number of people to pass through. Large windows allow for natural surveillance and contribute to a semi-public openness that is in contrast with the private enclosure of the Bow Bridge stairwell.

Bow Bridge (A01)

The entrances to the buildings at Bow Bridge have no discernible lobby space at the foot of the stairs and are poorly lit with no window openings and little natural light. Encounter in these spaces can be unsettling if the light is low and inconvenient where there not quite enough space for paths to cross on the stairs.

4.1.4 Conviviality and sociability of spaces

In terms of the numbers of people sharing the spaces and frequency of use, the communal stair cores in the higher density schemes in particular, present the greatest opportunity for harnessing the density of the scheme to provide opportunities for encounter. Because of their integral role in the organisation of the building as the location through which every journey to and from the building passes, the frequency of activity in the entrance lobbies is greater than in other shared spaces such as communal gardens. It could be argued that the opportunity for social encounter in the communal entrances of St Andrew's Block A and Bradley House at Bow Bridge are roughly equivalent in that they are used by similar numbers of people. However the difference in the spatial qualities of the entrances spaces makes the lobby at St Andrew's more convivial as a space of potential social encounter than its equivalent at Bow Bridge.

St Andrews (B03) – communal landing

St Andrews (B03) – front door to ground floor maisonette

Bow Bridge (A01) – balconies

The galleries at Bow Bridge showed some evidence that residents use them for hanging out laundry, growing plants and storing furniture. They are shared by a relatively small number of residents compared with the other gallery-accessed schemes, suggesting that the frequency and intensity of use might be affected by how private the space is and the amount of pedestrian traffic coming and going.

Bow Cross (B01) – small front yard in front of houses

Figure 4.1.5: Doorstep encounter – harnessing the social propensity of proximity between neighbours

4.1.5 Doorstep environments

Doorstep opportunities for encounter are also affected by frequency of use and the phenomenology of the space. In most of the case studies the frequency of use is limited by the relatively small number of dwellings sharing a landing or stair well. In the schemes with front doors onto the street, as at Arrow Road, Bow Cross and (ground floor dwellings at) St Andrew's, the density of activity in the street provides opportunities for encounter at the doorstep scale.

Marcus and Sarkissian suggest that spatial devices that provide an opportunity, or excuse for spending time outside of the dwelling increase the possibility of social encounter between neighbours and in this way, provide a devise for harnessing the opportunities of encounter. The small front gardens to the houses at Arrow Road and Bow Cross potentially provide that opportunity. Many appeared to be used primarily as storage for bins and bicycles, but these uses nevertheless necessitate frequent toing and froing between the house and the street front and therefore increase the opportunity for encounter between neighbours.

The higher density schemes, by comparison, presented the paradox of proximity without opportunities for encounter.

St Andrews (B03)

Internal corridors allow for anonymity and privacy, but not necessarily sociability.

Bow Cross (B01)

The landings in the new apartment buildings at Bow Cross (not the tower blocks) are shared between a maximum of three dwellings and in most cases have a window to the front and rear that gives views out.

Figure 4.1.6: Communal spaces and encouraging use

4.1.6 Doorstep spaces as an extension of the dwelling

Use is an important factor. The access-galleries at Bow Bridge showed some evidence that residents use the space and the outlook from them (albeit over a car park), draws some residents to stand out on the access galleries. By comparison, the internal access corridors at St. Andrew's are simply transitional spaces. They are not overlooked, and there is no additional space, or daylight that would enable them to be used for anything other than access. As a result, opportunities for bumping into ones neighbours are limited to chance.

Encounter: Discussion

The index of encounter was intended to provide a means of describing the way in which proximity is harnessed as a social opportunity within the site layout and design of the spaces around the site. The case studies were not incredibly rich in the opportunities for encounter that they presented. In terms of site layout, the street-based schemes provide a number of cues as to factors that affect the propensity for social encounter and exchange in the environment outside of the dwelling. The concentration of activity in clearly defined spaces was one factor, another was the proximity between the buildings, particularly the entrances to dwellings, and public space. The separation of buildings

and dwellings from the street edge clearly affects social propensity, but also affects the assembling of activity, part of the index of bustle which will be considered further in relation to 4.2. The index was related to the perception of intensity, which it was suggested above is affected by the proximity between buildings and the street. However, in the case of Bow Bridge, the spaces between the buildings were considered to be intense in terms of the perception of the physical density of the site, but suggested little opportunity for encounter as a result of the relatively limited activity in the space outside.

The case studies were also limited in the opportunities for doorstep encounter that were presented. Doorstep encounter should arguably be one of the essential characteristics of density. One of the first actions of increasing density – the joining together of dwellings – establishes that proximity between neighbouring dwellings is essential to density, and therefore the social propensity that generates should be a key design consideration. However, the dearth of social space between neighbouring dwellings in the majority of the schemes demonstrates that this by no means a given, and a number of simple design moves could be made in order to harness the social opportunities of proximity at the scale of the 'doorstep', landing or access gallery.

The density of use was an important factor in both site and doorstep encounter, in addition to proximity. The internal access corridors present the paradox noted above, between proximity and frequency of use, and the apparent lack of social opportunities created. The uniform front doors and anonymous corridor environment create the kind of density of numbers associated with the repetitive façade in the previous discussions on collective structure and built form. It seemed that the greater the proximity between the dwellings – as in the higher density schemes, the less that the social propensity of the situation was exploited by design. Indeed, the corridors began to reflect the unique condition of anonymity that was presented as one of the major assets of the hotel as a residential typology.[23] This clearly bears some further consideration, particularly in relation to the index of privacy, below. Meanwhile the inhabited garden fronts at Bow Cross and Arrow Road allude to the density of individuals. This refers back to the perception of density based on numbers, and how readily these numbers can be subdivided into identifiable units. It also suggests that providing opportunities for individualisation, which counter the potential for anonymity, also contribute to the potential for social encounter between neighbours which ought to be one a positive social logic for the design of the urban, and particularly the residential environment.

23 Groth, Paul. *Living Downtown: The History of Residential Hotels in the United States.* (London: University of California Press) 1994.

A01 - Bow Bridge

A02 - Lansbury

B01 - Bow Cross

B02 - Caspian Wharf

Figure 4.2.1: Traces of inhabitation and the perception of bustle


A03 - Gale Street


A04 - Lincoln's Estate


A05 - Arrow Road


B03 - St Andrews


B04 - New Festival Quarter


B05 - Abbotts Wharf

4.2 Bustle

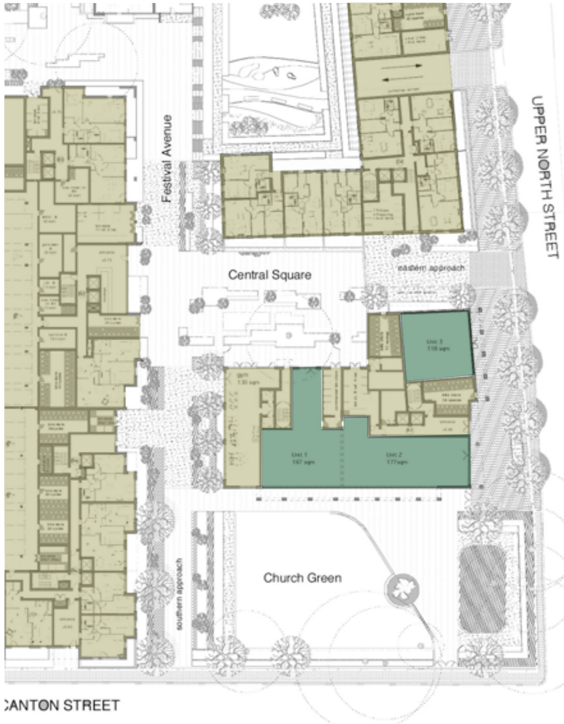
4.2.1 Site layout and concentration of activity

The impact of density on the activity or bustle in the streets and public spaces around the building overlaps with some of the subjects discussed in relation to the index of encounter. The discussion highlighted how the permeability between the dwelling and the space in front of it encourages the use and inhabitation of this space. The individuation of house fronts, landings and balconies not only creates distinction that alleviates the monotony that can come from collective structures and repetition across a large site, but also begins to conjure an impression of the activity that takes place within these spaces and the liveliness that can be brought about by the density of activity. The discussion on the index of encounter, above, also highlighted examples of streets being a focus for activity and, even where the density of the scheme itself is relatively low, as at Arrow Road, the site layout concentrates activity. By comparison with most of the other case studies, Arrow Road could be said to manifest a degree of bustle.

Figure 4.2.2: Mix of functions on site

KEY

- Commercial
- Community facilities
- Building Footprint

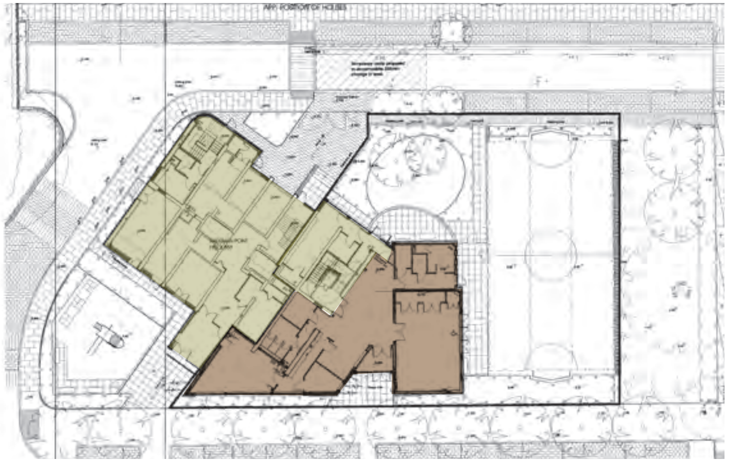


New Festival Quarter (B04)

The shops located at the entrance to the site are located in order to generate a concentration of activity and enliven the public square at the centre of the site.

Abbott's Wharf (B05)

The commercial units (shops and some live-work units) are located along the canal-side. They create a public frontage and, as designed would generate an active pavement along the edge of the canal. It should be noted that a number of the commercial units are in the process of being converted to residential use which will affect the amount of activity and the building frontage onto this space.



Bow Cross (B01)

The Community Centre combines the most diverse range of spaces and types of activity found in any of the case study schemes. It generates noise (ball court), a regular flow of visitors to the different classes that are run there and the housing office located inside. It also provides an IT centre for residents and play facilities for smaller children. By comparison with the other schemes- there is a perceptible concentration of activity around the building.

4.2.2 Bustle and mixed uses

Utyenhaak suggests that bustle is a consequence of a mix of functions, people and type of spaces.[24] Amongst the newer and higher density schemes, there are a number of commercial activities within the site developments. These are intended to enliven the street and generate a density of activity at the entrance to the site. At New Festival Quarter for example, there are a number of commercial units at the site entrance which are set out around a central square.[25]

However, at New Festival Quarter and Abbott's Wharf, the highlighted areas are the only non-residential activity in the immediate vicinity. Arguably, the phenomenon of bustle requires a greater diversity of uses and juxtaposition between them than is generated simply by a combination of shops and residential uses. The range of facilities at the Community Centre at Bow Cross is a better example, with a range of activities, and timetables for the different programmes. It is clear, however, that the qualities of bustle are dependent on more than the juxtaposition of residential and non-residential programmes.

24 Uytenhaak, Rudy. *Cities Full of Space: Qualities of Density.* (Rotterdam: 010 Publishers) 2008.

25 These units were not yet occupied at the time of the site visits, therefore there was no evident 'bustle' generated, but there is potential, nonetheless.

CHAPTER IV

Testing the usefulness of a spatial index of density

Figure 4.2.3: The perception of people and their traces

Arrow Road (A05)

The inhabited house front signifies the presence and activities of people in the street

Bow Bridge (A01)

The corner position allows for a garden to be created – again showing evidence of the inhabitation of the space

Communal Garden at Bow Bridge (A01)

The ground floor flats have direct access to the garden but there is little evidence of inhabitation and therefore bustle. In fact the space is completely without bustle.

26 It is noted that higher density case studies are much newer than the lower density case studies, therefore having less time to have been adapted and altered.

27 In the previous chapter it was suggested that collective structures of organisation also impose a collective identity on the site, and in so doing limit the capacity for residents to personalise, or indeed use the dwelling in their own way.

28 Gehl, Jan. *'Life Between Buildings: Using Public Space.'* (Copenhagen: Danish Architectural Press) 1987, 97-99.

4.2.3 Traces of use

The presence of people and their traces is central to the perception of density. The impact that residents' interventions and alterations have on the perception of people in the locality was apparent in the comparison between schemes where opportunities exist for these types of intervention and where they do not.[26] The small front gardens at Arrow Road provide an opportunity for individuation. These spaces also enable intervention irrespective of the tenure of the houses and therefore, in a small way, contribute to the residents' ability to alter and to personalise their dwelling environment.[27] It was also apparent that even though the balconies of the flats in the tower blocks were inhabited in much the same way as those of the lower-rise flats, the impact that these contributions had on the perception of activity and people diminished with the increasing height of the building. This reinforces Gehl's suggestion that proximity between the dwelling and the street is an important factor in generating a density of activity.[28] The range of building types and varying age of buildings across the site at Bow Cross [B01] proved to be a useful case study for observing how opportunities for individuation are integrated as part of the design of the housing, and responded to by residents.

Bustle: discussion

Although the case studies were not ‘bustling’ in the sense of Benjamin and Lacis’ Naples scene, a number important observations were noted nevertheless. The analysis focused on identifying factors that might contribute towards a density of activity, and the way that the site layout concentrated the activity that does exist.

The density of activity was not necessarily less in the lower density schemes. It was affected by the functions and activities around the site, and as was suggested by the site at Arrow Road, the layout of the site which either harnesses the potential of this activity to generate social opportunity, or not. As was demonstrated by the site plan at Bow Bridge, it can equally inhibit activity, or exclude activity taking place around the site.

The schemes where residents have personalised and inhabited the space in front of their dwellings are also the schemes that were identified in the previous section as encouraging the propensity for ‘doorstep encounter’. The small front gardens at Arrow Road and at Bow Cross manifest a diversity of use, decoration, personalisation and upkeep, all of which contributes to a diverse and active street front. They also contribute to the perception of people – which is fundamental to the notion of bustle as an index of density. By comparison, the higher density schemes make apparent the high capacity of the site, but the occupancy of the dwellings is concealed. The physical proximity between dwellings and the street is an important factor in the impact that the people and their activities have on the activity of the street. Gehl refers to ‘assembling activity’, which is dependent on the proximity between the interior domain of the dwelling and the street.[29] In the taller buildings of the higher density schemes, distance between the dwellings and the street is a greater obstacle. However, it was also apparent in a number of the schemes that the need for privacy determined that the apartments closer to street level did not open up to the street.

In Simmel and Engels and Raban’s depictions of the experience of the city, it was not only the impact of proximity to the public spaces of the city that was of interest, but the experience that proximity has on the experience of home. The final index considers this potential conflict more closely. In defining the index of bustle, above, it was anticipated that the urban realm would be animated by the various activities of the site’s occupants. However, the occupancy was barely apparent in any of the schemes, and it may be that ‘bustle’ is more affected by the culture of the neighbourhood or city than was previously anticipated, or more dependant on the number of people.

29 *Ibid.*

Figure 4.3.1: Dwellings and the spaces outside of them in each of the case studies

A01 - Bow Bridge

A02 - Lansbury

A03 - Gale Street

B01 - Bow Cross

B02 - Caspian Wharf

B03 - St Andrews

4.3 Privacy

4.3.1 Privacy and sameness

Privacy is potentially one of the most critical indices when it comes to designing for conditions of proximity. A number of the indices considered so far have generated some implications in regards to the privacy of the dwelling. In terms of site coverage, the notion of intensity was affected by the proximity of the buildings to the edge of the site or to the street, which can expose the dwellings to on-looking, overlooking, the impact of noise from the street and potentially compromise spatial privacy through the physical closeness between the dwellings and public space. Collective structures, and the indices of physical density, also highlighted the potential for anonymity, which as King argues, can contribute to a particular type of privacy generated by the sameness of dwellings in a street or in a block.[30] The index of privacy is considered in two parts. The first part considers privacy in terms of how it is affected by site planning and considers how proximity between buildings and to public space potentially impacts on privacy. The second part considers the impact of proximity in the immediate vicinity of the dwelling. It considers the relationship between adjacent dwellings, which the evidence so far would suggest, tends towards being more physically defined and less open, the greater the proximity between neighbours.

A04 - Lincoln's Estate

A05 - Arrow Road

B04 - New Festival Quarter

B05 - Abbotts Wharf

30 Peter King, *The Common Place: The Ordinary Experience of Housing* (Aldershot: Ashgate, 2005). Also for discussion on the particular type of privacy afforded to hotel residents - Rem Koolhaas, *Delirious New York: A Retroactive Manifesto for Manhattan,* New Edn. 1994 (New York: Monacelli Press, 1978); Paul Groth, *Living Downtown: The History of Residential Hotels in the United States* (London: University of California Press, 1994).

Figure 4.3.2: Separation distances and privacy

Photographs show that residents still feel the need for a secondary defence against overlooking, in spite of the distance between buildings.

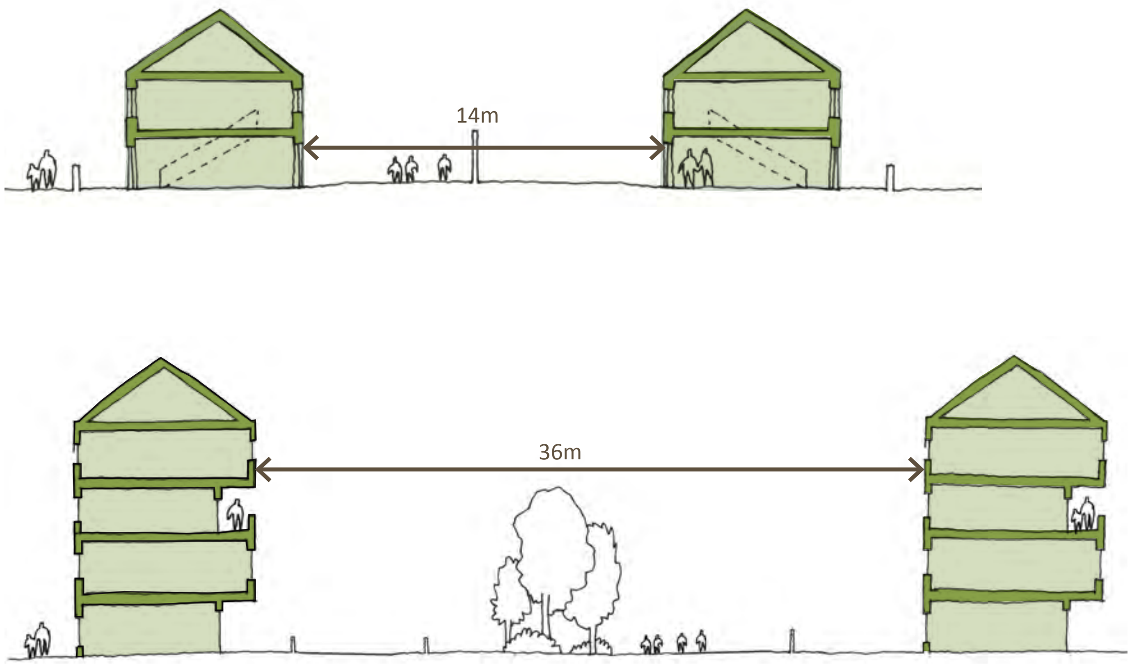
Arrow Road (A05)

At Arrow Road, where the street is approximately 14 metres wide, the majority of the dwellings have net curtains and blinds to prevent on-looking from the street and from neighbours

Lincoln's Estate (A04)

At Lincoln's Estate the separation distance is more than 35 metres between buildings, yet the dwellings also have net curtains and blinds at the window indicating that factors other than distance affect the experience of privacy

Section sketches and photographs



4.3.2 Privacy and proximity

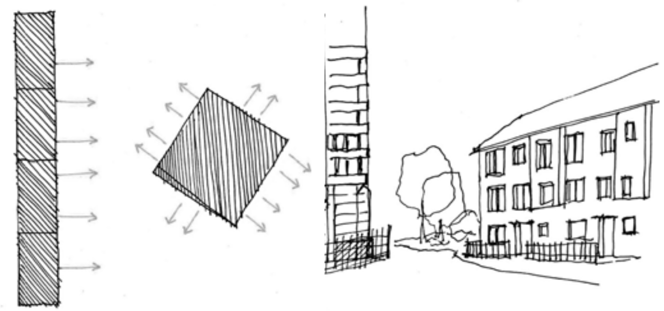
The analysis of site coverage above showed that there was a broad correlation between lower densities and greater distances of separation. With the exception of Arrow Road (which has a street width of 14 metres), all of the lower density case studies have separation distances between opposite facing buildings greatly in excess of the 18 metre rule-of-thumb distance assumed for privacy. However, the example of Lincoln's Estate shows that even where there is seemingly adequate distance between dwellings to protect against overlooking, privacy is not guaranteed. The perception of privacy is subjective, and whilst affected by traditional cultural values and expectations (governing what is considered an acceptable distance between two dwellings, for instance), the actual experience of privacy will be determined by the individual. This suggests that design strategies that are able to accommodate different demands in terms of ensuring and controlling the privacy of the dwelling are most effective for mitigating the impact of proximity on privacy.

Figure 4.3.3: Bow Cross (B01)

Development around the site edge increases the perceived intensity, but also generates proximity between buildings [1].

[2] and [3] Show apartments and houses developed with particular design strategies for mitigating the impact of the adjacent railways and underground lines.

1

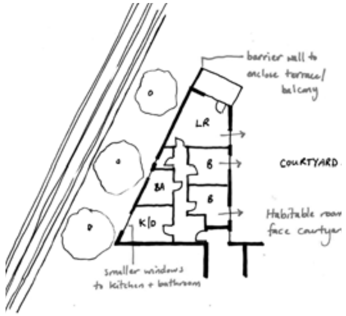


Bow Cross (B01)

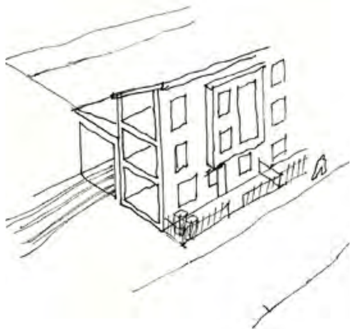
At Bow Cross the proximity between the new houses and the older tower blocks (14 metres at the narrowest point) and is an example of separation distances being reduced in order to increase the site coverage.

The houses are aligned obliquely to the towers - which may reduce overlooking, but there is a perceived intensity to the closeness of the buildings

(2) The impact of the adjacent railway line is addressed in the layout of the flats with habitable rooms located on the northern side of the floor plan and bathrooms and kitchens on the south, adjacent to the railway line. The terraces are also open to the north side, with a solid buffer screen adjacent to the railway.



(3) The houses are planned over three levels and wrap around the concrete tunnel structure that encloses the railway line. The acoustic comfort of the houses is determined by the technical resolution of the dividing wall that separates the bedrooms on one side from the train line on the other.



4.3.3

Amongst the higher density case studies there was evidence of the distances between buildings being squeezed.

At Bow Cross, new development around the site edges has generated close distances between the newer and older buildings on site.[31] These recent additions improve the definition of streets through the site and increase the perceived intensity of development and concentrate activity. However, where the buildings are very close together, this impacts on the privacy of the dwellings. The new houses and flats demonstrate a number of design strategies intended to mitigate the impact of proximity to the adjacent railway lines on the privacy of the dwellings. In the case of scenario 3 it can be seen that the solution is technological - and that complex construction techniques for creating effective acoustic separation and absorbing vibration, in this instance, are essential to bringing about the more positive aspects of density such as increased intensity and propensity for bustle and encounter.

31 The Bow Cross scheme is a redevelopment of a site that previously comprised the three tower blocks (remaining) and a single terrace of houses. The capacity of the site has been doubled by the new housing that has been built and the layout that has been adopted has attempted to define streets and connect the site, (which previously existed as an island with narrow paths across it but no clear thoroughfare) into the surrounding street network.

Bow Bridge (A01)

Grundy Street, Lansbury (A02)

Gale Street (A03)

Lincoln's Estate (A04)

Figure 4.3.4: Thresholds between the dwelling and public space

Arrow Road (A05)

Caspian Wharf (B02)

St. Andrew's (B03)

4.3.4 Thresholds and intensity

In comparing ground floor dwellings in the case studies it was apparent that in general, in the lower density case studies the privacy of the ground floor dwellings was protected by the distance between the dwelling and the street. At Bow Bridge, Lansbury, Gale Street and Lincoln's Estate there is a significant set-back between the street and the buildings that separates the front door or windows of the ground floor dwellings from the street.

Arrow Road is the exception amongst the lower density case studies. The distance between the dwellings and the street is around 1.5 metres, comparable with St. Andrew's and Caspian Wharf and therefore establishing equivalent proximity between the dwelling and the street. However, the privacy of the ground floor of the dwellings in each of the schemes, highlights a number of other factors that affect the impact of proximity on the privacy of the dwelling. These include:

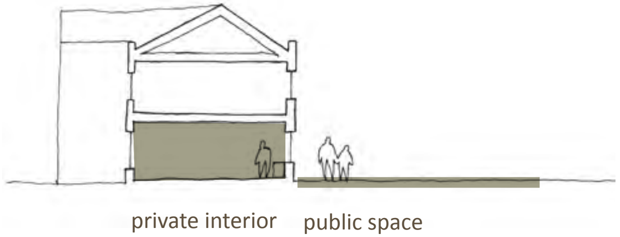
- Dwelling size and layout
- The size of windows and doors
- The type of public space

These factors are considered briefly as a means of understanding how design can be used to mitigate the impact of proximity on privacy.

Figure 4.3.5: Dwelling layouts and privacy

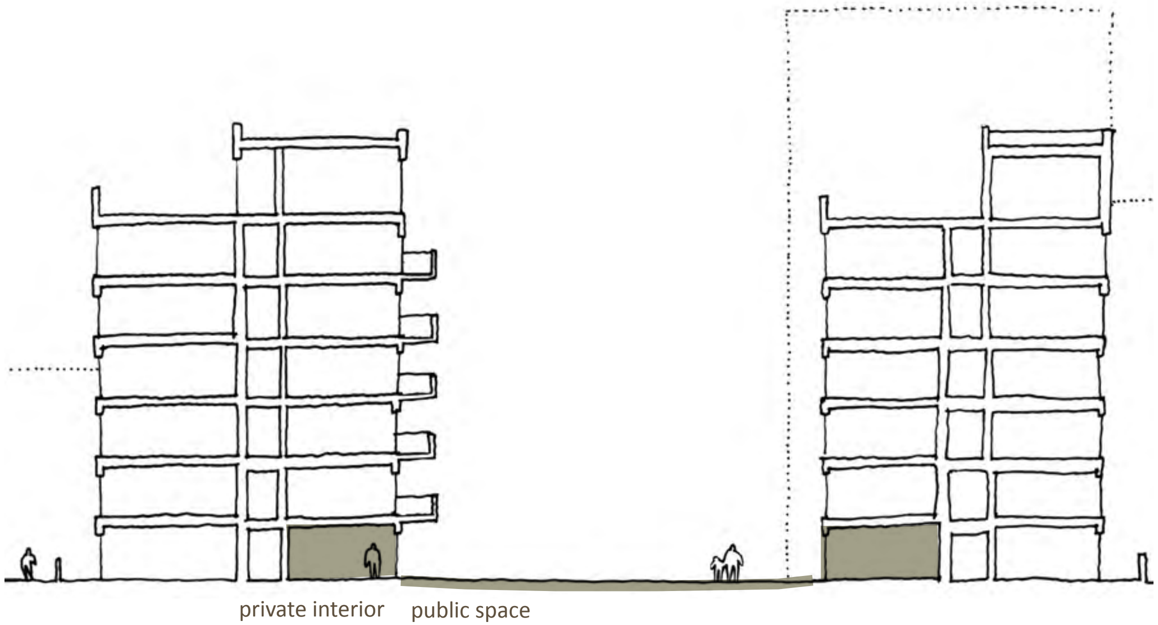
Arrow Road (A05)

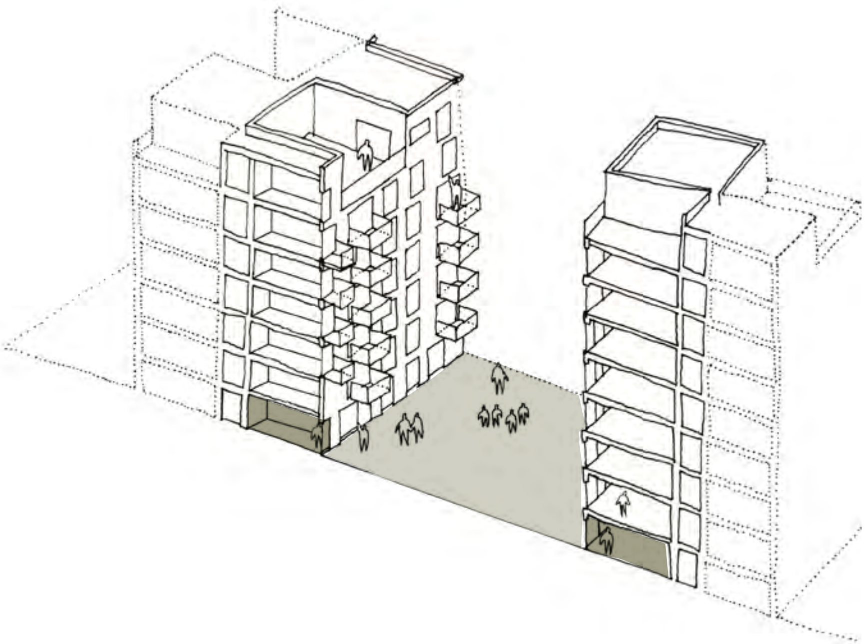
The houses at Arrow Road allow for more private rooms within the houses – particularly bedrooms and bathrooms-to be located on an upper floor, removed from the exposure of the street.



St. Andrew's (B03)

Threshold spaces to Block B with kitchens adjacent to the entrances allowing for smaller windows than in dwellings with living spaces on the ground floor





4.3.5 Proximity, privacy and dwelling layout

The dwelling layout affects how the proximity between the dwelling and the street impacts on privacy inside the dwelling. Strategies for mitigating the effect on privacy are essential to retaining or achieving the qualities of proximity in the built environment and demonstrate how the design of the dwelling and the urban layout are simultaneously affected by one another.

The examples shown demonstrate that having more than one storey, or having more than one aspect allow the dwelling to be planned in a way that mitigates the impact of proximity on the privacy of the dwelling. More private spaces within the dwelling, bedrooms, bathrooms and living spaces can be located away from the main street. Secondly, locating the main living spaces away from the street potentially allows for smaller windows onto the street, further reducing the exposure of the dwelling to on-looking.

Figure 4.3.6: Windows and Doors

St. Andrew's (A03): large windows to ground floor dwellings are required in order to meet the required daylight levels but expose the dwelling interior to on-looking from the street. In addition, the single-aspect layout means that all of the living spaces and bedrooms are adjacent to the street.

4.3.6 Proximity and visibility

In a number of the higher density schemes, the size of the windows contributes to the potential for overlooking between dwellings and on-looking from the street, thereby exacerbating the impact of proximity on the experience of privacy inside the dwelling.

It can be seen how the size of the windows, in addition to the single-aspect layout limit the opportunity for residents to control their exposure to on-looking.

Figure 4.3.7: Change in level between street and dwelling frontage

Bow Bridge (A01)

Abbott's Wharf (B05)

4.3.7 Privacy and site layout

Site planning strategies that could be used to mitigate the impact of proximity to the street on the privacy of the dwellings. The change in level between the street and the buildings at Bow Bridge and Abbott's Wharf limit direct on-looking from the street. Whilst this is not always possible where dwellings are accessed immediately off the street due to requirements for level access, it does suggest that if the ground floor is the most exposed part of the building, locating main living spaces and bedrooms on upper levels both mitigates the effect of proximity on the privacy of these spaces, but also allows for a more porous relationship between the dwelling and the space outside. At street level, larger windows can be used without impact on the main living rooms of the house, or at first floor, the rooms can have large windows and balconies on the street, to contribute to the bustle of the street but with a better degree of privacy for main living spaces in the dwelling.

This would not counter the potential for overlooking between opposite facing dwellings and other factors such as dwelling aspect would need to be considered.

Figure 4.3.8: Type of public space

Bow Bridge (A01)

At Bow Bridge the dwellings are accessed from the interior of the site rather than the street-facing side of the building – and although this impacts on the bustle of the street – allows for a sequence of thresholds between the main, public street, the communal landing and finally the dwelling. The communal courtyard/ car parking spaces at the rear are much less busy than the main street.

4.3.8 Porosity and semi-public space

Bow Bridge also demonstrates a potential strategy for limiting the impact of proximity. The subsidiary space within the interior of the estate acts as a sort of buffer, with little activity and public movement through. There would be an opportunity therefore to have a more porous relationship between the dwellings and these spaces without necessarily impacting on the privacy of the dwellings, than if these dwellings were accessed immediately from the street.

Privacy: discussion

The index of privacy is in many ways counter to the other indices of proximity. The porosity between the dwelling and the street that was associated both with opportunities for encounter and bustle, is potentially counter to the experience of privacy. There were suggestions from some of the lower density schemes where distances between buildings were in excess of the 18 metres generally required to ensure privacy from overlooking, that distance alone was not a guarantee of privacy. Instead, other factors, such as the size of windows, the layout of the dwelling, and in general, the exposure of the dwelling interior to on-looking and overlooking were identified as critical factors affecting the privacy of the dwellings. Furthermore, these are critical design issues that also affect the possibility for encounter, and the bustle of the environment.

There were a number of examples where it was apparent that the closeness of the distance between the dwelling and the public street, in addition to the layout and exposure of the dwelling through large windows compromised the privacy of the dwelling, and also residents' opportunities to control the privacy of the dwelling. These examples were particularly useful in highlighting ways in which design could significantly improve opportunities for privacy.

In terms of site planning, there were few examples of site layout being planned in a strategic way to control the

32 Evans and Lapore propose that the experience of crowding as a consequence of density is determined by the impact that the density condition has on the individual's activities. Where the density of a space impacts on the task in hand, then the individual might experience the density of the situation negatively. For this reason people can anticipate and cope with different degrees of proximity when they are engaged in different activities. Their study is cited in Amos Rapoport, 'Toward a Redefinition of Density', *Environment and Behavior,* 7 (1975), 133–158.

impact of proximity to public space on the privacy of the dwellings. Limiting the public-ness of the public space onto which dwellings open-out could allow for bustle, encounter between residents, and privacy to be present at once.

Aspect is a critical factor when it comes to the privacy of the dwellings. In the single-aspect dwellings it was apparent that daylight requirements and the design of the collective façade determined the size of the windows. The dwelling aspect also affects the porosity and potential for bustle. On one hand, the single aspect means that open windows and activity on the balcony spill into and animate the street outside. On the other, it means that the bustle of the street impacts directly on the privacy of the dwelling. There is a body of study that suggests that the negative experience of density (the experience of crowding) occurs where individuals feel unable to control the impact of density on their immediate environment and activities.[32] In the single-aspect dwelling, where windows are open for ventilation, residents have limited scope for controlling the impact of bustle outside of the dwelling. Not considering these issues at the design stage could contribute to the residents having a negative perception of this type of density because of the way that it impacts their home.

In the schemes with the single-aspect dwellings, the internal access corridors at the centre of the building floor plans raised another point of interest. In the previous discussion on encounter it was suggested that the phenomenology of these spaces limited their propensity as social spaces. However, their anonymity does contribute to a particular type of anonymous privacy.

Conclusions

The Bromley by Bow case studies were intended to provide a testing ground for the indices of density that had come out of the earlier historic and thematic investigations. Some of the indices proved to be useful as a means of drawing out fundamental organisational differences between case studies. There were instances where indices overlapped with one another. Other indices proved difficult to identify or to use as a meaningful, spatial analysis.

In general, the testing seems to have ratified the four proposed themes: numeric, physical, communality and proximity as useful ways of thinking about density for design. Although these themes had been drawn out of the different conceptions of density presented by the historical, conceptual, geographical and fictional sources studied in the earlier chapters, the process of identifying them on site challenged both how they were defined and what impacts they were expected to have. Testing them in this way has helped to better define the indices in terms of how each impacts on the experience of the built environment, and how they might be used to inform the design process. In the discussions on each of the themes there have been a number of recurring terms used to describe how density

Figure 3: The austere façade of the Bow Bridge estate (A01) emphasises the height and length of the buildings

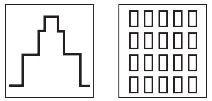


Figure 4: Despite strategies to contextualise the building heights at Caspian Wharf (B02), where the full extent of the building height is visible, the perception is of scale, capacity and density.

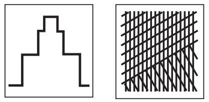
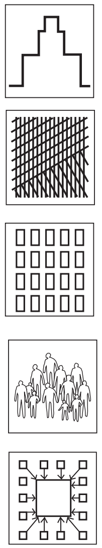


Figure 5: Five types of density – key to symbols



Scale

Intensity

Anonymity

Social Proximity

Collective Living/ Communality

is perceived. These include: scale, intensity, anonymity, social proximity and communality. Most of the indices were found to contribute to the perception of density in more than one way. For instance, collective structure potentially indicates density through the scale of the structure, and the communal organisation of the building or buildings on site. These have different effects and, in design terms, it might be desirable to mitigate the perceived scale of the scheme, whilst emphasising the perception of collective living. These should be design considerations. Interestingly, these terms begin to define a lexicon of density. They are referred to (with illustrative tags as in Figure 5) in Chapter Five, below, but it may be that these terms need expanding and defining in order to be useful to the design guide set out below and this may be something to expand upon in the future.

The use of ordinary case studies proved particularly useful. Looking at ‘ordinary' housing schemes has highlighted ways in which simply thinking about the experience of proximity, the bustle of the environment and privacy of the homes, for instance, could significantly improve the layout and qualities of the residential environment.

The suggestions and observations that were expanded through the discussions on each of the separate indices support the notion that density in numeric terms has limited use for design. However, understanding how each of the physical, communality and proximity indices are potentially affected by the pressure of numbers makes these analyses incredibly useful as a base for setting out a reference for design in the following chapter.

The indices of physical density relate to the perception of density two ways in particular. Building height and built form are related to the perception of density based on the physical scale of the buildings. Strategies for reducing the perceived scale of the building were evident in some of the case studies, but in many instances, the absence of any designed attempt to reduce the perception of the building's mass proved useful as a way of analysing the impact of built form and height on the perception of density (see Figures 3 and 4, opposite).

Whilst the amount of site coverage was not necessarily an important factor in the perception of density, the layout of the site and particularly the enclosure of open space on the site affected the ‘intensity' of the spaces between the buildings, as Unwin defined it. The perception of the pressure on the open space as a result of the number of people and dwellings that open onto it, proved to be a recurring quality, distinguishing between the conditions of density at the different sites. Open-ended spaces, with views through them, lessened the perceived intensity of development. In terms of design, therefore, the perceived enclosure of open space on the site and the relationship between the heights of the buildings and the amount of open space between them is the most useful aspect of the

Figure 5: The public space at Abbott's Wharf does not indicate communality in the same way that the community gardens at Lincoln's Estate do.

Figure 6: The communal, community gardens at Lincoln's Estate are under-used. Their presence indicates a type of communality as part of the strategy for the site organisation. It does not, however, determine usage.

33 Four of the lower density schemes and the 1970s tower blocks at Bow Cross are examples of post-war, publicly funded housing development.

index of site coverage and the index could therefore be refined in scope to reflect these primary issues.

The indices of communality, particularly collective structure and communal space, were most affected by the numeric densities of the case studies. It was expected that the higher density schemes would necessitate a greater dependence on communal space and collective structures. However, in the higher density schemes, almost all of the dwellings were incorporated in collective structures, requiring communal entrances, circulation, open space and utility and highlighting the importance of the design of these elements on the experience of the residential environment.

The indices of communality were also found to relate to perception of density in two ways: one, through the dominance of the collective identity and potential for anonymity, and two, in terms of a social and cultural association between density and certain housing typologies based on collective forms and communal open spaces. The first is easier to define in terms of spatial factors and therefore to identify ways in which design can mitigate the perception of it. The latter is more difficult and varies according to geographical, social, cultural and economic context. In the context of London, for instance, it is possible to identify architectural and spatial features that are culturally associated with a societal model in which communality and collective dwelling structures took an important role.[33] For the purposes of identifying design strategies that are relevant beyond the context of London, however, emphasis is placed on the organisational implications of the indices of communality, as opposed to the symbolic ones.

The dominance of the collective identity is a potential consequence of collective dwelling types irrespective of the stylistic characteristics of the built form. In terms of how design can be used to mitigate the predominance of the collective identity, two opportunities were identified from the case studies. One was to reduce the overall scale of the collective structure, or at least the perception of it, thereby limiting the repetition and potential anonymity of the collective building façade. The other is to provide opportunities for individualisation of the dwelling frontage. The importance of scale was also relevant to the index of communal space. It was apparent that the number of dwellings (or perceived number of dwellings) sharing the space impacts on the perceived density of the site, but also on the quality of the space itself.

Utility, and the provision thereof, is undoubtedly an important factor in the design of higher density environments. The required allocation of space for refuse, bicycles, energy distribution centres and car parking consume huge areas of the site on some of the higher density schemes and can be a defining characteristic of density. Furthermore, as indicated by some of the lower density schemes, where utility provision occupies a

34 The absence of people in the photographs of the case studies accurately reflects the activity that was observed on visits to the sites. Site visits were carried out on weekdays and weekends and as far as possible in fine weather.

35 Arguably it demands different methods and may be developed further as a supplementary study to this.

prominent position in the layout of the site it becomes both a critical element of the spatial organisation of the site, and a visual symbol of the communal organisation of the site. As in the case of collective structures, design can mitigate the prominence of utility as a defining element of the site, or it can emphasise it.

The indices of proximity proved difficult to identify in the Bromley-by-Bow case studies. However, as much can be learned from the absence of social activity as from it's presence. One such example was the apparent absence of social mindedness in the design of the internal circulation spaces in the higher density case studies. These corridors arguably represent a spatial model that responds to the particular proximity conditions of higher density, collective housing. The proximity between neighbours, and clustered organisation of dwellings around shared landings (as advocated by Marcus and Sarkissian as a way of encouraging sociability between neighbours) ought to provide the raw material for social space. However, in all cases, these landings and stairwells were designed as anonymous, internal, corridor spaces that provided little to encourage social encounter. Further consideration of these spaces in relation to the privacy that they provide, suggested that the anonymity of the front doors to each of the flats was integral to the privacy of the dwelling. At Abbott's Wharf, for instance, there is a stark contrast between the anonymity of the circulation corridor (and the privacy that provides) and the public-ness of the open space outside.

There is no 'communal' space as Marcus and Sarkissian would describe it, or shared space as Habraken would advocate. The evidence from these case studies suggests that the design strategy that has been developed for dealing with the proximity that results from higher numeric densities is premised on a model of the individual in the city. The organisation of the site and of the building, even the design of the façade precludes the expression of the individual and provides the anonymity of a collective identity, all of which preserves the privacy of the individual.

None of the case studies manifested the density of activity that could be reasonably described as 'bustle'.[34] This implies that the index needs further consideration. However, in spite of the absence of the qualities of bustle outlined in the previous chapters, the index is nonetheless a vital one. Of all the indices it is the most experiential and temporal. It captures (or at least, is intended to) the phenomena of multiple bodies, activities, and agenda, competing and at the same time collaborating to define the qualities of a particular place at a particular time. It is the illusive objective of most designers - the scene sketched out in the initial concept design. Therefore it is retained here as an index, but is the one that requires the most development and refinement.[35]

Chapter V

A reference for the design of higher density housing

CHAPTER V

A reference for the design of higher density housing

Introduction

This final part of the thesis aims to expand and present the findings of the analyses in the previous chapter in a way that is useful for design. This part of the thesis responds to, and brings together the discussion and analysis that has been carried out in developing this thesis over the previous four chapters, in response to the second of the two research questions; *how might the concept of density be elaborated or reinterpreted in order to be a useful starting point for design, specifically in relation to new urban housing?*

The response to this question is organised in two parts. Part one situates this chapter in relation to the study as a whole and sets out the reasons for using design propositions at this stage in the thesis in response to the research questions and the broad conceptual framework of the study as a whole. It expands on the indices that were proposed, tested and refined in the previous chapter. Part two is presented as a design reference. It expands on the conclusions drawn out in the previous chapter and sets out a series of strategies and tactics for design that seek to harness the potential positive spatial implications of density and mitigate the negative ones.

This chapter begins to draw conclusions to this thesis, suggesting ways in which design can be used responsively and creatively within the constraints imposed by numeric densities and furthermore suggesting ways in which the social and spatial attributes of density might be pursued through design. The analyses in the previous chapter demonstrated that the increase in numeric density between the two groups of case studies selected, had potential implications for the physical, organisational and social characteristics of the site. However, they also demonstrated that the indices that were set out provided a useful means

1 Alexander, Ernest R. *'Density Measures: A Review and Analysis'*.

2 Maccreanor Lavington Architects, Emily Greeves Architects, and Graham Harrington Planning Advice, *'Housing Density Study'* (Greater London Authority, 30 August 2012). The *'Housing Density Study'* which emerged out of a practice-based analysis of the regulations and economic parameters that determine the 'shape' of density under different urban conditions, is also formalist (in the sense that it is concerned primarily with the massing and type of housing on a site) and premised on the notion of density as a numeric index. Whilst it is a detailed and comprehensive study, it further strengthens the case for a study that considers the implications of density at the personal-political level - the implications for local, neighbourly social relations and for the empowerment of the individual as a result of the spatial and social relations that are established within the residential environment.

3 Roemer van Toorn, '*No More Dreams? The Passion for Reality in Recent Dutch Architecture* (2007) cited in Nishat Awan, Tatjana Schneider, and Jeremy Till, Spatial Agency: *Other Ways Of Doing Architecture* (London: Routledge, 2011), 39.

of identifying the different spatial characteristics of the case studies and, critically, different spatial characteristics associated with density. The four themes: numeric, physical, communality and proximity provided a useful starting point for thinking about density in terms of its physical and social implications, alongside, or in addition to the economic and strategic issues represented by numeric units and floor space densities.

This final part of the thesis sets out a reference for design that expands on these four types as different ways of thinking about the design of higher density environments. It also draws together the discussions that have been set out in the preceding chapters in order to situate these design possibilities within a framework of economic, policy and practice related issues that affect residential development.

The need for a design reference

In Chapter Three of this thesis, following the historical study that had exposed different ways of thinking about density, and the unpacking of the measurements and applications of density, it was determined that, in order to move towards a conception of density that would be useful for design it was necessary to define those issues that were of concern. The potential formal implications of numeric densities had been considered in various studies and conclusions drawn, however, there were two fundamental issues, even shortcomings associated with these studies. One is the emphasis on form and type (Ernest Alexander's study on density and typology is an example of this approach).[1] The other limitation is the reverence to density as a numeric ratio.[2]

The 'spatial' conception of density, set out in Chapter Three therefore marked a departure from the other, existing research on the subject. The twelve indices that were proposed were intended as points of reference – as a means of guiding designers towards consideration of the implications of density other than the economic and strategic implications of numeric density measurements. They were proposed a means of countering the emphasis on the economic and regulatory frameworks that exert significant and defining influence over housing design. These factors easily overwhelm and dominate concerns about design. As Roemer van Toorn, writes:

> *Instead of taking responsibility for the design, instead of having the courage to steer flows in a certain direction, the ethical and political consequences arising from the design decisions are left to market realism, and the architect retreats into the givens of his discipline.*[3]

Indeed, the predominance of numeric densities and the primary conception of density ratios as instruments of measure and control, establishes the factors that are represented by those measurements – economic viability and infrastructure planning – as the most important factors.[4]

4 Boyko and Cooper highlight the predominance of dwelling and habitable room densities and the impact this has in overwhelming other, potentially more useful ways of measuring density. 'Clarifying and Re-conceptualising Density', *Progress in Planning* 76 (2011): 1–61.

5 M De Certeau, *The Practice of Everyday Life,* New edition (2002) (London: University of California Press, 1984), xix.

The other three types of density: physical, communality and proximity have much greater impact on the lived experience of the urban and residential environment. The proposed index provides a framework for thinking about, identifying, and giving weight to, the spatial and social implications of density as key design considerations.

The selection of 'normal', even banal residential environments as case studies was intended as a 'sample' of typical, non-exemplary housing. They are arguably representative of what emerges when pragmatic architectural practice conspires with the dominant forces of economics and planning regulation as Roemer van Toorn alludes to. The extent to which attention or concern had been dedicated to the spatial politics of density, to the phenomenological experience of residential environment and the impact, for example, that an internal stair and landing has on the potential for social interaction, varied across the case studies. Whilst these concerns were often not evidently played out in the design of the residential environments in either the lower density or the higher (numeric) density case studies, it was apparent that the higher density ratios intensified the need for design to manipulate the spatial relationship between neighbouring dwellings and between the dwelling and the surrounding neighbourhood. In the schemes with lower numeric densities, it was apparent that the potential experience of intensity, or the physical proximity between people could often be overcome by distance. In this way, setting out indices that identify and attach weight to the spatial configuration and qualities of space and the potential social and phenomenological implications challenges the simple distinction between high and low numeric densities.

A scheme with a high numeric density, might have a very low density of social opportunities, or articulate the privacy of the dwellings very poorly, thereby compromising the experience of density in and around the dwelling. Yet, as long as density is defined simply in terms of numbers, higher is always better, and the spatial compromises that might result can be framed as inevitable or necessary consequences of the economic, environmental or political argument for higher densities. However, as was also demonstrated by the case studies in the previous chapter, these compromises can be limited. Design can mitigate the effect of proximity on the privacy of the dwelling, it can create opportunities for social encounter, and organise collective spaces and amenities in a way that harnesses their social potential, provided that these potential positive benefits of density are recognised.

The design reference is set out as a series of strategies and tactics for mitigating the negative impacts of density and harnessing the potential positive ones. It draws on the distinction made by Michel De Certeau between the 'strategy' as the product of the formal structures of practice, and tactics, as a seizing of opportunities and manipulation of events to alter the course set out by the

1. NUMERIC DENSITIES	2. PHYSICAL DENSITIES	3. COMMUNALITY	4. PROXIMITY
1.1 Dwelling Densities	2.1 Building Height	3.1 Collective Structure	4.1 Encounter
1.2 Habitable Room Densities	2.2 Intensity	3.2 Communal Space	4.2 Bustle
1.3 Plot Ratio	2.3 Built Form	3.3 Communal Utility	4.3 Privacy

Figure 1: Refined index showing
the twelve indices for design.

dominant forces of production.[5] Both are dependent upon a thorough understanding of the critical factors that affect density – the economic, political, environmental, physical and professional. These issues that conspire to determine the numeric densities that make development viable, and on the other, the typological characteristics, amenities, infrastructure and tenure requirements that affect the layout and organisation of housing.

The architect Teddy Cruz argues that designers need to be equipped with an understanding of the economic and political frameworks that surround housing development in order to manipulate and deal with them in a productive way.[6] In the case of Cruz's work, these tactics are not only design-based. They involve a thorough understanding of how the division and ownership of land affects density. Strategies for operating within the regulatory framework specific to London were set out in some detail by the recent Housing Density Study.[7] Other studies such as the Superdensity study, and even Berghauser Pont and Haupt's critical Spacematrix study, provide potential strategies for operating within the demands imposed by numerically defined density requirements and the planning and housing policies that affect the design of housing itself.[8]

In the reference set out below, some of the tactics suggested address the organisation of the housing development process, or the ownership of space or services within the site – factors that are normally outside of the role of the architect, but nonetheless have the potential to unlock the social potential of higher densities. The majority of the design strategies deal with the elements that were considered as part of the analysis in Chapter Four. They focus on the spaces between the buildings and critical decisions such as site layout and massing, the design of building facades, and thresholds between the buildings and surrounding spaces. These are reflect the areas that architects typically have the most control over, and the spaces in which the perception of density, as defined over the course of this thesis, is experienced. The experience of density in the interior of the dwelling was separately defined and is beyond the scope of this thesis and is therefore not referred to in the design reference.

The structure of the design reference

The design reference is organised according to the indices set out in Chapter Three and refined in the previous chapter (see Figure 1). The three numeric indices are discussed briefly in terms of their significance for the design and planning of new residential environments. However, the earlier chapters in this study have considered the implications of these measurements in some detail and therefore it is not intended to re-visit them here. Suffice to say that understanding of how numeric densities are applied and the potential implications that they have for the massing, layout and organisation of dwellings and people on a site is essential for enabling designers to operate in

6 Teddy Cruz, 'Architecture: Participation, Process, and Negotiation', in *Verb Crisis*, Boogazine 6 (Barcelona - New

7 *The* Housing Density Study, again, sets out the myriad policy factors and frameworks that affect the layout and design of residential environments – demonstrating the very real impact that these factors potentially exert over design. Maccreanor Lavington Architects, Emily Greeves Architects, and Graham Harrington Planning Advice, 'Housing Density Study'.

8 Design for Homes, *'Recommendations for Living at Superdensity'* (Design for Homes, July 2007); PRP, *'High Density Housing in Europe: Lessons for London'* (East Thames Housing Group Limited, 2002); Meta Berghauser Pont and Per Haupt, *Spacematrix: Space, Density and Urban Form* (Rotterdam: NAI Publishers, 2010).

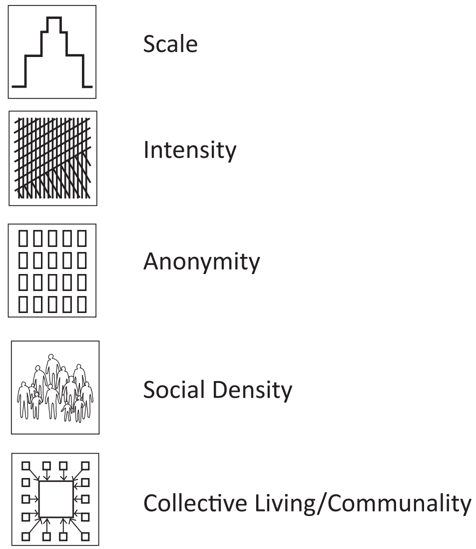


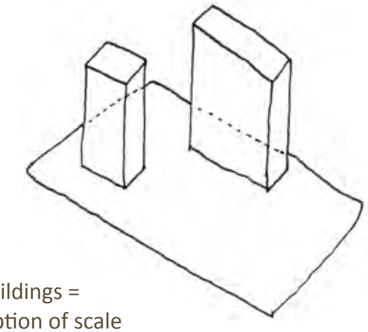
Figure 2: Five types of density – key to symbols

a tactical manner within the onerous constraints imposed by economic viability measurements and infrastructure provision.

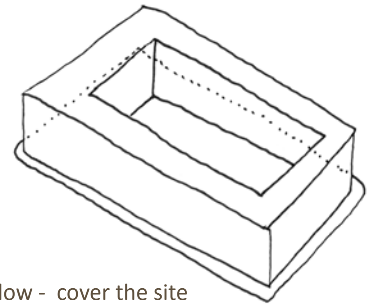
A design reference is then set out for each of the other nine indices. They are intended as references only; pointers that direct attention towards the critical spatial consequences of density and the opportunities for design to improve the experiential qualities and harness opportunities that arise out of density and proximity. A number of these design pointers appear simple, to the point of being banal in design terms, but they are nonetheless factors that have a potentially transformative effect on the experience of the residential environment within a given condition of density. Others may seem obtuse, or overtly specific in the criteria to which they respond (the communal utility pointers, for instance). These have emerged out of the case studies that have been explored in the course of this research are included because they exemplify a creative approach towards a problem that, although seemingly limited in scope, can have a significant impact on the residential environment.

The indices are each expanded with a number of design pointers. These are categorised by the scale at which they are relevant. Some issues can be addressed at the scale of the site layout, whilst others are a matter for the design of the building or the individual dwelling itself. The fourth scale is the scale of inhabitation which deals with design considerations that anticipate how space might be used. The fifth and final scale is that of policy and regulatory controls. These factors are often outside of the scope of the designer, but nevertheless present opportunities for thinking tactically and devising ways of operating within the pressures imposed by density ratios and associated planning regulations. These are apparent particularly in relation to the communality indices.

The design reference also refers to the qualities of density that were defined following the discussion in Chapter Four. These are: scale, intensity, anonymity, communality and social density (Figure 2). In the analysis in the previous chapter it became apparent that these qualities of density were recurring terms used to describe the perception or experience of density associated with each of the indices. They are included therefore as a guide as to the different ways in which the design tactics affect the perception of density.



Tall buildings =
perception of scale



Build low - cover the site
but with less height

Site

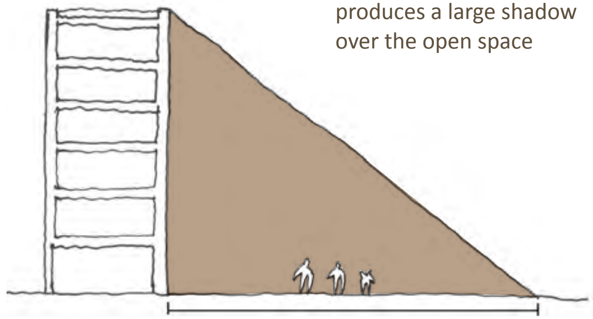
1.1 The perception of the physical height of the buildings can be limited by reducing the actual physical height of the buildings. As Neave Brown suggested: “to build low, to fill the site… to integrate”, this was what makes housing the background stuff of the city.[10] To build low is immediately the opposite of the monumental that Koolhaas describes, although lower buildings can still be perceived as large scale [see notes 1.3 – 1.5 and 3.1- 3.2].

Tall building on the street edge

Tall buildings set back from street edge

Site

1.2 The site layout can be designed to limit vantage points from which the overall mass of the building can be seen. Some of the higher density schemes used for testing the indices in the previous chapter demonstrated strategies for reducing the visibility of the height of buildings by concealing the tallest buildings at the centre of the site whilst the edges of the site were set at heights equivalent to the neighbouring buildings.



The building profile
produces a large shadow
over the open space

The stepped profile
reduces the impact of
overshadowing at street
level

Site

1.3 Careful planning and orientation of the building mass can reduce the area of the site subject to overshadowing as a result of the building mass, thereby reducing the impact of the building’s height

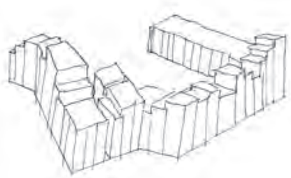
Physical Densities

1. BUILDING HEIGHT

Beyond a critical mass, each structure, in view of its size becomes a monument. That was what Koolhaas asserted.[9] The analysis in the previous chapter reinforced this notion and demonstrated that physical mass, on its own can signify physical density. In particular, building height, impacts on the perceived scale of the buildings, the potential for repetitiveness and anonymity, and, in combination with site layout can also affect the perception of intensity.

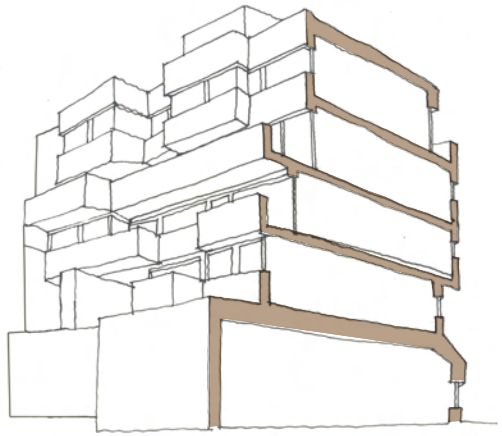
A critical factor was the perception of the physical mass of the buildings. Devices that concealed the full extent of the building's height or depth reduced the perception of scale and therefore physical density. The strategies set out opposite address, firstly, the physical height of the buildings, and secondly the perception of that height.

At the Greenwich Millennium Village, the height of the apartment blocks is stepped up from three storeys adjacent to the houses, to eight storeys opposite the open space of the nature reserve. The broad width of the boulevard, and open space opposite counters the increased height of the buildings along this edge, whilst the lower height adjacent to the houses provides a discreet transition between the two building types.



Site

1.4 Contextualising the building height can also help to reduce the perception of height. Christopher Alexander set strict rules for building height, stating that buildings should never be more than one storey taller than their neighbours.[11]



At Lillington Gardens the building profile is stepped with generous terraces at the first and fourth floors that respond to the horizontal strata in the façade of the Georgian terrace opposite. The upper two floors are set further back so that they are barely seen from the street.

Site Building

1.5 Stepping the building profile back at the upper storeys interrupts the continuity of the vertical façade and can reduce the visibility of the upper storeys. Accommodating an additional floor within the pitched roof of a building also has a similar effect. These strategies also reduce the impact of overshadowing from these upper storeys.

9 Rem Koolhaas, *Delirious New York: A Retroactive Manifesto for Manhattan,* New Edn. 1994 (New York: Monacelli Press, 1978), 100.

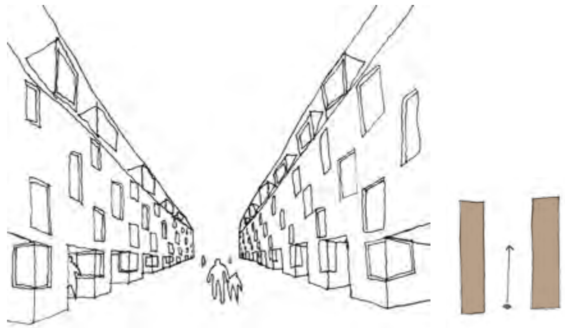
10 Neave Brown, 'The Form of Housing', *Architectural Design* (September 1967): 433.

11 Christopher Alexander, Sara Ishikawa, and Murray Silverstein, *A Pattern Language: Towns, Buildings, Construction* (Oxford University Press, 1977), 417–419.

Site

2.1 The relative enclosure or openness of the spaces between the buildings affects the perceived intensity of development. Streets, that have a long view beyond the edge of the site, for instance, reduce the perceived intensity because there is a sense that the capacity of the buildings could simply spill out. By comparison, an enclosed space is assessed in direct proportion to the perceived capacity of the buildings surrounding it.

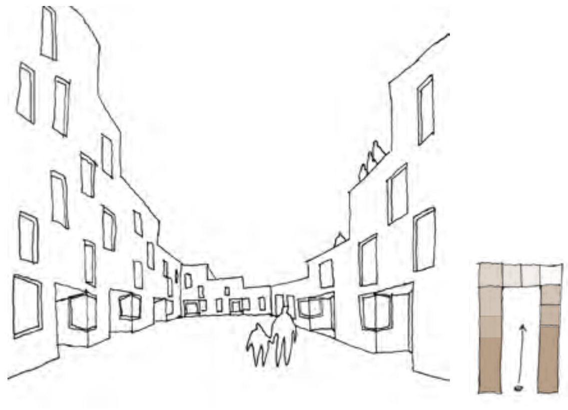
Enclosed court



Open street

Semi-enclosed court with view through

Openings cut through the building mass to create views out



Building mass stepped down to give views out

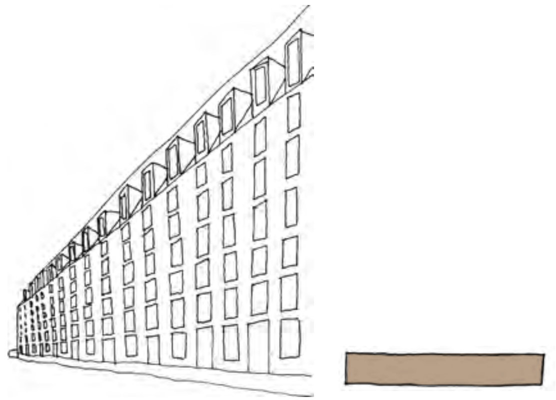
Building

2.2 The mass of the building itself can also be designed to enable views out. This might be achieved by lowering the height of the building on one side of the block, or cutting into the block to establish views out.

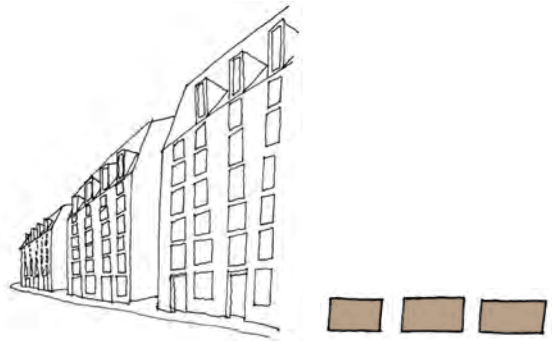
2. INTENSITY

The index of intensity was refined from the index of site coverage. It is concerned with the relationship between the height of the buildings and the space in between them and how that impacts on the perceived density of the site. An intense environment is one in which the perception of the building's mass and capacity (which Unwin who originally referred to a measure of intensity, considered the main concern), appears to be high in relation to the amount of open space available on site.[12] The perceived intensity of development on a site can be affected by strategies for limiting the perceived mass of the building (see building height, above), or through strategies that increase the perception of the amount of open space available on site.

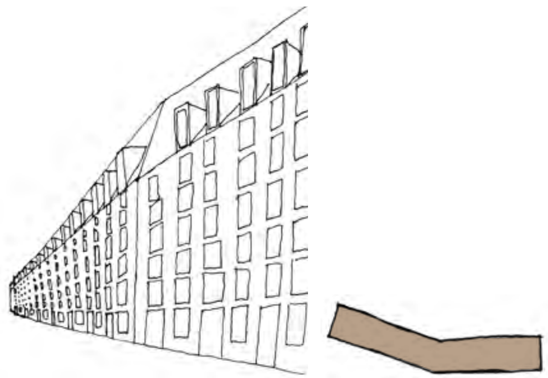
12 Unwin was concerned with a measure of the intensity of use of un-built ground, which he as, the condition that would occur if the population of all the buildings in an area goes out at a given moment, how much room there would be for them in the streets and other nonbuilt ground? Meta Berghauser Pont and Per Haupt, 'The Spacemate: Density and the Typomorphology of the Urban Fabric', *Nordic Journal of Architectural Research* no. 4 (2005): 58.



Continuous building frontage



Building length broken



Skewed profile - breaks continuity of facade

Site

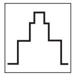
3.1 Dividing the length of the building into shorter elements reduces the actual and effective length of the building.

Wansey Street, Southwark, South London – designed by DRMM (2006)

The building has a long street façade that is broken where the stair core rises through the building, dividing the length of the building into sections that, proportionally, reflect the adjacent terraced street.

Bear Lane, Southwark – Panter Hudspith Architects (2009)

The building façade is designed to appear as though the site comprises a series of tall buildings, aligned in a terrace. Each distinct 'building' as it were, is also divided into horizontal sections, to give the impression of individual dwellings stacked on top of one another.



Building

3.2 The perception of the building's mass can also be affected by dividing up the façade into shorter vertical sections, or defining distinct clusters of dwellings within the overall mass. This distinguishes different parts of the scheme and reduces the perceived scale of development on the site.

3. BUILT FORM

The index of built form is also concerned with the physical mass of the building, and the perception or visibility the building mass. The depth of the building and length of the building façade can contribute to the perceived scale of the buildings, and where it is repetitive, to the perception of anonymity. Strategies for limiting the visibility of the building's mass, therefore contribute to limiting the perceived scale of the building.

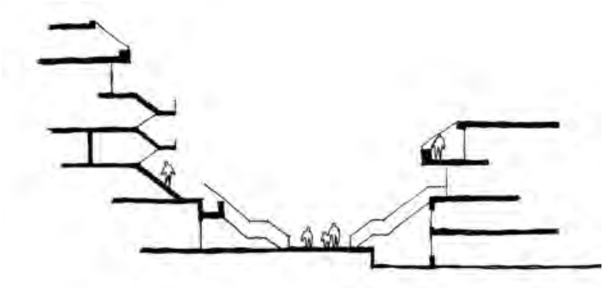
Breaking up the length of the façade, either by dividing the length of the building into shorter elements, or introducing vertical breaks at regular intervals can also mitigate the perceived endlessness of the façade and lessens the sense of anonymity that can result from a very large (tall, extended or both) building façade.

A notched profile is used in these houses in Mexico designed by Elemental, with space to accommodate an extension to the dwellings in the future. The overall façade is designed to embrace these infill developments.

Site Building

4.1 At the scale of the site, designers may promote variation and individuality as a positive quality of density (associated as it is with bustle and the perception of people). The architect Peter Barber talks about designing opportunities for residents to inhabit and use external space, and how these uses add to the 'colour' and activity of the street.[14]

Alexandra and Ainsworth Estate, Camden. Neave Brown and L.B. Camden Architect's Department, 1972



Site Building

4.2 At the scale of the building itself, the design of the façade might expose and express the use of the building and in this way enable the residents' inhabitation of the scheme to become part of its defining character -irrespective of tenure. At the Alexandra and Ainsworth estate in Camden, the size of the terraces means that their use contributes to the overall scene of the street.

Bear Lane, Southwark

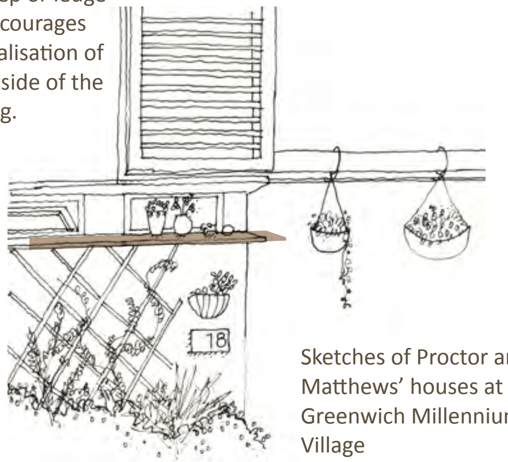
Panter Hudspith Architects
2009

Building

4.3 The building façade can also be designed in a way that accommodates future changes and alterations by individual residents. The façade of the Bear Lane scheme, again, is divided into many distinct parts, each of different proportions, in a way mimicking the vertical stacking of distinct dwelling units found in Kowloon Walled City. The intricacy provides flexibility. If one dwelling was altered - windows replaced or balcony enclosed, for instance - the façade would retain its character, as opposed to a uniform façade, in which any alteration would stick out like a 'sore thumb'.

Providing an empty planter with trellis for each dwelling anticipates the plants (that may be) grown by each household as part of the designed façade of the building as a whole.

Or, a step or ledge that encourages personalisation of the outside of the dwelling.



Sketches of Proctor and Matthews' houses at Greenwich Millennium Village

Dwelling Individual

4.4 At the scale of the dwelling, designers can work within the constraints of tenure and leasehold covenants to provide opportunities for residents to inhabit and personalise their dwelling.

4. COLLECTIVE STRUCTURE

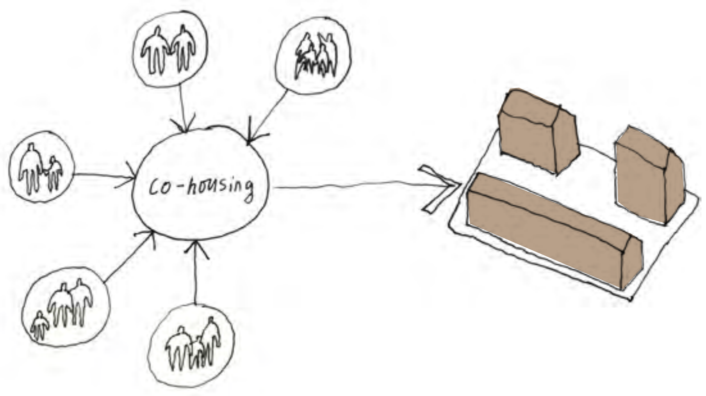
The collective structure impacts on the experience of density in two ways: through the need for communal space as part of the internal organisation of the building (considered below), and secondly, through the impact that the collective structure has on the articulation, and flexibility of use of the individual dwellings within the structure.

Drawing on the case studies considered in the previous chapter, it became apparent that two factors impact on the autonomy of the individual household in terms of how the dwelling can be used, altered or personalised. Those were the physical scale of the buildings – the larger the buildings and the higher the density ratios, the less autonomy individual households had- and secondly, tenancy and leaseholder covenants. In most of the higher density schemes, covenants controlled how outdoor space (typically a balcony) could be used.[13] As well as affecting use, these rules (i.e. no laundry, no bikes, no painting, no hanging garden boxes, for instance) acted as effective aesthetic controls. This lead to the suggestion that the dominance of architectural expression of the collective structure over the individual dwelling was symbolic of the communality associated with density.

Whilst the covenants themselves are a matter of legal precedent, designers can anticipate the limitations that are imposed by these covenants by exploiting those uses that are permitted. In rented homes, the tenant's freedom to alter the physical fabric of the dwelling is also strictly limited. Designers can, however, pre-empt this and create opportunities for and flexibility for the way that the dwelling is inhabited and furnished (the scale at which tenants and leaseholds are able to control their dwelling environment). Such tactics provide a means of challenging the dominance of the collective structure where this proves inhibitive to the freedom of use, alteration and personalisation of the dwelling.

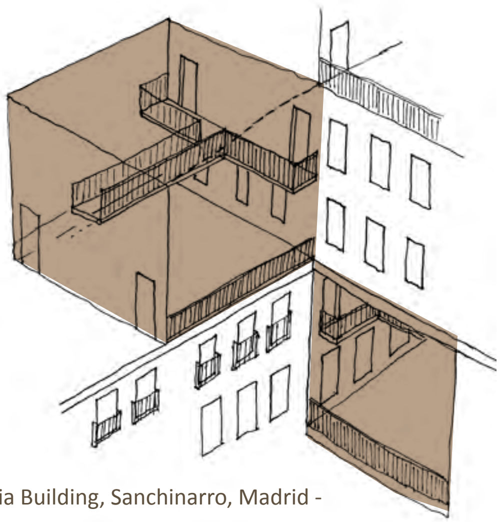
13 Leaseholder deeds on new apartment buildings in London often designate the extent of the lease as the interior of the dwelling only; whilst the external walls of the building and any space outside of the dwelling might be designated for access by the leaseholder, but remains the property of the landowner or freehold owner.

14 Barber, Peter. 'Alternative Housing Checklist'. *Architect's Journal* (15 March 2013) and *'Donnybrook Quarter, Bow'*, (London: University of Westminster) 2008.



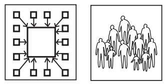
Strategy

5.1 Collective or co-housing models have a great deal of potential for harnessing the opportunity for communality as a result of density and proximity. They provide a model for organising communal space in a way that it benefits residents. Cohousing can take a variety of different forms, and can vary in terms of the amount of space that is shared and degree of interdependence between households. This can range from the integrated, 'collective housing unit' in which residents share a number of facilities and responsibilities for housework (for example the Swedish 'kollektivhus' model) to the Baugruppe model popular in Germany.[16] The latter often differ very little in terms of their spatial organisation from commercially-funded housing development, but is premised on a cooperative funding model in which residents form a collective, or 'Baugruppen' in order to share the development costs. The degree to which space is shared on site varies by scheme, but crucially, the residents themselves have determined what is shared, how, and how it will be managed. In this way co-housing offers a potential strategy for negotiating the compromises that can be associated with communality as a strategy for higher density housing.



Celosia Building, Sanchinarro, Madrid - MVRDV, 2009

Smaller terraces shared between four or six apartments form part of the entrance sequence to each of the dwellings and are integral to the daily coming-and-going. They are also immediately accessed from each of the surrounding apartments - alleviating ambiguity over ownership or access.



Site Building

5.2 As well as the strategic organisation and ownership, the number of people sharing space impacts on the perceived communality and institutional sense that can be associated with density. Smaller spaces, shared by a limited number of dwellings, each with equal access to it, can mitigate the institutional sense of communality (a signifier of density). The integration of communal space also affects the perceived ownership and therefore, use of the space.

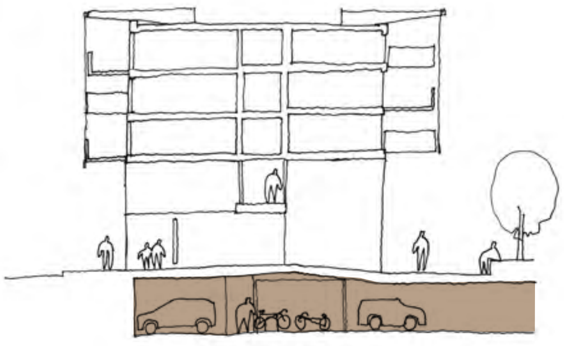
5. COMMUNAL SPACE

Communality and communal space, are in themselves indicators of density. Communal space also has an inherent influence over the layout of housing and can affect the experience of density in two ways, firstly, through the degree of sharing that it necessitates, and second, the perceived ownership and access to communal space. Strictly managed communal space is one way in which density can potentially inhibit residents' freedom to inhabit their residential environment.

Marcus and Sarkissian also suggested that limiting the number of people sharing the space was essential for it to become a space for social encounter between neighbours, as opposed to the anonymous encounter of public space.[15] In terms of the second issue – ownership of space – the tenure and leaseholder arrangements of the site play an important role in affecting the extent to which residents feel able to inhabit and use the communal parts of the site freely. In the St Andrew's development considered in the previous chapter, the number of people sharing the communal gardens not only heightened the perception of intensity and communality, but also determined that responsibility for maintaining the gardens would be taken by the site owners and their management company. External ownership and management arguably impacts on residents' perceived capacity to use the spaces freely, positing these spaces as a key example of the communal as an indicator of density, but not necessarily communal in the sense of shared and collectively owned.

15 Marcus, and Sarkissian, *'Housing as If People Mattered: Site Design Guidelines for the Planning of Medium-Density Family Housing'.*

16 Vestbro, Dick, Urban, 'From Collective Housing to Cohousing—a Summary of Research', *Journal of Architectural & Planning Research*, 17 (2000), 164–178.



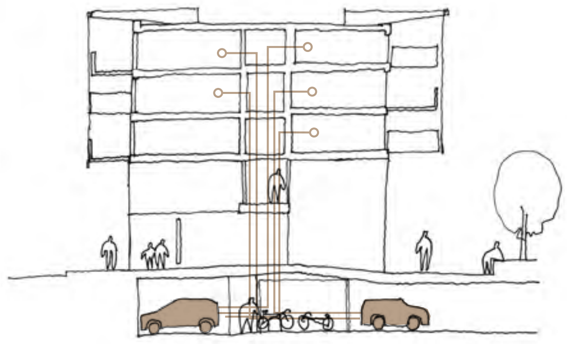
Sketch section showing the location of utility spaces - car parking, cycle storage and refuse stores.

Adelaide Wharf, Hackney, East London.

AHMM, 2007

Site Building

6.1 Underground is a good place for building services. It mitigates the impact of large, uninhabited service zones on the street. Alternatively, in large buildings, building services and storage space can occupy dark space at the centre of a deep building plan



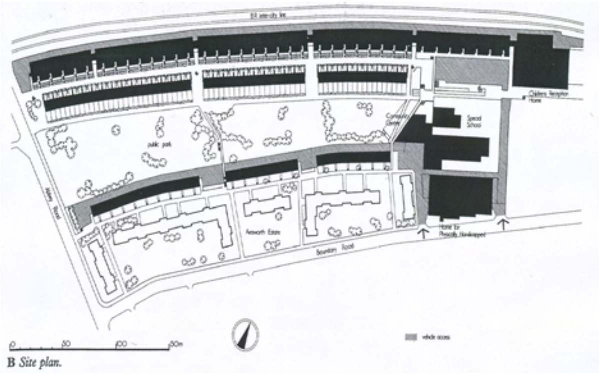
Individual Strategy

6.2 Shared ownership of service provisions on site is one way in which residents are encouraged to invest, socially, in the communal organisation of the site. It is also a way in which residents can be made aware of the potential social, economic and environmental benefits of higher densities and more communal forms of housing. For instance, shared ownership and organisation of a car club would generate a direct benefit for residents as well as providing a mechanism through which neighbours might become acquainted socially.

6. COMMUNAL UTILITY

Communal Utility is one of the indices that, where it is designed well, has relatively little impact on the perceived density of the scheme. Where it is done badly, however, and is visible and obvious, the 'utility aesthetic' becomes a defining indicator of density.

Controlling the appearance and impact of utility on the layout and experiential qualities of the site is affected by site, building and service design. It is also inherently affected by sustainability factors. The need for on-site energy distribution centres which consume large parts of the site area for instance, can impact negatively on the liveliness and bustle of the street. Furthermore, communal utility provision, as with communal space can be more effective in harnessing the social propensity afforded by the density of the site where its ownership and management are also controlled collectively. Co-housing provides a potential strategy for this too, and suggests a way in which service provisions could be harnessed as a positive social device within the organisation of collective, multi-dwelling housing developments.



The site plan for the Alexandra and Ainsworth estate was designed to knit the building into the surrounding street network, with a continuous thoroughfare running through the centre of the site that creates a link with the neighbourhoods that surround it.

Site Building

7.1 Connectedness to the rest of the city is essential for creating opportunities for encounter with those who share the public spaces of the city. In terms of density, it is one way in which the social propensity of urban densities can be harnessed as part of a positive social and spatial logic for the organisation of the city.

This café and basketball court in Utrecht by NL Architects is an example of two uses being brought into proximity with one another to generate opportunities for social encounter and a hubbub of activity.

Site Building

7.2 Mixed uses on site provide an opportunity for encounter between users of different spaces. However, in order to take advantage of the social proximity of the site, spatial opportunities might be designed – for instance a shared lobby where different groups using different spaces pass through at different times.

The Bennet's Courtyard scheme in Merton, South London, designed by Fielden Clegg Bradley Studios replaces the central corridor with a winter garden atrium. It was described as the 'perfect space to meet neighbours'.[18] The circulation is pulled away from the front doors, to provide privacy, but the decks themselves are wide enough with sitting spaces incorporated, and the atrium provides a warm and naturally lit space in which it is pleasant to spend time chatting with neighbours.

Building Individual

7.3 Thinking of shared spaces as social spaces changes the way that they are designed. The qualities of the space, access to it and how it is overlooked become important qualitative considerations when the stair core is considered as more than merely vertical circulation. Designing these spaces in a way that encourages social encounter harnesses the opportunities presented by density and proximity to others.

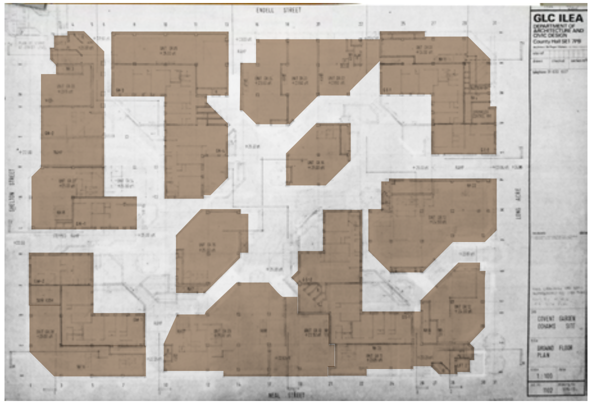
7. ENCOUNTER

The index of encounter is a reminder, a nudge to designers, that the spaces shared between different households in higher density housing have a social potential. The case studies considered in the previous chapter seemed to indicate that the greater the number of households with which walls, floors, structure and services were shared, the greater the need to create at least an illusion of isolation, and seclusion. In spite of the physical connectedness between the dwellings themselves, the opportunities for social interaction between immediate neighbours were minimal.

Opportunities for social encounter can be established at all scales, from the site to the dwelling itself. At the site scale, the normative planning objectives of recognition and difference provide a sociological argument for a spatial strategy that harnesses opportunities to encounter the otherness and strangeness presented by the public space of the city at large.[17] At the scale of the building and the dwelling, the social density of the site affords opportunities for social encounter with neighbours. The opportunity for encounter- both familiar and strange- is an inherent condition of urban housing and proximity. By addressing it, designers are therefore exploiting the unique condition and experience of density.

17 Sophie Watson, *City Publics: The (dis) enchantments of Urban Encounters* (Oxon: Routledge, 2006); Ruth Fincher and Kurt Iveson, *Planning and Diversity in the City* (Basingstoke: Palgrave MacMillan, 2008).

18 Review of the scheme cited in Martin Spring, 'Show Homes', *Building Design* no. 29 (2005).



Odham's Walk, Covent Garden, London

Greater London Council Architect's Department, 1979

Site Building

8.1 The site layout can concentrate or disperse activity. As the site layout of the Alexandra and Ainsworth estate (see 7.1) creates a main thoroughfare through the centre of the site, the site plan at Odham's Walk in London's Covent Garden is designed to do the opposite. The intricate spaces and indirect route inhibit pedestrian traffic moving through the site, demonstrating an effective strategy for mitigating the effect of bustle through site layout.

Haworth Tompkins' Iroko scheme in Southwark is designed so that all of the dwellings have balconies overlooking the communal garden at the centre of the site. The access gallery to the upper levels is also located along this façade, creating a density of activity around the space that provides supervision, but also establishes a strong connection between the qualities of the dwelling and the private outdoor space, and the communal garden; each contributes to the other.

Site Building

8.2 Proximity and porosity between the dwellings and the space outside affects the extent to which activity spills from one into the other. In the Barcelona streets for instance, the large windows onto the street, the small balconies and the warm weather that encourages windows and doors to be opened up, create a porous relationship between the apartments and the street.

Borneo-Sporenburg, Amsterdam

Street tables encourage gathering between neighbours

Site Building Dwelling

8.4 Street activity can also be encouraged by providing opportunities for residents to inhabit the space outside of their dwelling. The tactics considered in relation to the index of collective structure, for encouraging individualisation of the dwelling front also contribute to the perception of people and therefore bustle in the surrounding streets. As Jacobs suggested, the street itself provides spectacle and therefore exploiting opportunities to create sitting spaces and balconies, can also add to the scene.[20]

8. BUSTLE

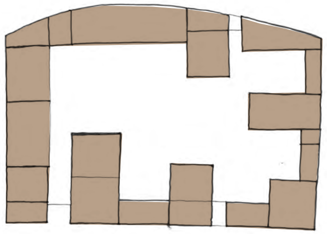
The index of bustle is concerned primarily with the perception of people in the environment. This can be affected by noise, the visible presence of people, or traces of people. The experience of bustle is affected by the concentration of people or their traces. Qualitatively, it is best depicted by Benjamin and Lacis' essay, cited in Chapter Three.[19] The scene described in their essay is dynamic and momentary. However, the opportunities for that scene to exist are spatial as much as they are social. Therefore, despite having found little evidence or example of bustle in the case studies used in the previous chapter, a number of design strategies were suggested for how the perception of people could be intensified, or limited, through design.

In terms of site strategies, the layout of the site so as to concentrate activity maximises the opportunity for overlap, juxtaposition and spectacle as depicted by Benjamin and Lacis by maximising the social density of the site in one space. Architectural concerns such as the porosity of the façade between the building and the street that allows the activity of the street to infiltrate the dwelling and to affect the experience thereof and at the same time, allows the activity of the dwelling to add to the animation of the street or public space outside, are also critical.

19 Walter Benjamin and Asja Lacis, 'Naples', in *Reflections: Essays, Aphorisms, Autobiographical Writings,* ed. Peter Demetz, trans. Edmund Jephcott (London: Helen and Kurt Wolff, 1925), 163–173.

20 Jacobs, Jane. *Death and Life of Great American Cities.* (London: Jonathan Cape) 1961.

Scheme in Westerdok, Amsterdam.



The courtyard is accessed through open gateways that imply privacy. It can be seen that the courtyard portrays ‘intensity’, as well as creating opportunities for bustle and encounter

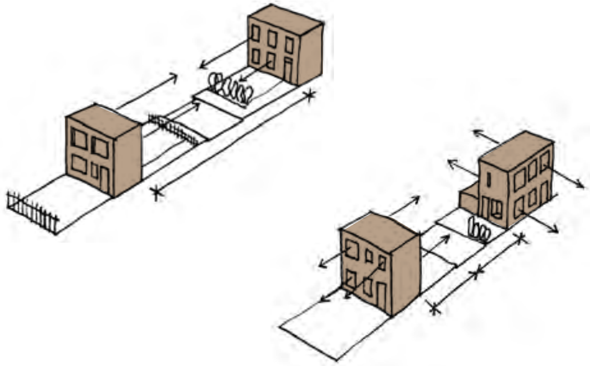
Site

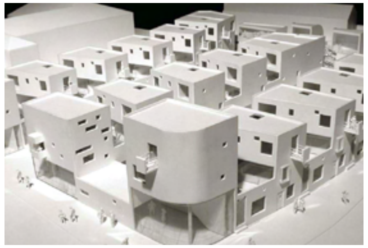
9.1 Site layout can be designed to either limit proximity between dwellings and public space, or where proximity is inevitable, to control the ‘publicness’ of the space outside of the dwellings. The example of Odham’s Walk was cited above [8.1] – the site layout reduces public access to the space and therefore the potential impact of proximity to that space on the privacy of the dwellings. Meanwhile the perceived intensity and social density of the site itself are maintained.

The change in level between the street and the common London townhouse (the better class ones with half-basement) gives some privacy to the rooms at upper and lower ground-floor level with close proximity between dwelling and street.

Site Building Dwelling

9.2 Changes in level between the street and the dwelling allow for proximity as well as privacy. Requirements for level access make this difficult to achieve, but design strategies that can reconcile these issues are clearly useful as part of a density design toolkit.





Model of Donnybrook, East London - Peter Barber Architects (2006)

Being strategic about the orientation and outlook from dwellings can enable closer proximity between buildings (potentially contributing to the intensity and bustle of the site). This is done very effectively at Donnybrook in east London where the dwellings each have a dual aspect, one to the street, and one onto a private terrace or courtyard.

Site Building Dwelling

9.3 The orientation of the buildings and/ or dwellings to provide outlook onto private space can mitigate the impact of proximity to public space. Also, locating more private rooms within the dwelling away from public spaces mitigates the impact of proximity and potential infringement of privacy.

Recessing the front door into the building, as at Anne Mews, establishes a semi-private porch between the pavement of the street and the front door itself.

In this scheme on the river Lea in Hackney, East London, angled fins are projected from the building façade to give a view out from the main bedrooms. The second bedrooms have a view directly across, but the windows on the opposite façade have been located so as to prevent a direct view between the two.

Site Building Dwelling

9.4 Where site and building layout makes proximity to the street and unavoidable consequence (for example at St. Andrew's), the design of the threshold to windows and doors can improve the perceived privacy and create a sense of separation from the activity of the street. Very high windows that provide only daylight without allowing a view out can be a useful device for achieving the required daylight levels whilst mitigating the potential for overlooking between dwellings. However, they do not allow a view out, and give no opportunity for the activity inside of the dwelling to contribute to the liveliness of the street. Incorporating screens as part of the design of the building façade provide flexibility for residents to control the exposure of the dwelling. Orienting windows to create a view out at an oblique angle to the opposite façade prevents overlooking from the windows opposite whilst allowing close proximity between the buildings. It can be seen how tactics such as this contribute to the perceived intensity of the site, whilst mitigating the impact on privacy.

9. PRIVACY

The case studies used in Chapter Four highlighted the impact that higher density ratios, building height and site coverage can have on the privacy of the dwellings if it is not considered as a critical factor when designing higher density environments. In the first instance, the site layout can create conditions of proximity that compromise common standards in relation to privacy. However, there are various strategies that can be used to counter the impact of proximity on privacy.[21] The layout of the site, building and dwelling as well as the threshold between the dwelling and public space outside can all potentially be designed to mitigate the impact of proximity on privacy. It should be noted that those suggestions presented here are set out with a view to maintaining the social and experiential benefits of proximity in terms of encounter and bustle.

21 Those presented here represent a select number of strategies. However, other, more instructive design guides such as those cited here provide cover this ground in some detail. Mulholland Research and Consulting, *'Perceptions of Privacy and Density in Housing'* (Design for Homes and Popular Housing Research, 2003); Design for Homes, *'Recommendations for Living at Superdensity'*; Helen Cope, *'Delivering Successful Higher-Density Housing: A Toolkit-Second Edition'* (East Thames Group, 2008).

Making use of the density reference

The list is by no means exhaustive. The design strategies and tactics that are set out above are in no way intended to be prescriptive, but merely suggest ways of approaching the design of higher density housing in order to harness the potential social and spatial benefits associated with density. Each of the indices could be developed further through design research as a means of more fully exploring the implications of these strategies as a design approach.

It would be useful to test the usefulness of the indices and the design strategies and tactics in relation to live design projects. A number of the suggested strategies overlap with recommendations for good practice in regards to housing design, for instance, the strategies for mitigating the perception of a building's height. However, they nevertheless address directly the spatial consequence of building height that has been identified as a physical condition of density, and furthermore, can affect the perception of density through the imposition of scale.

Where possible intervention extends beyond the scope of design and into the realms of policy, organisation and inhabitation, these factors are merely suggestive of a vast range of opportunities and strategies that might be adopted in response to the conditions that arise out of density. A different study and a different methodological approach would be required in order to trace the opportunities for development strategies and tactics, or housing policies in response to density.

Conclusions

Conclusions

At the time of beginning the research for this thesis considerably less information on the implications of urban density had been published. Over the course of the past four years, Berghauser Pont and Haupt's Spacematrix study, Boyko and Cooper's taxonomy of density, and most recently, the Housing Density Study have all been published.[1] These all point to the wealth of interest in the subject at present. Each of these has contributed to the understanding of the implications of density in different ways and goes some way to clarifying the ambiguity and complexity that frustrated this research in its early stages. However, none respond to the specific problem identified at the beginning of this thesis.

This PhD research set out to identify the implications of the initiative to increase urban densities, for the design of new urban environments. Two research questions were identified:

1. Expanding on the conception of density as a numeric ratio, what are the spatial implications of urban density?
2. How might the concept of density be elaborated or reinterpreted in order to be a useful starting point for design, specifically in relation to new urban housing?

These two questions are considered here in terms of the research methods and conclusions that have been drawn over the course of this thesis in order to define the relevance of the study, to situate it in relation to other work in the field, and to define the limits of the research as it is presented.

The conceptual approach

In broad terms, chapters One and Two dealt with the first research question, the fourth and fifth chapters dealt with the second research question, whilst Chapter Three marked the point of transition between the two. A number of different methods have been used in order to address these research questions. The historical, thematic approach adopted in Chapter One expanded on previous histories of 'density', by drawing on a range of sociological, architectural and planning sources to define key themes and agenda within each episode. Tracing an historical perspective established immediately the need to differentiate between

1 Berghauser Pont and Haupt, *Spacematrix: Space, Density and Urban Form*; Christopher Boyko and Rachel Cooper, 'Clarifying and Re-conceptualising Density', *Progress in Planning* 76 (2011): 1–61; Maccreanor Lavington Architects, Emily Greeves Architects, and Graham Harrington Planning Advice, '*Housing Density Study'* (Greater London Authority, 30 August 2012).

density as a measured ratio, and the concept of density, with the latter defined more broadly as the relationship between the number of people or the amount of building and the space that they share. Thinking about density in terms of it's broader implications introduced notions of shared space and communality which was a common theme running through the historic discourse on density. Proximity was also an integral theme. In the first episode, proximity motivated architectural endeavours to separate individual households and define thresholds between public and private space. In the fourth episode, it was considered a positive attribute of urban life and harnessed in the design of low-rise, courtyard and patio-type housing. The discussion demonstrated that although these ideas were not new, they had been largely subsumed by the dominant conception of density as a ratio measurement.

The historical studies also made apparent that it was the qualitative implications of density that determined the numbers at which the density standards had historically been set. Maximum ratio measures were used to control against various conditions, and the units of measure, and scale at which they were applied also varied according to these concerns.

Chapter Two set out to unpack the numeric definition of density, analysing the units, and ways of measuring density and the implications of each. It was demonstrated that the numeric densities, dwellings, habitable rooms, or population densities on which approximations about site capacity are based, in themselves provided a limited means of describing the qualities, or even the amount of development on a given site. There are also a number of implications that arise out of the scale at which density is measured that problematise the use of density ratios even as a quantitative measure. Parks or water courses that have an impact on the experienced intensity of the urban environment, for instance, are omitted from measurements of density at the site scale, but dilute the measured density at the larger scale, meaning that neither provides an accurate reflection of the intensity of development within the measured area. This characterises a more general problem with the areas used to calculate density in that they are often defined according to abstract boundaries that bear little relation to way that density is perceived. Furthermore, dwelling and habitable room densities do not calculate land that is not used for residential purposes which further distorts the calculation. In spite of the compromises associated with these measurements, however, the vast majority of research into the subject of density, within both architectural and planning fields has sought to reinforce the dominance of this numeric conception of density by attempting to correlate numeric densities with different indices of built form, travel behaviour or perceptions of the built environment. It was concluded that the perpetuation of the conception of density in purely numeric terms contributes to the continued dominance of those factors that are captured and described by these measurements: economics, land use efficiency and strategic planning of transport and amenity.

2 Lionel March and Leslie Martin, 'Speculations', in *Urban Space and Structures* (Cambridge: Cambridge University Press, 1972), 28–54; Berghauser Pont and Haupt, *Spacematrix: Space, Density and Urban Form*.

An alternative index was proposed therefore as a means of identifying those implications of density that are relevant for the design and the spatial qualities of the urban environment. The proposed spatial conception of density set out in Chapter Three marked a point of departure away from existing research on the subject of density. The proposed indices drew on sources from architectural, historical, theoretical, literary and socio-psychological studies in order to expand on the existing, limited definition of density prevalent in so much of the architectural and planning research on the subject (that considered in Chapter Two). The conceptual divergence came from the expanded notion of 'the spatial' that was introduced at the beginning of Chapter Three. Lefebvre's tri-partite definition of space in terms of conceived (representational), perceived and lived, provided a setting-off point. The implications of density in terms of conceived space had been thoroughly investigated. Martin and March and Berghauser Pont and Haupt's studies had tested the formal consequences of density through morphological, form-based and, in the case of the latter, poly-metric, mathematical analyses.[2] The implications of density in terms of perceived and lived space had also been considered. However, this research was primarily pursued within the social science disciplines and the understanding of the spatial implications was often reduced to simplistic, categorised conditions such as dimensions of privacy or the amount of outdoor space attached to the dwelling. In spite of having established that density as a ratio has relatively little baring on the physical dimensions of built form, site layout, or the occupancy of the buildings or spaces in between, these studies continued to attempt to correlate qualitative conditions with measured density ratios.

The historical analysis in the first chapter had highlighted a number of phenomenological implications associated with the condition of density (rather than its ratio measure): scale, anonymity, communality, and the social potentiality of density. These were further elaborated by the theoretical and literary depictions of the city that posited density as a defining experiential quality of the urban environment. This all pointed towards an experience of density that comprised of formal, social, political and temporal factors. Using and expanded notion of lived and perceived space to expand the conception of density beyond the measured, the index set out in Chapter Three defined an entirely new conception of density.

The methods used to define the indices drew on different ways of reading and describing density drawn from different disciplines and fields of study. The objective was to establish a conception of density that was useful for design. In the same way that design makes use of a variety of numeric, written, fictional, drawn and experiential accounts in order to explore the potential of different spatial ideas, then the index also allows draws together a variety of sources that posit different, sometimes contradictory ways of thinking about, and experiences of, density. The combination of different types of information, representation and description that are drawn together, both in defining the indices, and later in testing them, represent designerly

methods and a research approach that reflects the iterative process of design. The mixed methods approach contributes to expanding the range of research methods used in architectural research.

Chapter Four was dedicated to testing the veracity of these indices for describing the qualities of density. The analysis drew on a variety of sources of information and methods of representation. Having defined the indices in the previous chapter, the process of exploring these in the case studies required different ways of looking at these elements and raised questions about the value that was being placed upon them. Perhaps the most complicated in this respect were the communality indices. The visibility of refuse chutes as part of a functional, modernist aesthetic challenged the simpler idea that the notion of communality as a logic for the organisation of urban housing was largely positive, and highlighted the negative connotations associated with the institutional aesthetic (which had been raised previously in relation to different architectural elements). It posited that the way that these elements are perceived is affected as much by social attitudes towards an architectural aesthetic as much as by attitudes towards communality generally. Therefore, whilst the theoretical discussion in the previous chapters had allowed the indices to be posited as neutral terms used to describe spatial tropes, the case studies used in Chapter Four demanded that the characteristics being observed were also considered in terms of their value (either positive or negative). These indices were retained, however, as they potentially have significant implications for the social and spatial character if a place. By including them in the design reference it is intended that the decision over how these elements are designed is passed onto the designer(s) and enables a judgement to be made based on the context of a particular development.

The design reference presented in Chapter Five assimilated the findings drawn out of the case study analyses and observations in the previous chapter and attempts to distil these into a concise reference for design. Whilst it presents only a summary of the potential design issues raised in the previous chapters, the chapter recognises and positions the role of the designer in relation to these issues.

Moving from measured ratios to spatial qualities

The discussion on planning practice in Chapter Two suggested that preconceptions and rules of thumb that were identified as limiting the scope for design are still present and condition the use of density in planning and architectural practice. This has implications for the design of the built environment, discussed in more detail below, but is inherently affected by the way that designers consider and use the concept of density. The design reference potentially has a number of critical implications therefore. It emphasises the qualitative conception of density and acts as a nudge to designers to think about the spatial conditions of density that they are working within or aiming to bring about. It also situates the role of the designer in relation to the various economic and planning conditions that both set numeric density ratios for development, and

perpetuate their position as the dominant conception of density. As the architect and activist Teddy Cruz insists, as a profession "we need to realign ourselves with matters of economic development and urban policy, a relationship that has largely been ignored in our field."[3] Whilst there has been a wealth of discussion about the political implications of architectural and urban practice, there had thus far been little consideration of the particular political and ethical implications that architectural and urban practice could assume in relation to the regulatory and economic conditions that determine urban density. This was still more surprising given that the fabric affected by density is the fabric of housing, the residential environment; the design of which has profound implications for the interplay of social relations.[4]

The suggestion that there are political and ethical implications associated with density has been acknowledged by other scholars, too. Berghauser Pont and Haupt have pointed to the impact of controlling maximum densities on the qualities of the urban environment, and posited that controlled densities are the premise of urban planning practices oriented around the collective well-being of the community.[5] They are instruments of egalitarian planning. Unlimited densities, on the other hand can promote maximisation of the mass of building on the site, as in the vertical expansion of Manhattan.[6] Such expansion of the built fabric has myriad implications for the organisation, size and qualities of the dwelling environment within the city, and can be detrimental where they go unchecked. Drawing on the historical analysis of nineteenth century London and New York, the laissez-faire approach towards density allowed for the pressure on available space and increase in rents to impact on the physiological conditions of sunlight and ventilation, and on the privacy of the dwelling environment. These impacts are unevenly distributed too, with space available to those that can afford it. Density is clearly a political issue therefore, and the control of maximum densities through set upper and lower ratios impacts economically and socially.

The qualitative index shifts the terms of the debate about density.[7] At the beginning of Chapter Three it was noted that the drive to prove or disprove various claims about the benefits associated with higher density according to numeric densities, perpetuates this as the dominant conception of density and ensures that, in numeric terms (the terms of the debate), higher is always better. This is particularly critical in view of the current shortage of housing which validates myriad compromises in quality for the primary objective increasing the supply of housing. A qualitative index that requires social encounter or the potential anonymity of a development to be considered as part of the debate about density highlights these issues and acts as a check on the perpetual demand for higher density ratios.

The indices also have distinct socio-political implications. The indices of communality effect the autonomy of individual dwellings, inhabitants, and the social relationships that can result from proximity between people. Although

3 Teddy Cruz, 'Architecture: Participation, Process, and Negotiation', in *Verb Crisis*, Boogazine 6 (Barcelona - New York: Actar, 2008), 153.

4 Nishat Awan, Tatjana Schneider, and Jeremy Till, *Spatial Agency: Other Ways Of Doing Architecture* (London: Routledge, 2011), 38.

5 Meta Berghauser Pont and Per Haupt, *Spacematrix: Space, Density and Urban Form* (Rotterdam: NAI Publishers, 2010), 45–46.

6 The fullest implications of this expansion are depicted in Koolhaas, *Delirious New York*.

7 This extends Bruno Latour's essay on distinguishing between facts, and critical issues of concern. The various deliberations over numeric densities and their assumed implications for transport use, energy consumption, social sustainability (to name but a few), are examples of those 'facts' that academics fetishise over, in an attempt to proveor disprove for once and for all through sound methods and data. The spatial conception of density draws out the 'matters of concern' from within the mire of research on the subject of density. 'Why Has Critique Run Out of Steam? From Matters of Fact to Matters of Concern', *Critical Inquiry* 30, no. Winter 2004 (2004): 225–248.

the indices came out of the historical case studies considered in Chapter One which showed that communality was an essential condition of higher density housing, the concept has not previously been considered in relation to density. The dominance of the collective identity and collective housing form impacts socially, aesthetically, and politically. The increasing collectivisation of housing at higher density implies consolidation of the ownership of land within the city.[8] Multiplied across a neighbourhood, or across a city, this has a profound impact on land ownership, the structure of the urban fabric and therefore the character of the urban environment. At the scale of the home and its immediate environment, ownership impacts on how residents inhabit and use the home and the space around it. If the case studies considered in Chapter Four are indicative of current housing, then the trend is towards a model of individual autonomy and physical separation between neighbours, irrespective of the closeness and physical integration of the dwellings themselves. This has implications for how neighbours interact (if at all) and the socio-spatial structure of neighbourhoods and communities.

The final set of proposed indices deals specifically with the impact of proximity. Again, social proximity emerged in Chapter One as one of the inherent spatial consequences of density. The analysis in this thesis has dealt primarily with the scale of the urban block, or singular housing development. However, social-geographers, Fincher and Iveson posit social encounter as one of the primary social logics for the organisation of the city as a whole.[9] Architects such as Herman Hertzberger and Jan Gehl, have encouraged social encounter as the base logic for the design of the dwelling itself, and thresholds between the home and the space around it.[10] However, it had not previously been considered as a consequence of density - density which provides the components of people and proximity that generate opportunities for encounter.

The proposed index of bustle has proved difficult to define and difficult to identify. It is undoubtedly also difficult to design (although this is a potential avenue for further work, as set out below). Although illusive, it is nevertheless the most convincing candidate for defining the urban experience of density. It summarises the qualities depicted in the literary excerpts cited in Chapter Three, and is arguably the desired quality when terms such as 'vibrancy' and 'vitality' are used to describe the city.[11] Therefore, whilst it remains loose in its definition, it has perhaps the most potential for shifting the terms of the debate about density away from the numeric and economic, and towards the qualitative.

Further work

The final two chapters of the thesis have tested the application of the density index at the scale of the urban block or thereabouts. The second research question determined that the index be tested at the scale at which designers have the most impact. It therefore dealt with the site, the spaces in between the buildings and the edges of the buildings themselves. Neither the interior, nor the wider expanse of the neighbourhood have been considered in

8 The effect was seen in a number of the historical episodes. It is perhaps most apparent in tracing the transition of the Manhattan grid from individual tenement houses occupying a single lot, to hotels consuming an entire block - swallowing up the diversity and autonomy of individual landowners.

9 Ruth Fincher and Kurt Iveson, *Planning and Diversity in the City* (Basingstoke: Palgrave MacMillan, 2008).

10 They are sometimes referred to as 'humanists' because of their emphasis on the human scale in architecture. Gehl, Jan. *Life Between Buildings: Using Public Space.* 6th Edn. 2008. Copenhagen: Danish Architectural Press, 1987. Hertzberger, Herman. *Lessons for Students in Architecture*. Revised edition (2005). Rotterdam: 010 Uitgeverij, 1991.

11 These were terms used in the Urban Task Force report, *Towards an Urban Renaissance* to describe the desirable qualities of a city that people would want to live in. London: Department of the Environment, Transport and the Region, 1999.

any detail. It would be interesting to test the application of the index at the micro scale of the dwelling and the larger scale of the neighbourhood. It is likely that there would be different physical and organisational characteristics that affect the perception of density at these different scale and would therefore need to be defined.

However, as has been suggested by Fincher and Iveson et al, the social indices of encounter and bustle, and the indices of communality are just as relevant for the organisation of the city as for the building.

The indices could also be further tested. The methods used to define and test the indices were chosen to reflect analytical methods used in design practice. This makes the findings and the design reference proposed in Chapter Five more readily accessible to practitioners and potentially useful for design practice. It would be interesting and indeed, probably necessary to test the design strategies in relation to some live design projects. Making the design guide available to practitioners and gathering feedback might be one way of achieving this. Some of the indices, for instance 'bustle', which remains somewhat esoteric could be elaborated and clarified through some more exploratory research-through-design. This could be done in practice, but might be more fruitful carried out in a collaborative way, as a student design project or ideas workshop.[12]

Finally, testing the veracity of these indices and proposed design strategies in different geographical contexts would be interesting and perhaps suggest new indices that have not emerged by nature of the emphasis on UK and Western European case studies. Testing of the index in relation to a wider range of case studies including international examples that would present a different context in terms of numeric densities and the planning regulations that impact on housing design. It is possible that the qualities of density would differ too, and it would be interesting to explore these and, through doing so, further clarify the scope of the index and its potential for housing design.

12 Interviews were not used as part of the research methodology for this thesis because many researchers had already pursued this method and their findings were available for use, and because there were reported difficulties in defining what was meant by density - it is a highly subjective and somewhat sigmatised term. Gathering different perspectives on the proposals at this stage would certainly be fruitful, however, and might produce new ways of describing or articulating what is meant by the indices.

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Figures

Where stated as 'original' the drawings have been prepared by the author or photographs taken by the author.

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Source for Photograph: Honorate Grzesikowska, *Odham Walk, Covent Garden*, London, 2010

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Chapter 2

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Figure 17: Diagram showing typology mix of the different illustration schemes referred to in the Housing Density Study. Source Maccreanor Lavington Architects, Emily Greeves Architects, and Graham Harrington Planning Advice, *'Housing Density Study'* (Greater London Authority, 30 August 2012), 149.

Figure 18: Van Niftrik's plan for the expansion of Amsterdam (1866). Source: Berghauser Pont and Haupt, *Spacematrix: Space, Density and Urban Form*, 44.

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Chapter 3

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Figure 8: Rules for determining building height, as set out in Christopher Alexander, Sara Ishikawa, and Murray Silverstein, *A Pattern Language: Towns, Buildings, Construction* (Oxford University Press, 1977).

Figure 9: Façades: Robin Hood Gardens, The Smithsons (1972) Lillington Square, Darbourne and Darke (1968 - 1972) and Dolphin Square, Gordon Jeeves (1936-38). Original

Figure 10: Three indices of physical density. Original

Figure 11: Nursery School on the Rooftop of the Unité d'Habitation, Marseille, Photograph, 1952, http://punica-granatum-nana.tumblr.com/post/16738869113/le-corbusier-unite-dhabitation-marseille.

Figure 12: Habraken's hierarchies of enclosure. Source: N. J Habraken, *Structure of the Ordinary: Form and Control in the Built Environment*, ed. Jonathan Teicher (London: MIT Press, 1998), 61.

Figure 13: Le Corbusier's proposed alternative to the single family house with small garden. Source: Le Corbusier, *The City of To-Morrow,* Translated from the 8th edn. (London: John Rodker, 1929)

Figure 14: Axonometric showing a completed housing block based on the Cellular System. Source: *Ibid*.

Figure 15: Karel Teige's Existenz Minimum. Source: Karel Teige, The Minimum Dwelling, trans. Eric Dluhosch (Cambridge, Massachusetts: MIT Press, 1932).

Chapter 4

Sources of information for each of the case study schemes:

<u>A01 Bow Bridge</u>

Greater London Council: Department of Architecture and Civic Design

Drawings held at the London Metropolitan Archives. Accessed 04 July 2011

<u>A02 Lansbury</u>

G. A. Jellicoe.

Drawings held at the London Metropolitan Archives. Accessed 04 July 2011

<u>A03 Gale Street</u>

Plans taken from Planning Application: PA/01/431,

Randall Shaw Billingham: Proposed renovations to Mollis House and Gale Street (19.03.2001)

<u>A04 Lincoln's Estate</u>

Drawings held at the London Metropolitan Archives. Accessed 04 July 2011

<u>A05 Arrow Road</u>

Floor Plans for five houses were previously available at via property search engine.

Plans for new houses taken from Planning Application: PA/00/1488

Baily Garner Architects. Accessed 8th August 2011

Plans for new houses taken from Planning Application: PA1000849

Pollard Thomas Edwards architects. Accessed 8th August 2011

<u>B01 Bow Cross</u>

Plans (including plans of existing tower blocks) taken from Planning Application: PA/03/1683 (and subsidiary applications)

PRP Architects, for Swan Housing Group . Accessed July – December 2011

B02 Caspian Wharf

Plans taken from Planning Application: PA0501647

KKM Architects. Accessed 4th April 2012

B03 St. Andrew's

Plans taken from Planning Application: PA/08/01162 (and subsidiary applications)

Maccreanor Lavington Architects

Allies and Morrison. Accessed 8th August 2011

B04 New Festival Quarter

Plans taken from Planning Application: PA/10/00161

Stock Woolstencroft Architects. Accessed 13th April 2012

B05 Abbott's Wharf

Plans taken from Planning Applications: PA/02/01550, PA/100/2751

Jestico and Whiles Architects

MGL Architects.

All photographs are the author's own

All sketches: original

Base maps for Figure Ground plans taken from Bromley by Bow Ordnance survey map used in Figure 2.

Chapter 5

Figure 1: Refined index showing the twelve indices for design. Original

Figure 2: Five types of density – key to symbols. Original

1.4 Photograph Greenwich Millenium Village. Source: .Martin., *Greenwich Millennium Village,* London, August 2007, http://www.flickr.com/photos/martinrp/1063329015/in/photostream

3.2 Wansey Street, Southwark, South London – designed by DRMM (2006). Source *A+t*

4.1 Houses in Mexico, by Elemental. Source for photographs: unknown.

7.2 Café and basketball court in Utrecht by NL Architects. Source: NL Architects

7.3 Bennet's Courtyard in Merton, South London, designed by Fielden Clegg Bradley Studios. Source: Fielden Clegg Bradley Studios

8.1 Odham's Walk site plan. Source: Greater London Council Architect's Department, 1979. London Metropolitan Archives.

9.3 Model of Donnybrook. Source: Peter Barber Architects.

Unless otherwise stated, all photographs and sketches in Chapter Five are original.

Appendix I

Field Notes- testing the indices in Bromley by Bow

Appendix I

Field notes - testing the indices in Bromley by Bow

This appendix documents the field observations that were used in order to test the proposed indices. The observations focussed on the design of the housing and its immediate environment. The site studies highlighted a number of interesting factors such as the apparent absence of people in a number of the schemes, in spite of relatively high densities. Some of the notes also include suggestions for how design could improve the ‘bustle’ of the street, or privacy of the houses or apartments.

Initial observations from three schemes are included below:

A02: Lansbury

A04 Lincoln’s Estate

B04 New Festival Quarter

LANSBURY (GRUNDY ST / RICARDO ST).

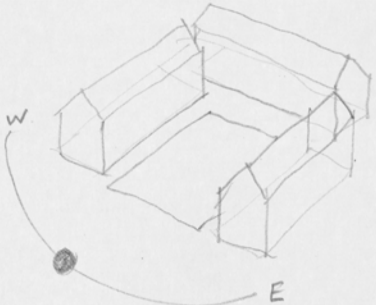
Building Height.

3 storeys (Grundy St). 4 storeys (Ricardo St)

Expansive dev site.

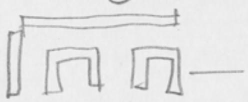
Relates to scale of preserved older bdgs

Coverage



During day small enclosed greens / comm. gardens exposed to direct sunlight

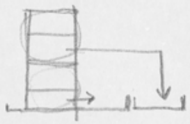
Site dev. quite intensely.
Ricardo & Grundy St dev right to bdg edge of street.
(w. small front garden space).
Communal greens also maintain street edge along Grundy St.



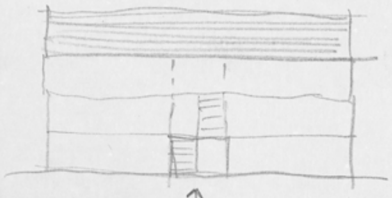
Grundy St. closes used to extend effective street length & min wasted space interior of site.

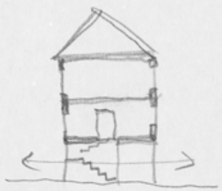
Typology.

Ricardo Street - 4 storey (2×2) maisonettes
- deck access
- individ. front doors
- communal stair access
- GF have private rear gdns.
Plans sugg upper mais. also have private gdns.



Grundy St - mix studios / bedsits, 4 bed maisonettes, 3 bed maisonettes & 2/3 bed flats.
- mix is concealed & typology not at all apparent from street





Open access stairs to upper floor flats / maisonettes.

A02 - Lansbury

Architectural predominance.

Facades quite austere

No recesses for window boxes,

Small balconies – iron (black gloss) railings

Even in the small closes – little articulation of the facade.

View – privacy of view from Grundy St. closes.

Ricardo St – exposed. No private view – except GF.

BYGROVE STREET

Personal touches have limited impact on overall facade

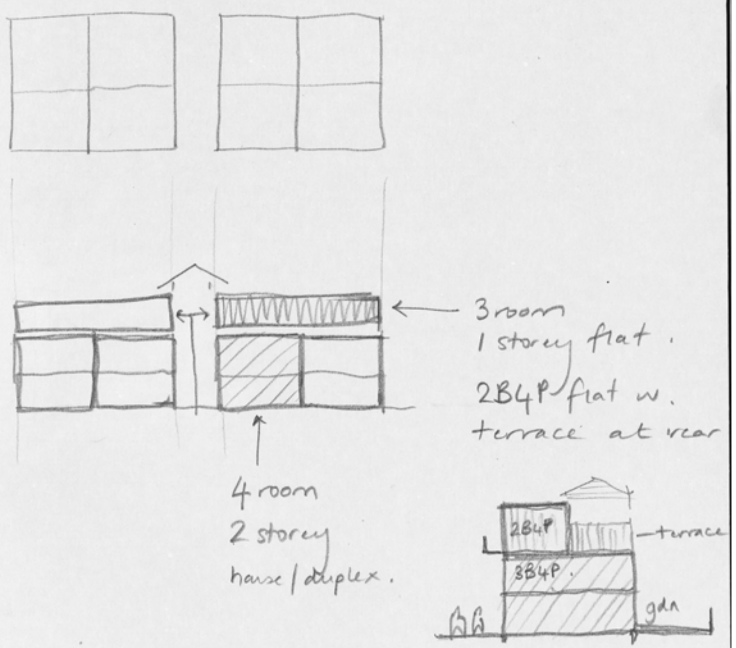
• curtains / blinds

• awning mounted over window.

Bygrove St.

6 No.	3 room dwgs	18
12 No.	4 room dwgs	48
		66 hr.

Presumed layout

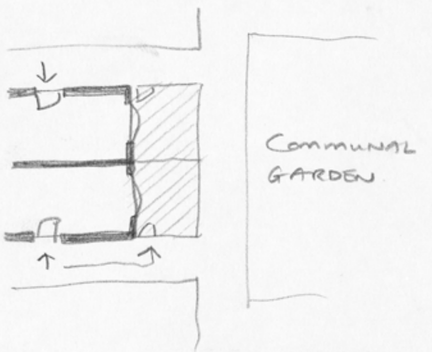


Strangely – gf dwgs w. front / rear gardens not always largest, family-size dwgs.
Small studios / bedsits comprise ½ gf. dwgs.

Open Space

Grundy St.

Front gardens – appear poorly maintained & not used particularly productively.



Private front gardens do not provide extension of living area / house.
Have to come out then go into garden
Most unused.
(esp. compared to balconies above).

Ricardo St.

Rear gardens – some have sheds
unable to get access – but have photos.

Upper mais – small balconies on rear

Communal – Greens on Grundy St – never seen them being used.
Quite exposed to view.
Create semi-private domain for looking out onto (VIEW).

Public – large green to north of site
large play area / football / ~~site~~ ball games NW of site.

Utility

Parking – on street.
External storage – rear gardens – high fences (max. security).
Internal:

URS applic. refused.
Purple bins cluttering street / close (Grundy)

Communal Facilities

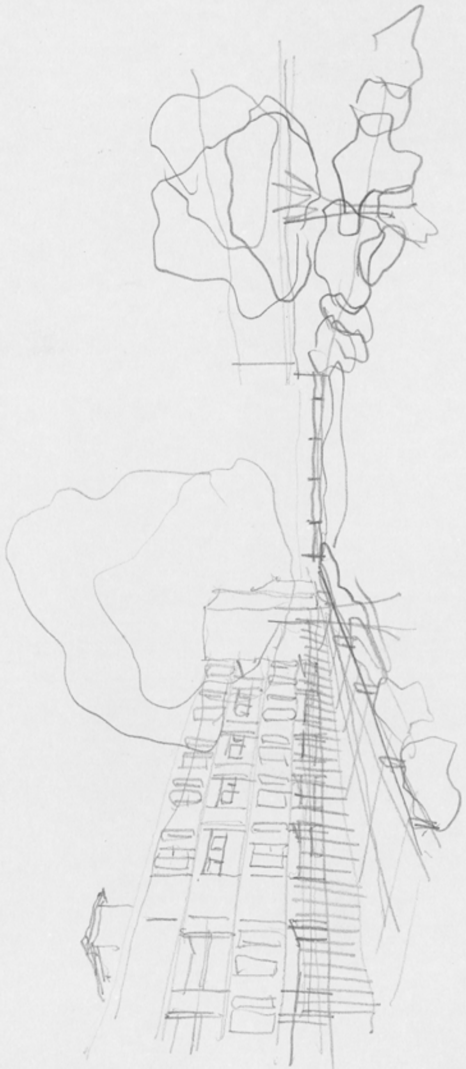
Public ownership apparent – in scale of maint. works.

Some residents have replaced front doors differently & planted to ~~conceal~~ prevent view into windows.

A04 - Lincoln's Estate

28/09/11

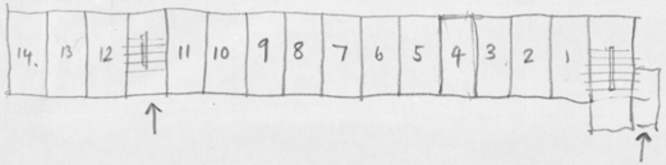
WHITEHORN STREET



Building Height

Maisonettes – 4 storeys (2 maisonettes)

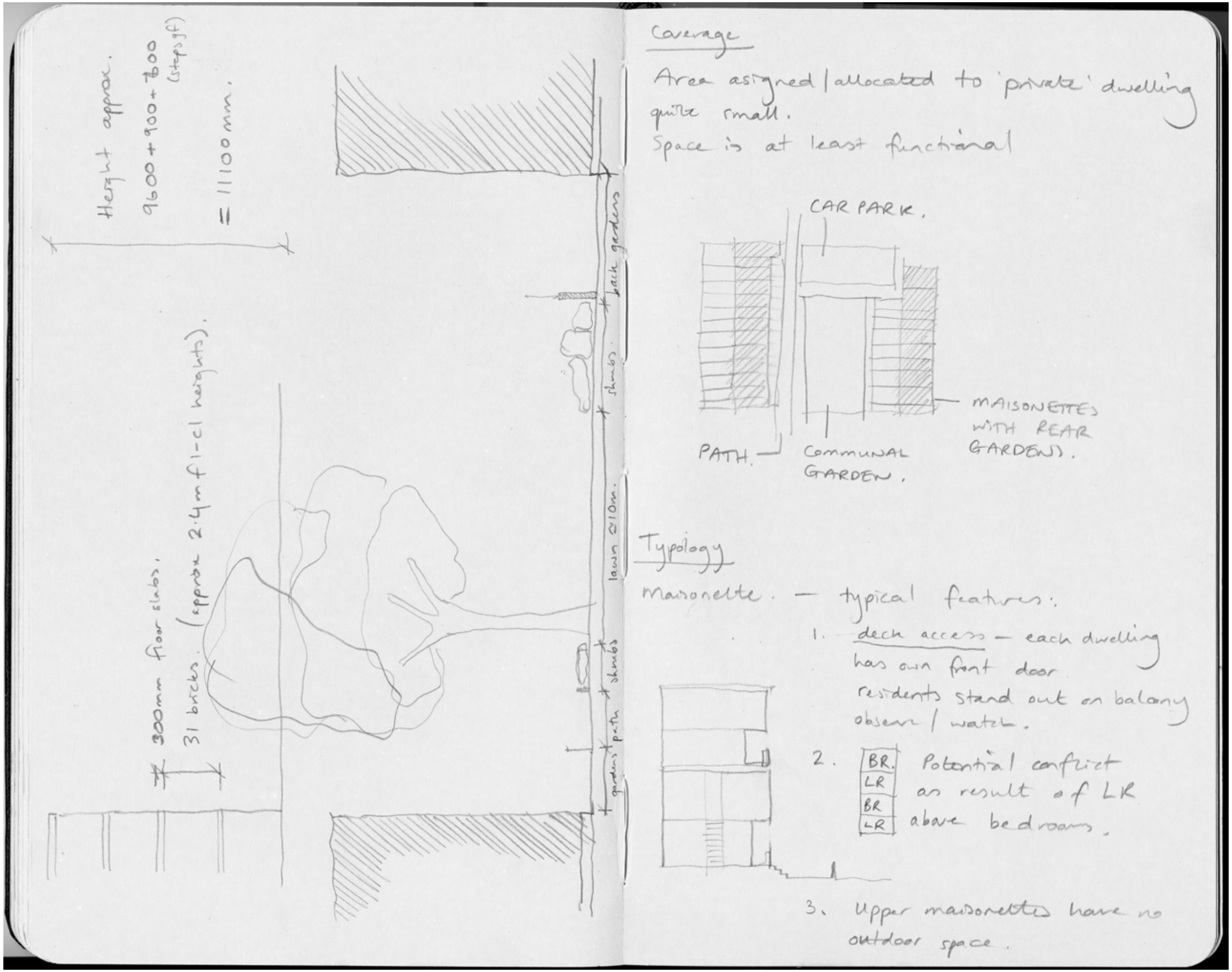
Deck access – entrance via communal stairs



Proportionality between 4 storey building and open space left infront

Heights continuous – all 4 storeys
(London precident ?)

A04 - Lincoln's Estate



4. Stair access to upper deck (think no lift).
5. Bedrooms on upper level – create privacy hierarchy.

Open Space

Private

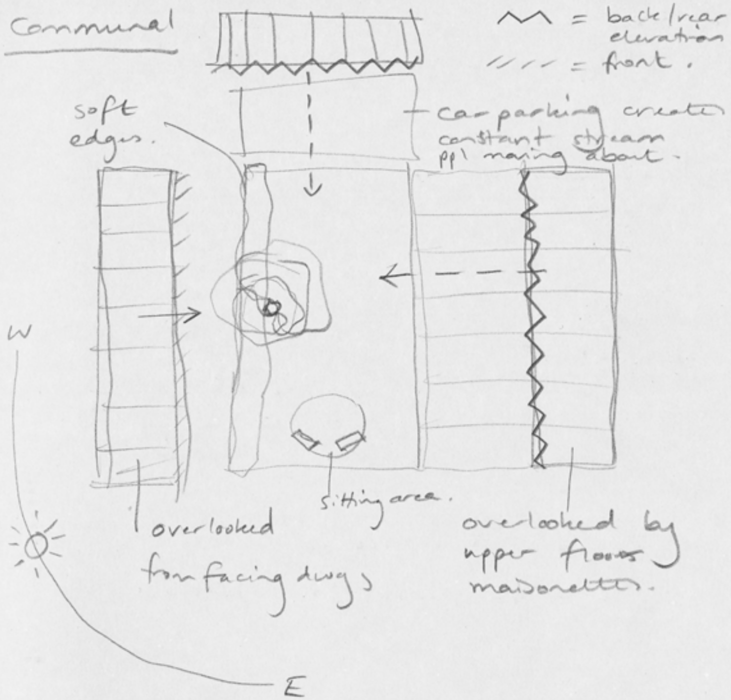
GF maisonettes have small front garden encl. w. steel railings (note all railings same). + reasonably large back garden.
Back garden encl. by wall ≃ 1600 mm + wire fence (add 2m).
1800mm fences betw. rear gardens.

People have – sheds.
– veg patches.
– games equipment in rear gdns.

Front gardens – paved – continuation of street paving.
Hedges between front gardens.
Front gardens not 'private' at all.

Mother / Grandmother / toddler – whole conversation reverbs betw. the buildings.

Communal



* Concerns over maintenance + cleanliness of communal gardens (dog poo).

Public.

Communal is also public – although overlooked and when I sat down 3 ppl emerged from houses to see what I was doing.

Furze Green 100m. away.

A04 - Lincoln's Estate

Utility

Car park (communal).

No obvious bike storage – residents seen bringing them out of dwgs.

Balconies at rear – most used for storage (as well as laundry). → Sugg shortage space internally.

Communal facilities

Concerns over maint (cleanliness) of communal garden

Stairs – have standard screens – all balconies painted same – overall ownership. managed & maintained by external bodies/parties.

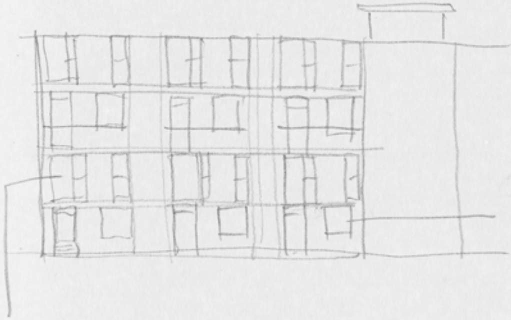
* Have counted 4 children around (at home w. parents) – noone using communal green.

On previous visit – obs. 1 man w. dog exercising dog there.

Privacy

Visual;

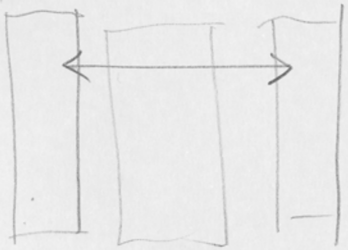
Rel. to street ⇒



windows mostly have nets up.

gf windows sep. from street w. recess under upper story. Still have nets at majority.

Neighbours ⇒



* Nets & blinds on all windows facing the deck

Facing distance > 25m but direct / uninterupted. Almost all windows on rear elevations have nets.

A04 - Lincoln's Estate

Potential conflict betw. LR / BR floors.

* Mother w. toddler spoken w. everyone who's gone past. — Also w. ppl from upstairs. Neighbourliness.

Acoustic

Workmen in rear garden of one of maisonettes
Noise reverbs around.

'Ding dong' — amplified across the site.

* Solely residential, so although ppl are passing through the site — not a constant stream. No reason to pass through. (Whitehorn & Lincolns estate = cul de sac & eventual dead end).

Architectural predominance

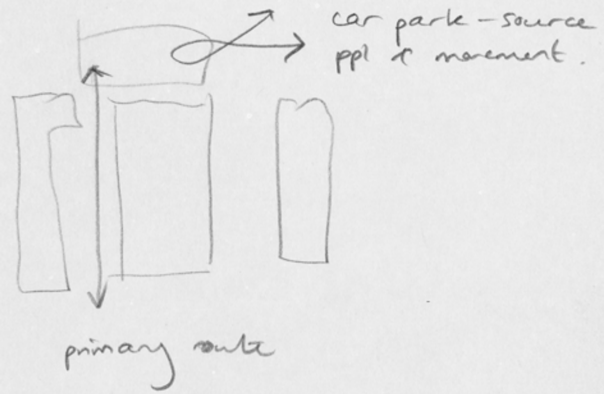
Continuous / overall coverage / materials used for communal features (stairs) & for railings around gardens & deck fronts indicates ownership by external parties / agency of another party in respect of designing / maint. housing & space around.
Rear gdns only place ~~demonstrating~~ exhibiting variation.

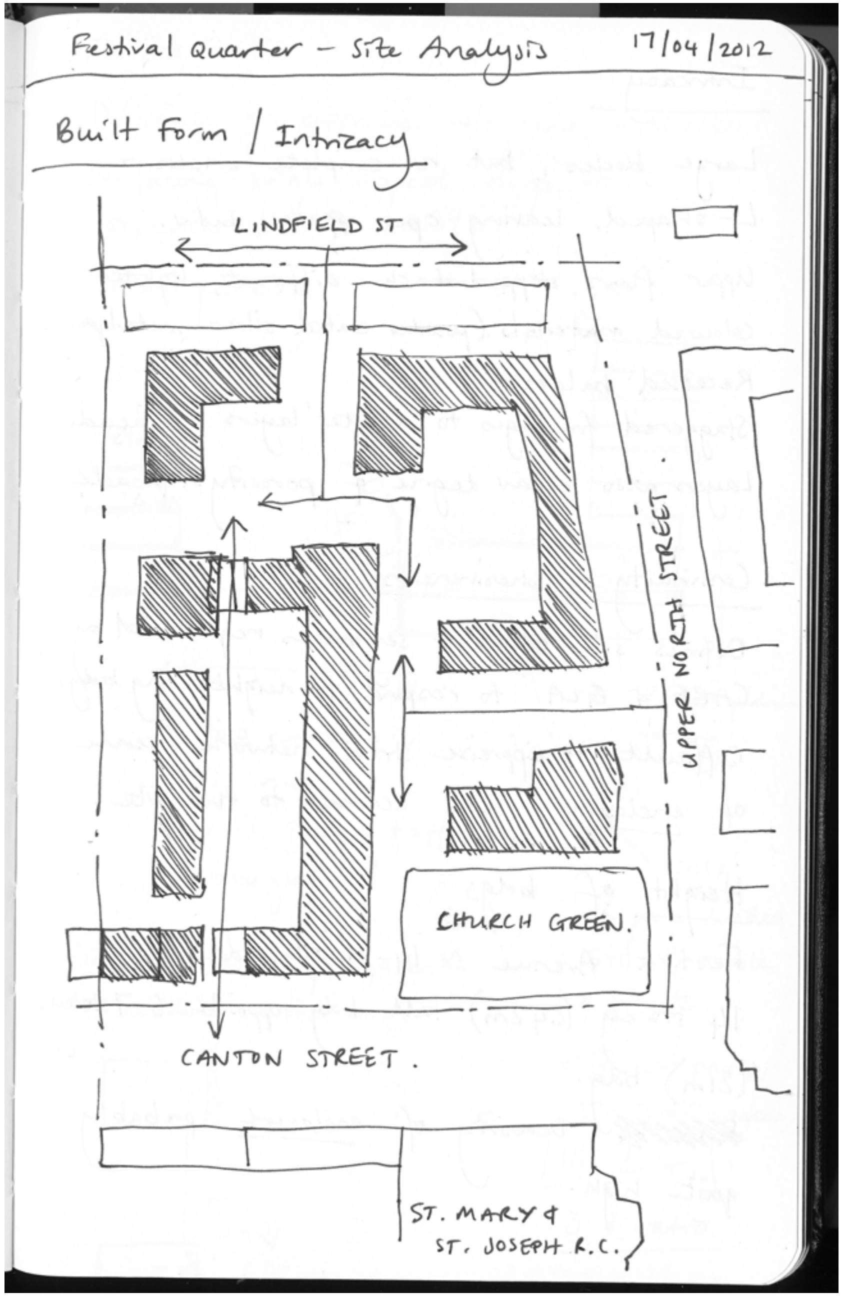
Residents have not appropriated front gdn spaces or spaces on decks (exception of occ. hanging basket).
[See photos]

Bustle

Residential only
Whole estate basically a dead-end / cul-de-sac.
Whitehorn is gateway to Devons Rd though.

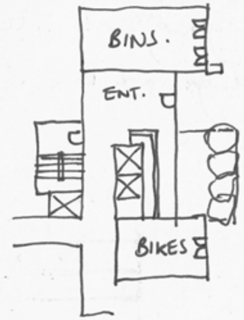
Movement thro' site concentrated on path infront Whitehorn flats.



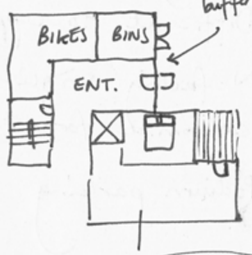

Festival Quarter – Site Analysis
17/04/2012
Built Form / Intricacy
LINDFIELD ST
UPPER NORTH STREET
CHURCH GREEN.
CANTON STREET.
ST. MARY &
ST. JOSEPH R.C.

B04 - New Festival Quarter

AFFORDABLE ENTRANCE



PRIVATE ENTRANCE



1 BED FLAT.

Immediately next to main entrance.
No privacy whatsoever.

Shared Space / Communality

Very definite division of space betw. affordable & private.

Communal Gardens encl by L / U shaped blocks – additional to small private gdns for indiv. dwgs & no immediate access from 1 to other.

In terms quality – gardens at least open on one side for sunlight.

Proximity & Privacy

Entrances – A number of situations where a dwelling's only POS is directly adjacent to main entrance to bdg.

Single-aspect – many single-aspect dwgs.

N-facing single aspect appears to be minimised

2 studio flats – 1 No. Block C (per floor) 5 No.
1 No. Block A (per floor) 5 No.

10 No. dwgs.

Projecting glass balconies offer little privacy.

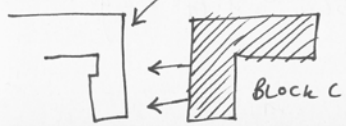
Recessed balconies much better – where included.

Dwgs have fl–ceiling windows for light, w. blinds up for privacy.

Layouts – buildings & dwgs themselves based on internal corridors w. rooms facing outwards.

Proximity / Facing distance to neighbours ∴ paramount.

Facade = deck-access ∴ no overlooking issues altho quite limited aspect.



B04 - New Festival Quarter

Intricacy

Large blocks, but no complete enclosure
L-shaped, leaving open space betw.
Upper floors stepped back - different, lighter coloured materials (powder coated silver metal panel)
Recessed balconies
Staggered frontages to create 'layers' in façade
Layers also allow degree of porosity in façade.

Continuity & Cohesiveness

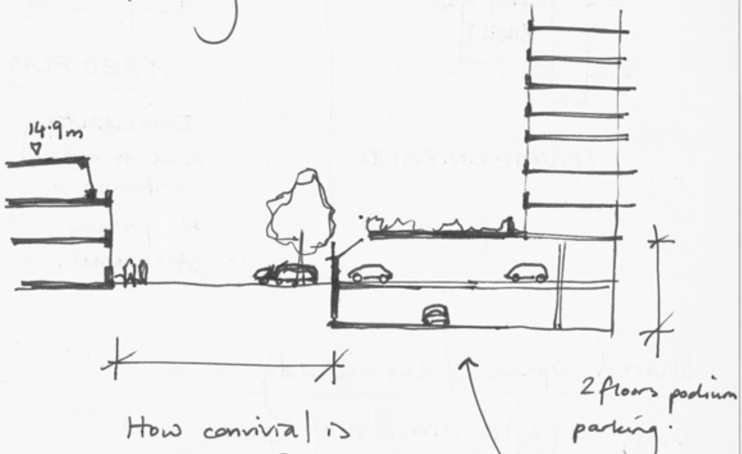
Defines site edges - set-backs requested by CABE & GLA to respond to neighbouring bdgs
Difficult to appraise street network / sense of <u>enclosure</u> w/o access to the site.

Height of bdgs

Festival Avenue ≃ 14-16 m wide
14 storey (c.42m) tall bdg opposite 6-7 storey (21m) bdg.
~~[illegible]~~ Density of <u>enclosure</u> probably quite high.

Utility

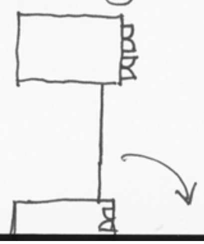
Difficult to appraise w/o going onto site.
N-facing single-aspect dwgs are a compromise for 'viability'.
Podium parking



How convivial is this route?
Is it just a traffic thoroughfare?

Note
Carpark divided into affordable & private.

Bin stores directly adjacent to building entrances.



Aff car park
15 + 17 = 32 spaces
[148 units]
<u>5:1 ratio</u>

B04 - New Festival Quarter

N. facing dwgs blocks C & D - have expansive view over Bartlett park.
Idea of a 'private view' not really embraced.
Recessed balconies useful for this - orient a view over private outdoor space.
But little attention to orientation - dwgs happen to have private balcony stuck on to front of living room - does not make a 'private view'
Esp w. glass balustrades.

Threshold - ~~#~~ internal corridors.
main entrances gen aligned w. axes.

Rel. betw GF dwgs & main entrances not particularly resolved.
Density of proximity high.

Monotony → [Index should move to bdg form]

Facades quite austere. Esp away from main approach on Upper N. street.
Repetitive window styles.
Little ornamentation - if any.
Form broken up into blocks diff height

Encounter No.

Shared spaces deliberately divided into private & affordable.
Narrow, internal corridors - not exactly meeting places.
Park = opp. for meeting ppl.

Bustle

Glass balustrades - glossy & diff to maintain.
Recessed front doors provide some opp ppl to inhabit & animate.
Scale of devpmt & commercial activities should generate activity - cannot tell.

Appendix II

Key to the Bromley-by-Bow Case Studies

Appendix II

Key to the Bromley-by-Bow Case Studies

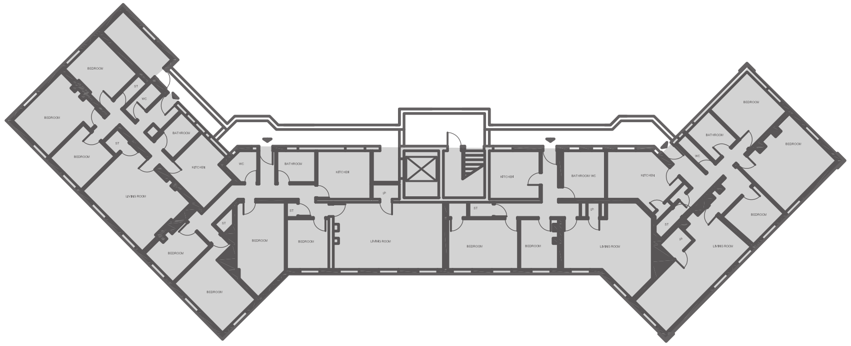
- A01 - Bow Bridge
- A02 - Lansbury
- A03 - Gale Street
- A04 - Lincoln's Estate
- A05 - Arrow Road
- B01 - Bow Cross
- B02 - Caspian Wharf
- B03 - St Andrews
- B04 - New Festival Quarter
- B05 - Abbotts Wharf

This appendix sets out key information for the Bromley-by-Bow case studies used in Chapter Four.

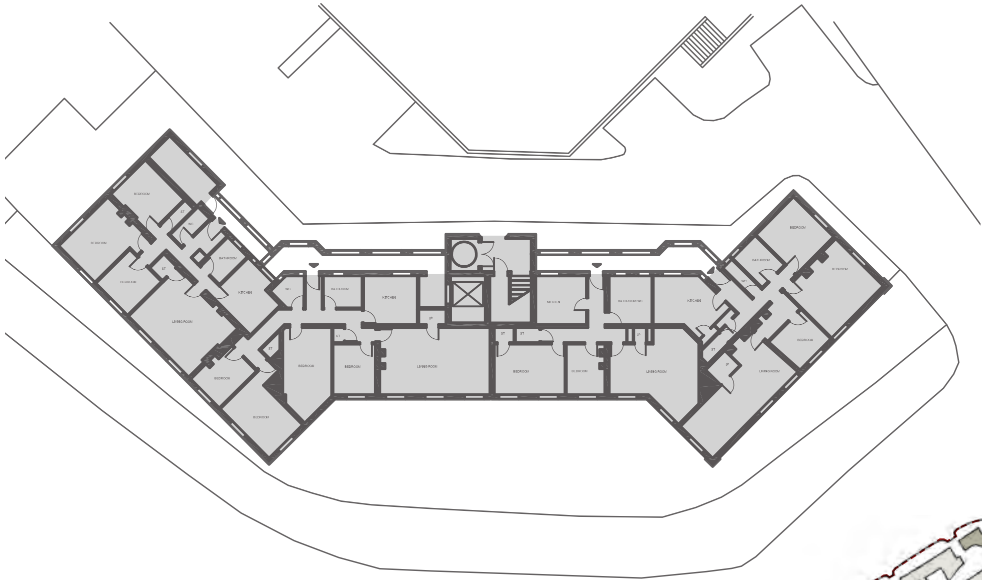
It includes massing images aerial photographs, digital models, site plans and floor plans for each case study and gives useful background information to the analyses and discussion in Chapter Four.

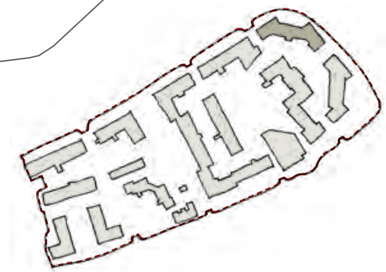
A01 Bow Bridge

Architect:	London County Council
Client:	London County Council
Year:	1930-35 (renovated 1970s)
Dw/ha:	149
Hr/ha:	277
Bedspaces/ha:	291
Plot Ratio:	1.27
Site Area:	2.35
No. dwgs:	351
Building Height:	4-6 storeys
PTAL:	5



Bradley House
Typical Floor Plan





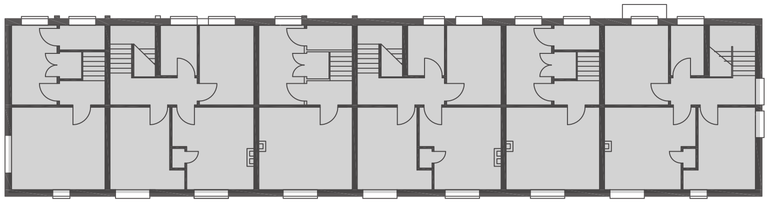
Bradley House
Ground Floor Plan


BOW ROAD
BOW ROAD
BOW ROAD
BOW ROAD
PAYNE ROAD
BLACKWALL TUNNEL NORTHERN APPROACH
BROMLEY HIGH STREET
St Mary's Court
RAINHILL WAY
Stroudley Walk
ARROW ROAD
EDGAR ROAD
PRIORY STREET
FRANKLIN STREET
Taft Way
ST LEONARD'S STREET
0 1 3 5 10 15 25 50

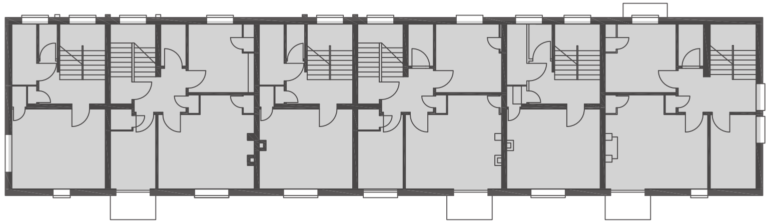
A02 Lansbury Estate

Architect:	G. A. Jellicoe
Client:	London Country Council for The Festival of Britain
Year:	1951
Dw/ha:	98
Hr/ha:	322
Bedspaces/ha:	451
Plot Ratio:	0.86
Site Area:	1.23
No. dwgs:	121
Building Height:	3-4 storeys
PTAL:	3

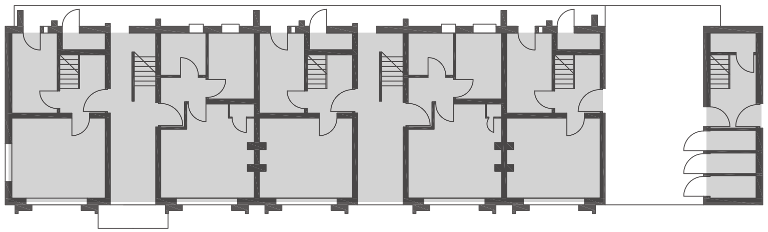

CORDELIA STREET
SOUTHILL STREET
CHRISP STREET
FLORA CLOSE
MARKET WAY
RICARDO STREET
BYGROVE STREET
KERBEY STREET
GRUNDY STREET
DUFF STREET
PLIMSOLL CLOSE
STURRY STREET
ANNABEL CLOSE
RIGDEN STREET
01 3 5 10 15 25 50



Second Floor Plan



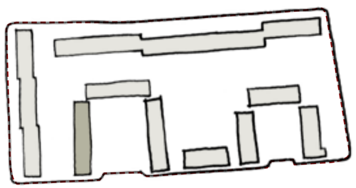
First Floor Plan



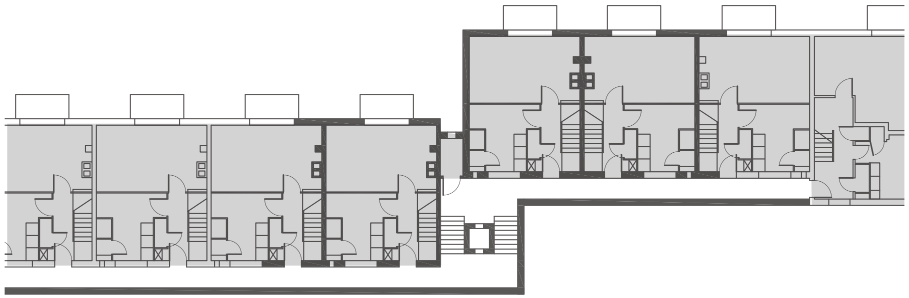
Ground Floor Plan

Lansbury: Grundy Street

Floor Plans showing groups of three dwellings, comprising ground-floor flat, maisonette above, and three-storey house

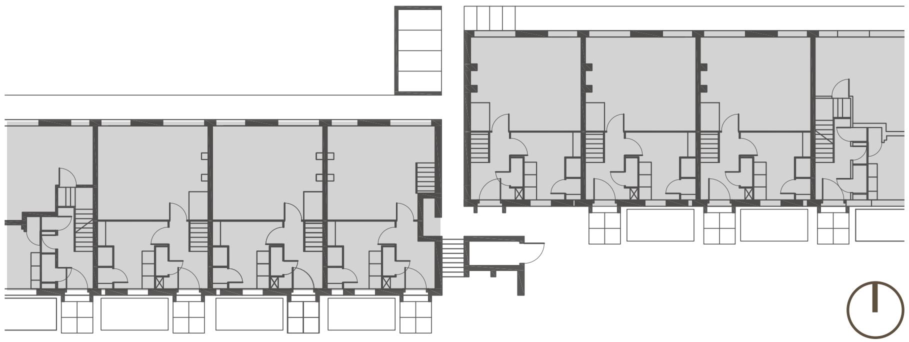


Third Floor Plan



Second Floor Plan

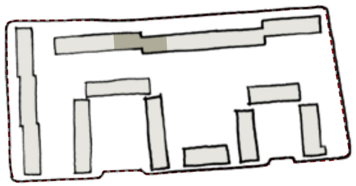
First Floor Plan



Ground Floor Plan

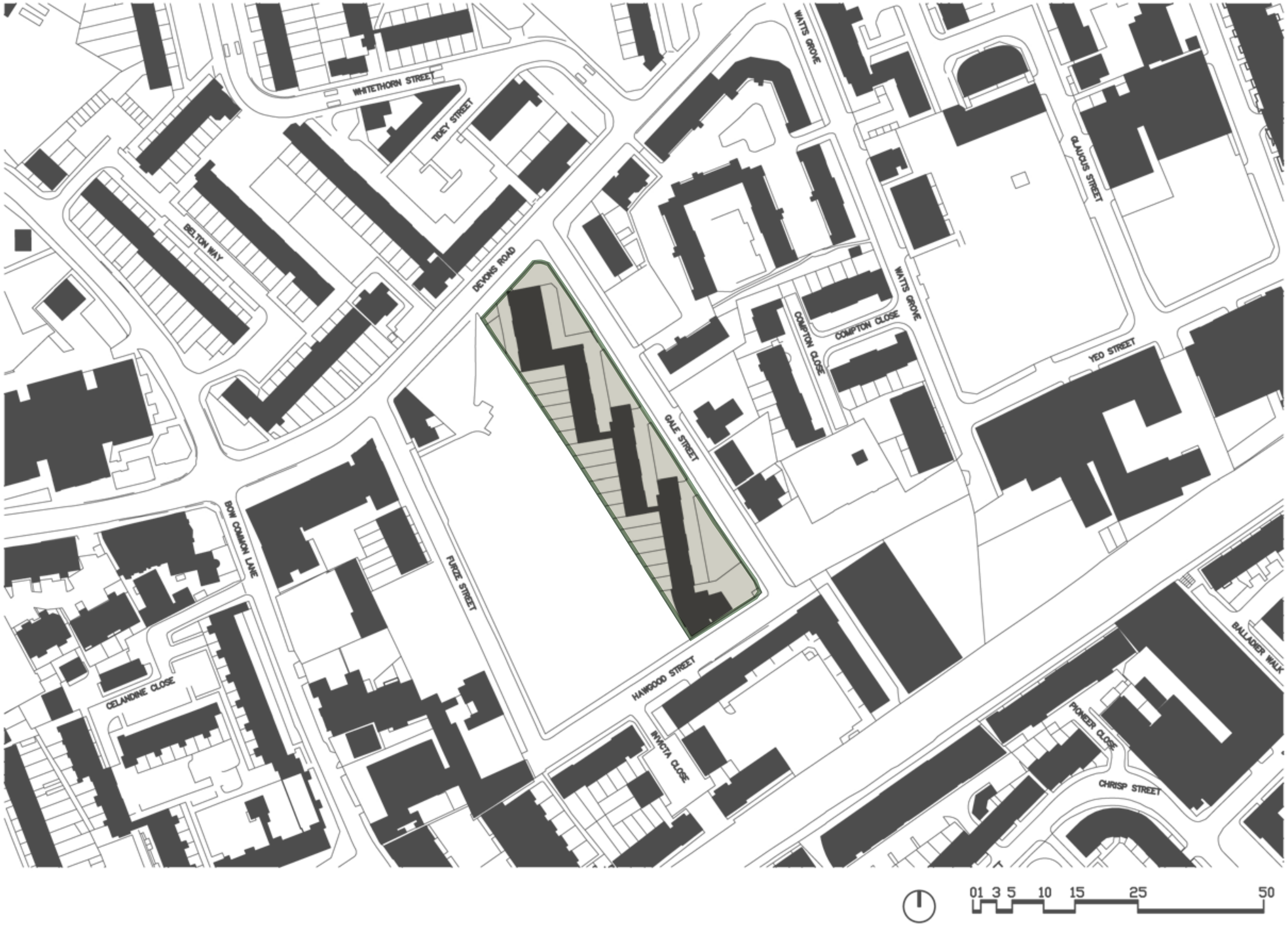
Lansbury: Ricardo Street

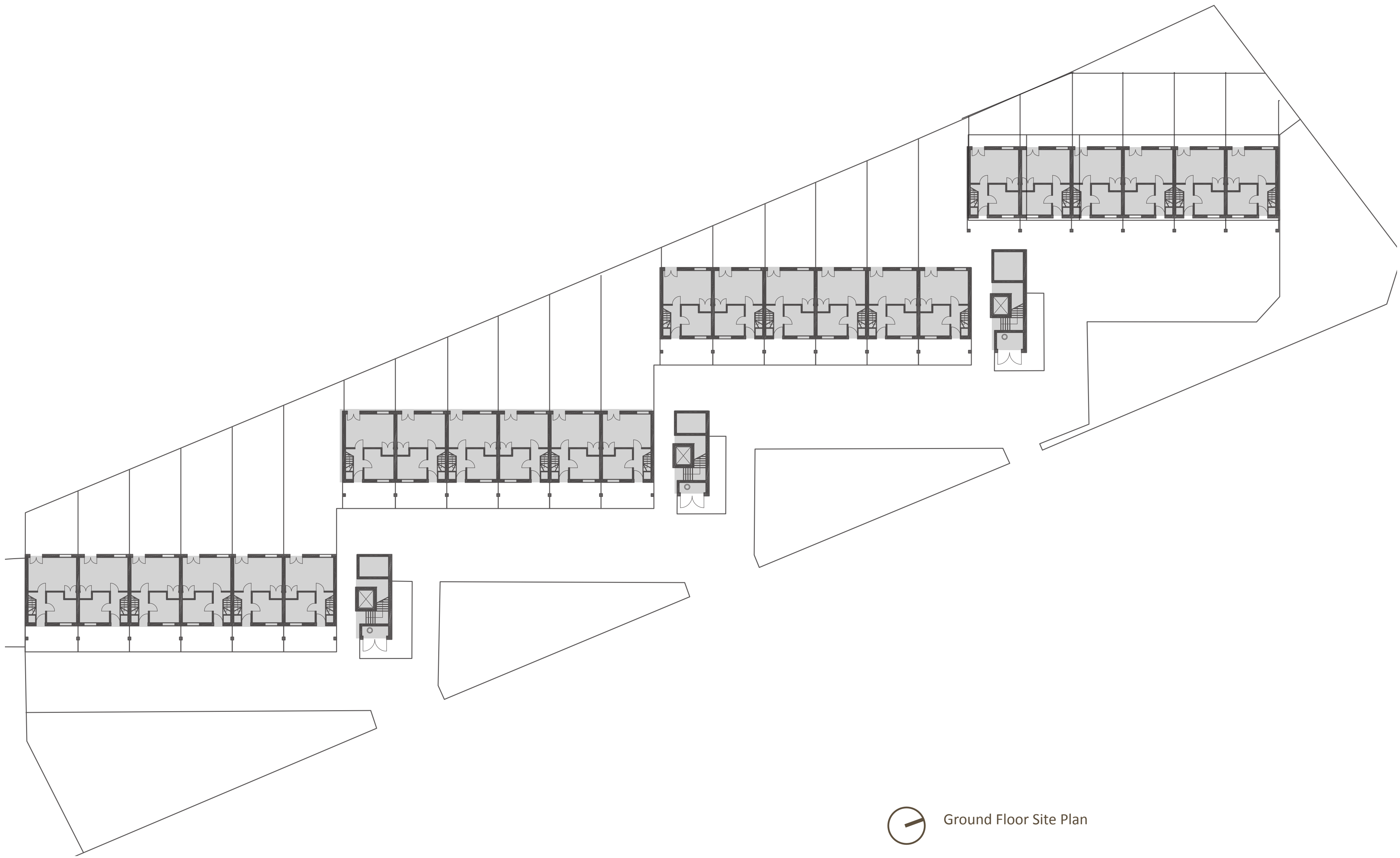
Floor Plans showing two-storey maisonettes



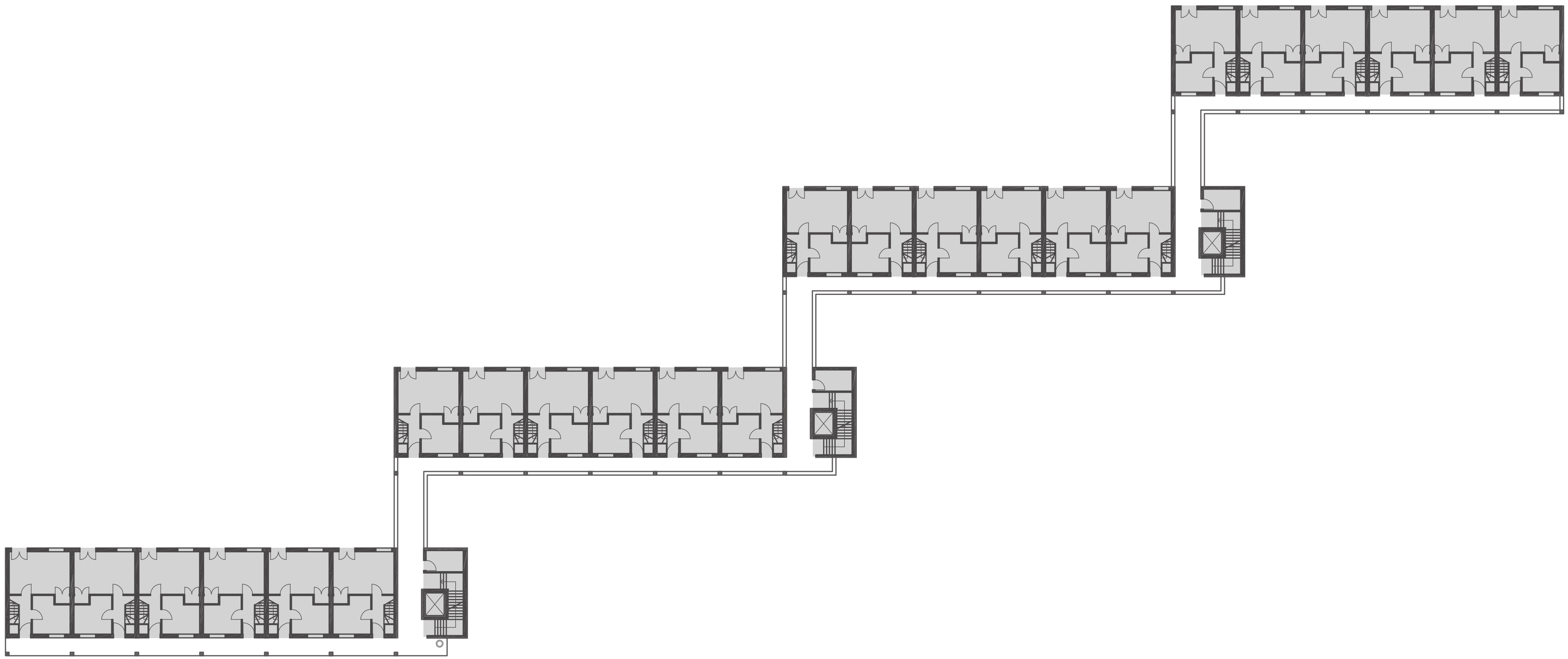
A03 Gale Street

Architect:	London County Council
Client:	London County Council
Year:	1960- 1970
Dw/ha:	146
Hr/ha:	510
Bedspaces/ha:	587
Plot Ratio:	1.43
Site Area:	0.47
No. dwgs:	69
Building Height:	6 storeys
PTAL:	2


WHITETHORN STREET
TIDEY STREET
BELTON WAY
DEVONS ROAD
WATTS GROVE
GLAUCUS STREET
COMPTON CLOSE
YEO STREET
GALE STREET
BOW COMMON LANE
FURZE STREET
HAWGOOD STREET
CELANDINE CLOSE
INVICTA CLOSE
BALLADIER WALK
PIONEER CLOSE
CHRISP STREET
0 1 3 5 10 15 25 50



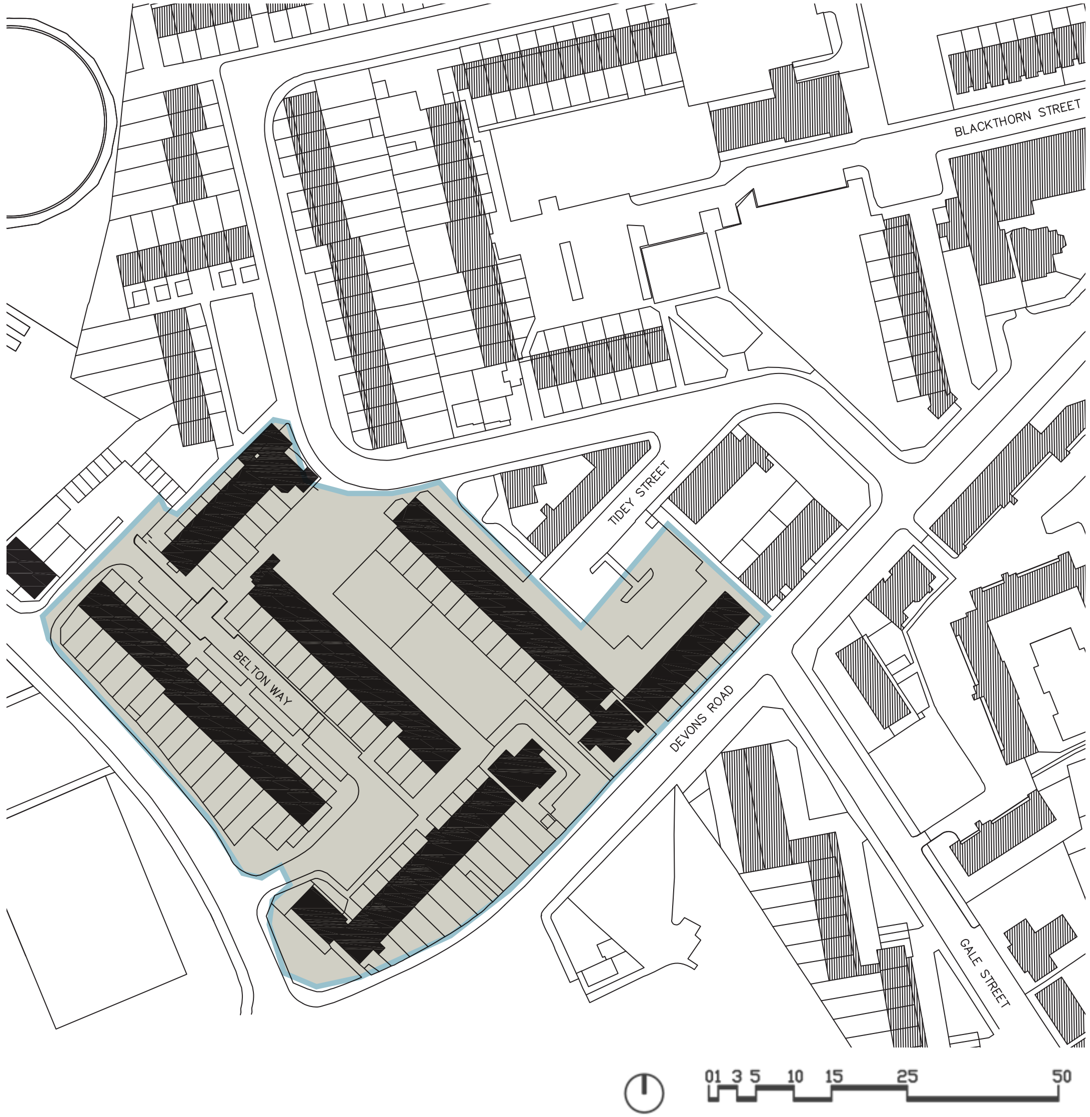
Ground Floor Site Plan



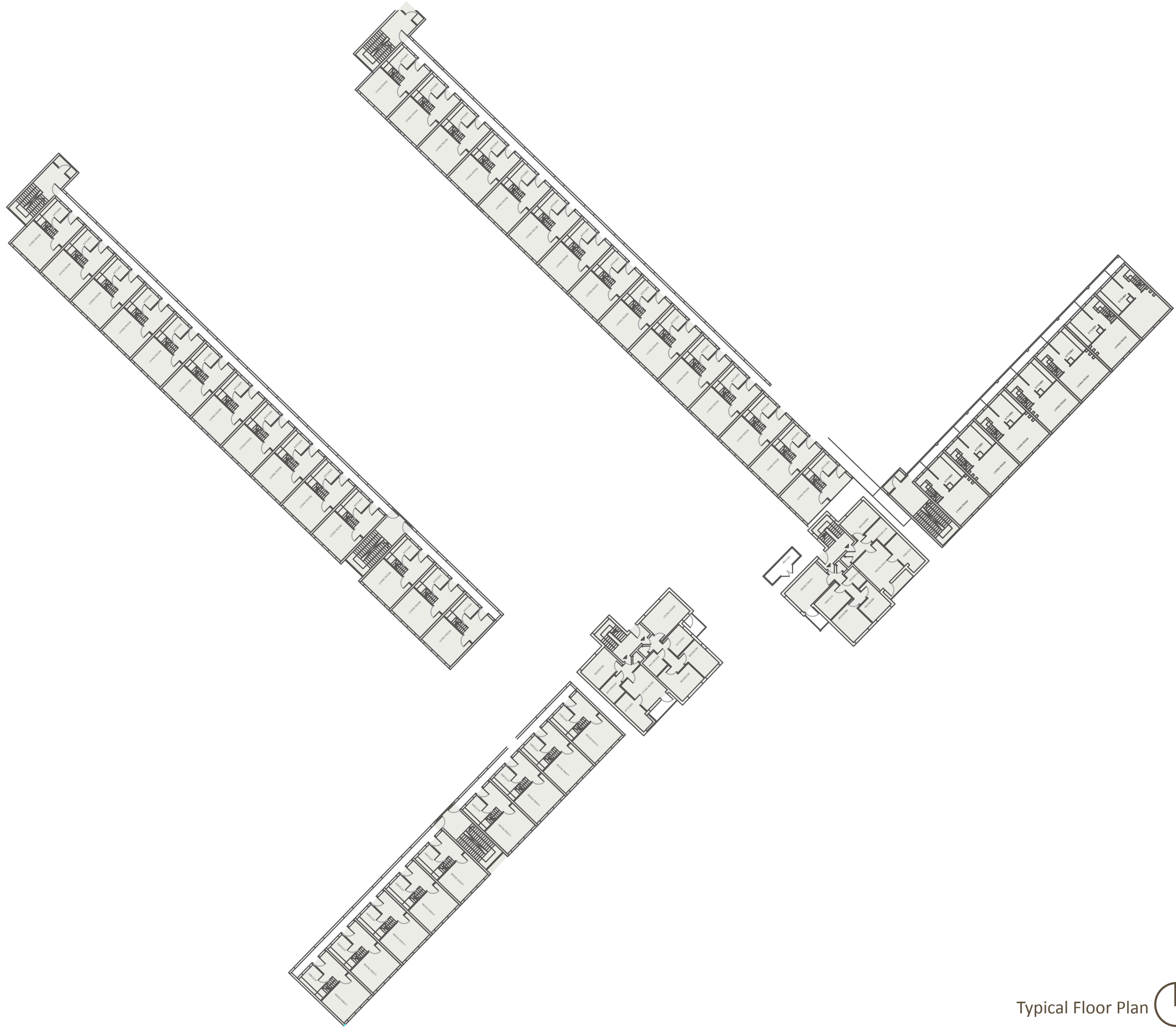
Typical Floor Plan

A04 Lincoln's Estate

Architect:	London County Council
Client:	London County Council
Year:	1961-1965
Dw/ha:	111
Hr/ha:	420
Bedspaces/ha:	460
Plot Ratio:	1.02
Site Area:	1.5
No. dwgs:	166
Building Height:	4 storeys
PTAL:	2


BLACKTHORN STREET
TIDEY STREET
BELTON WAY
DEVONS ROAD
GALE STREET
0 1 3 5 10 15 25 50

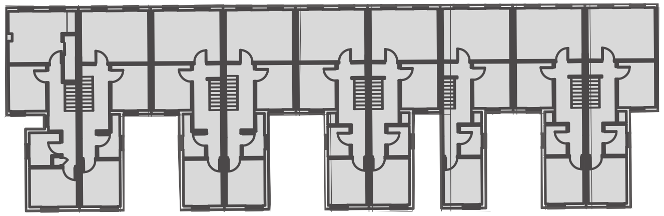
Ground Floor Site Plan



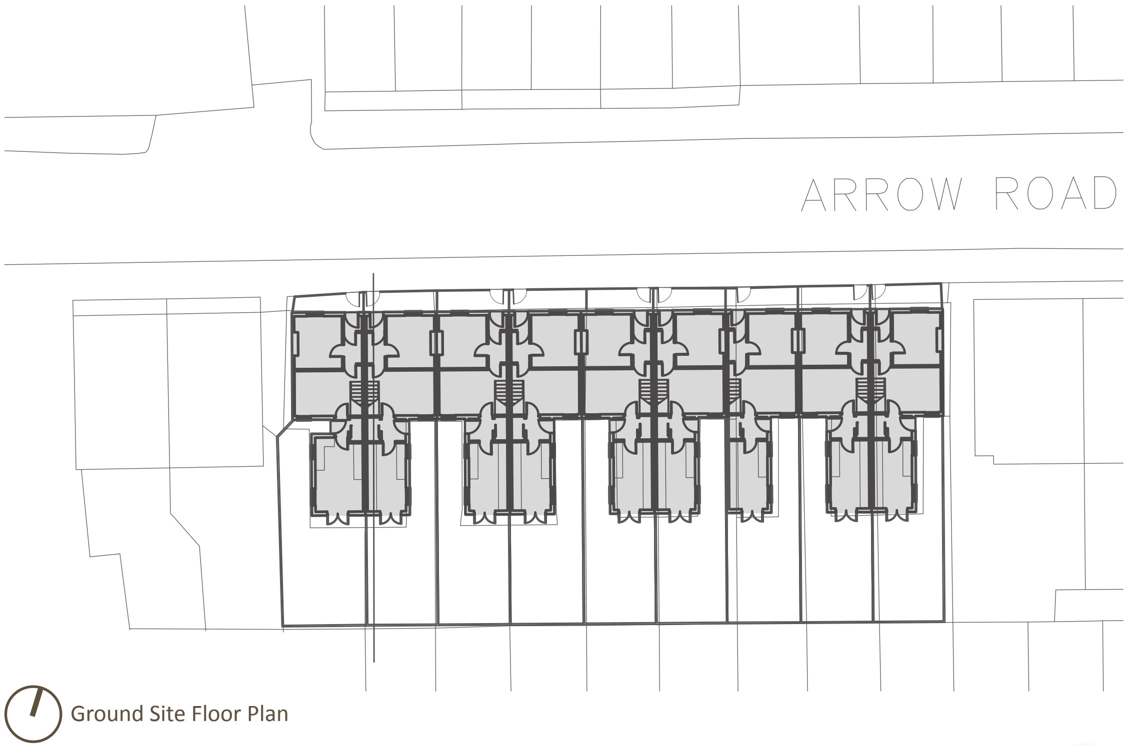
Typical Floor Plan

A05 Arrow Road

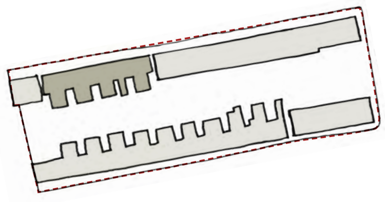
Architect:	Unknown
Client:	Unknown
Year:	1890 - 1910
Dw/ha:	88
Hr/ha:	458
Bedspaces/ha:	493
Plot Ratio:	0.98
Site Area:	0.91
No. dwgs:	83
Building Height:	2-3 storeys
PTAL:	5

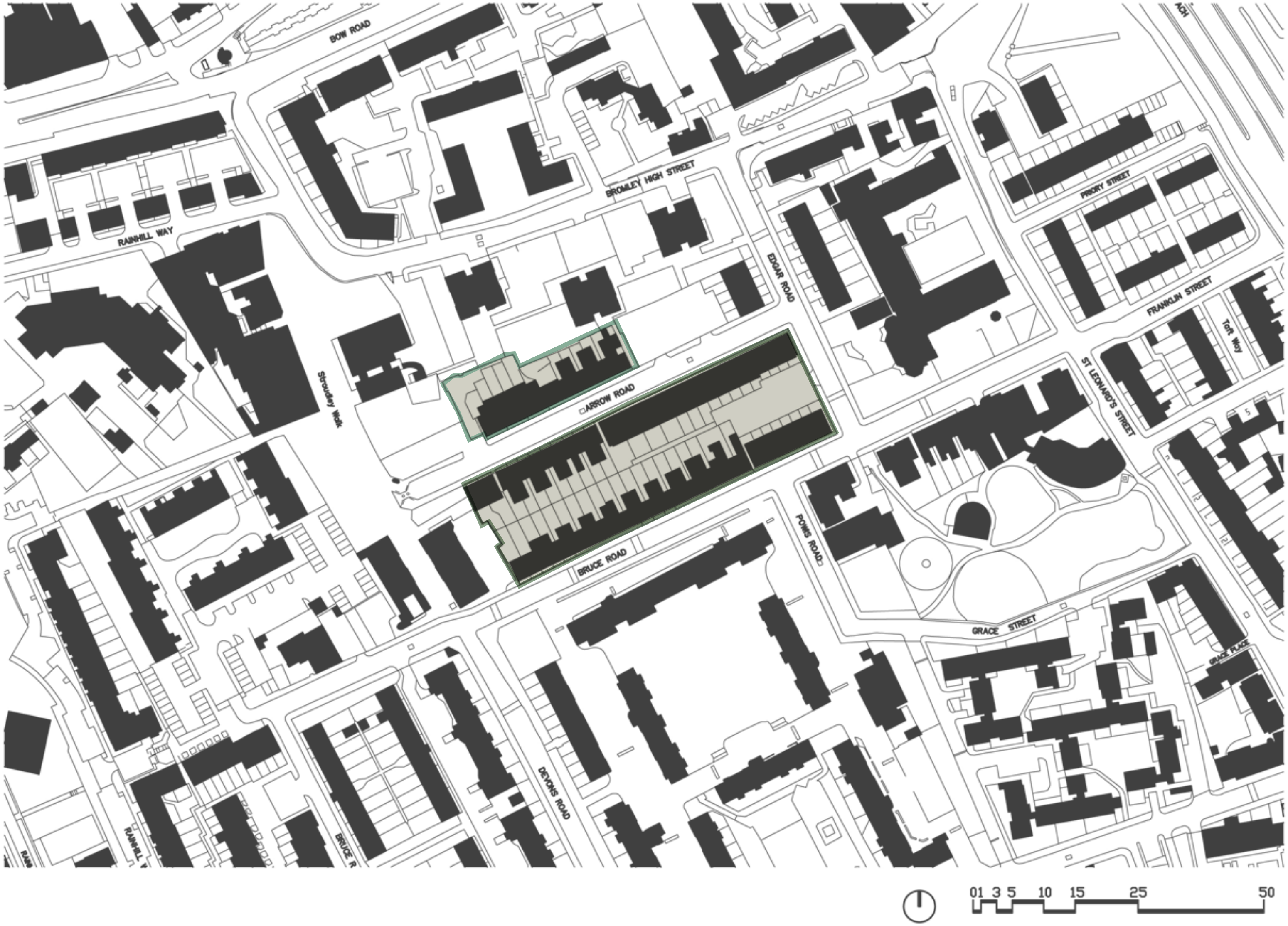


Typical Floor Plan



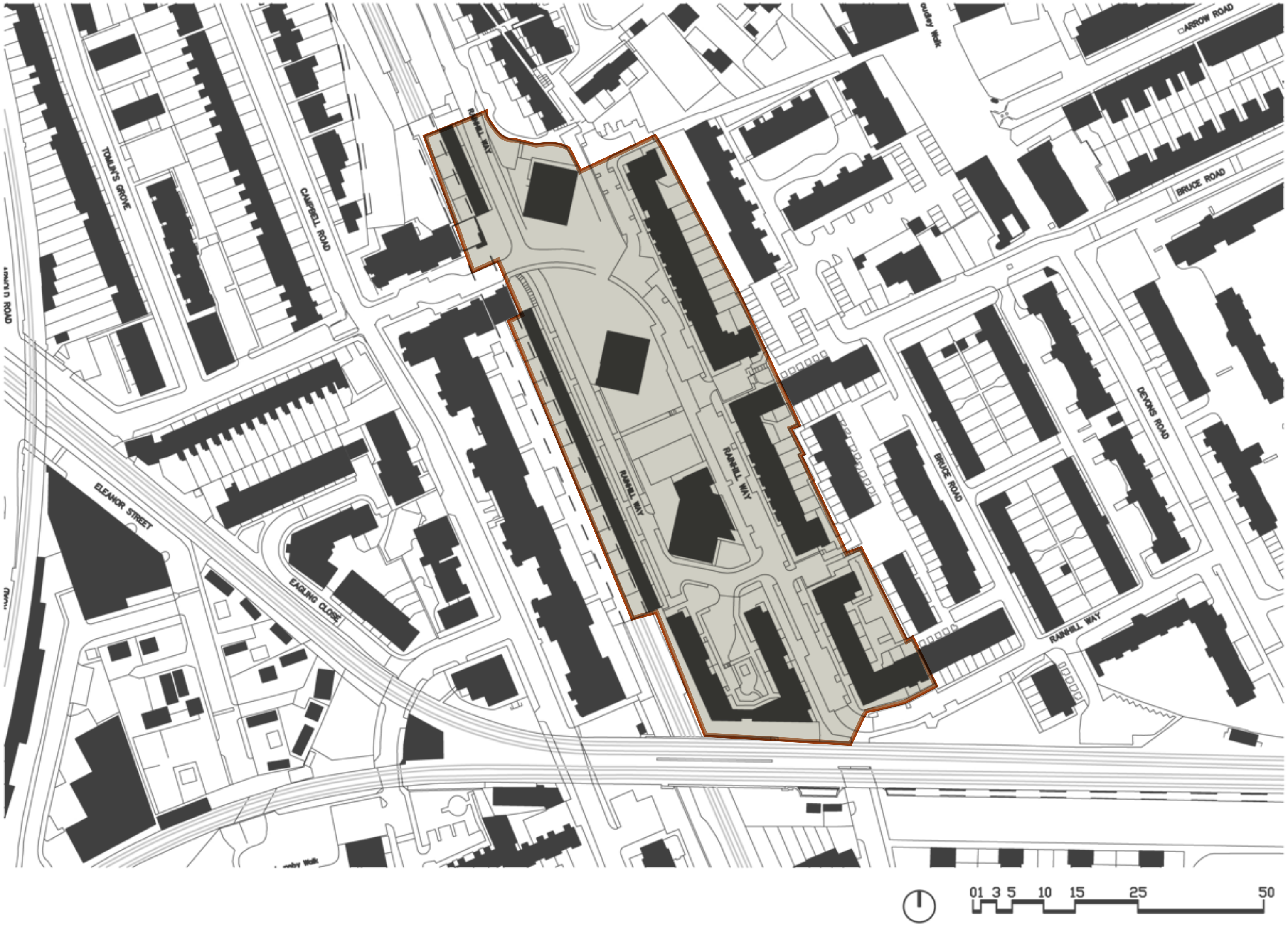
Ground Site Floor Plan

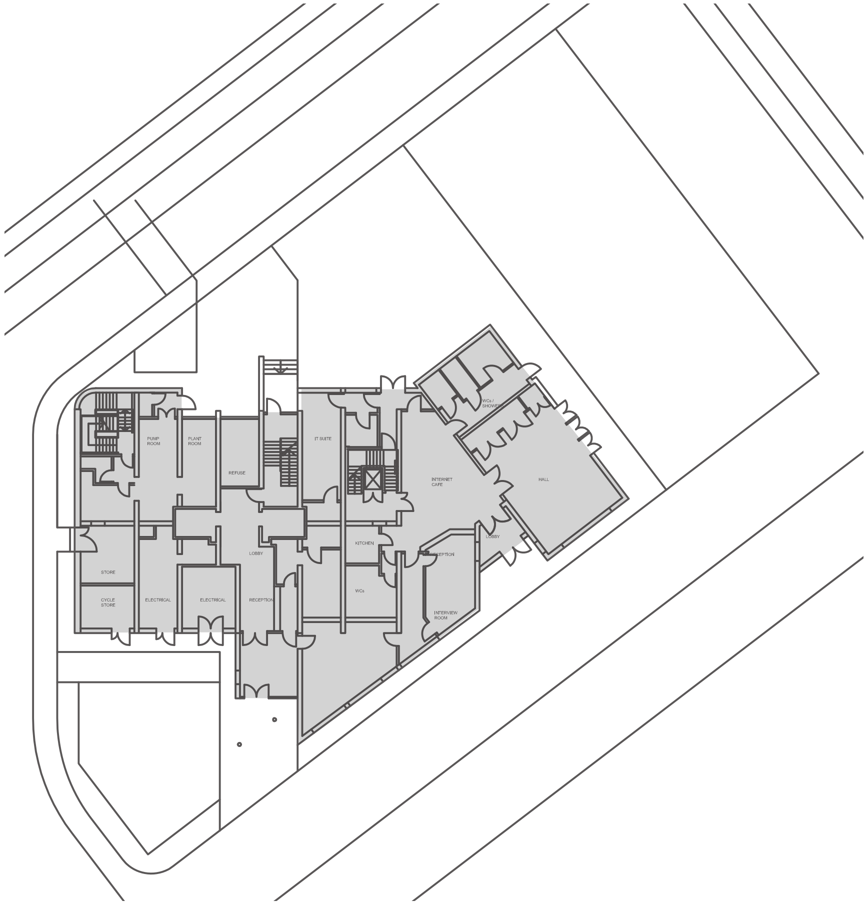



BOW ROAD
BROMLEY HIGH STREET
RAINHILL WAY
EDGAR ROAD
PRIORY STREET
FRANKLIN STREET
Stroudley Walk
ARROW ROAD
ST LEONARD'S STREET
Taft Way
BRUCE ROAD
POWIS ROAD
GRACE STREET
GRACE PLACE
DEVONS ROAD
01 3 5 10 15 25 50

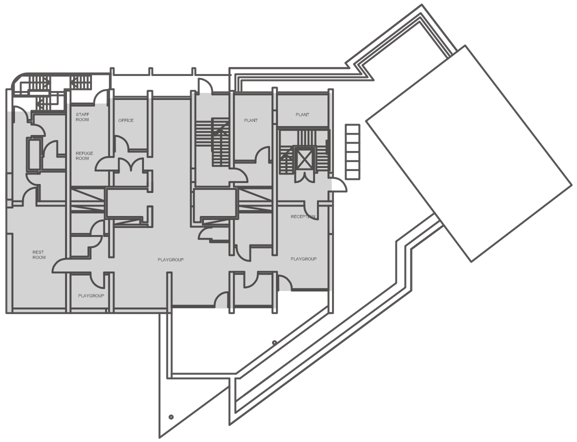
B01 Bow Cross

Architect:	Greater London Council
	Redeveloped by PRP
Client:	Greater London Council
	Revelopment - Swan Housing Group
Year:	1970’s
	Redevelopment - 2007-
Dw/ha:	234
Hr/ha:	77
Bedspaces/ha:	976
Plot Ratio:	2.02
Site Area:	1.83 ha
No. dwgs:	429
Building Height:	3-25 storeys
PTAL:	2

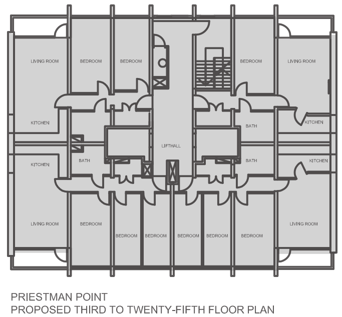

TOMLIN'S GROVE
CAMPBELL ROAD
RAINHILL WAY
ELEANOR STREET
EAGLING CLOSE
BRUCE ROAD
DEVONS ROAD
ARROW ROAD
RAINHILL WAY
01 3 5 10 15 25 50



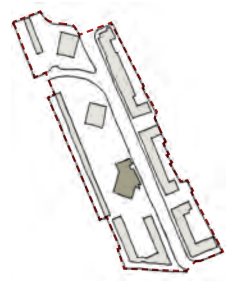
Priestman Point
Ground Site Floor Plan

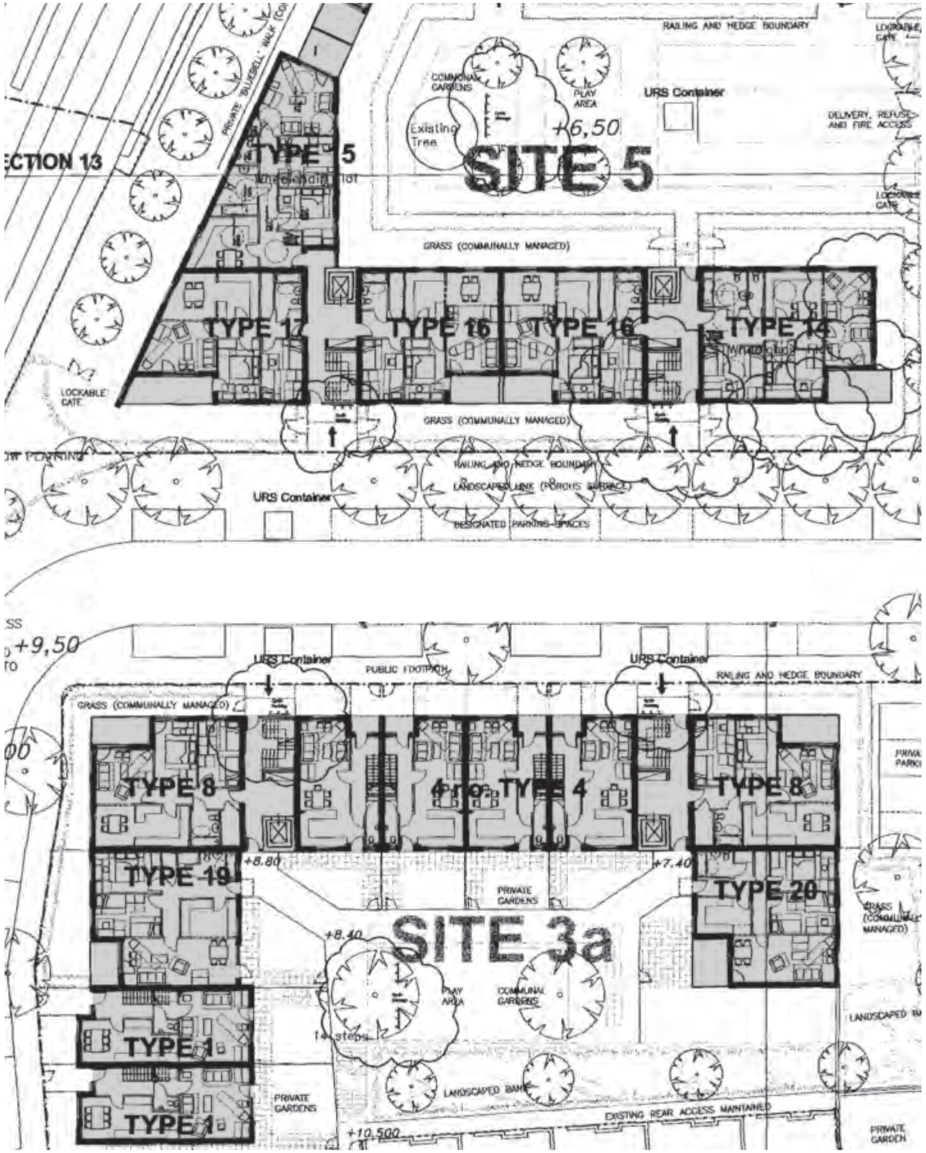


Priestman Point
First Site Floor Plan

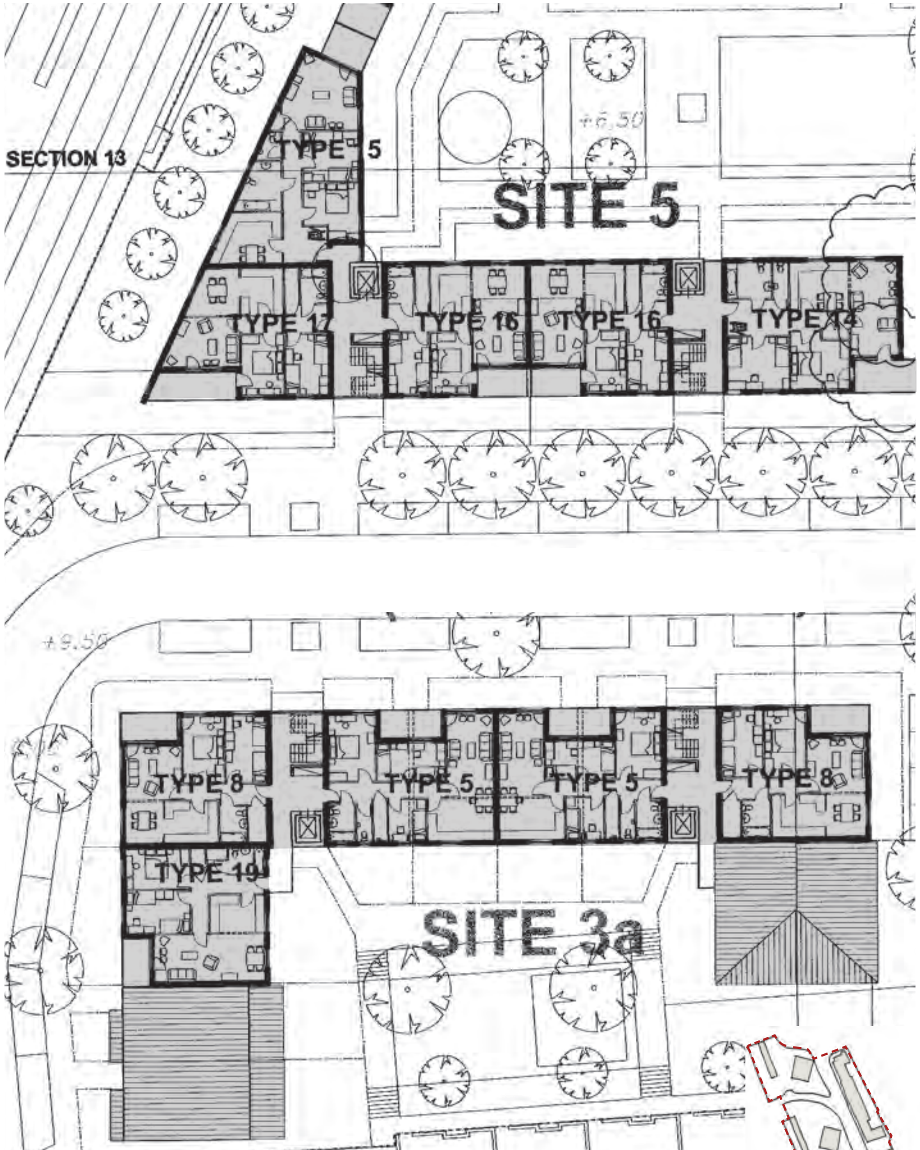


Priestman Point
Third to Twenty Fourth Site Floor Plan

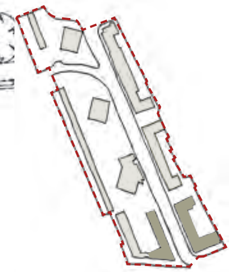




Apartments and houses
Ground Floor Site Plan

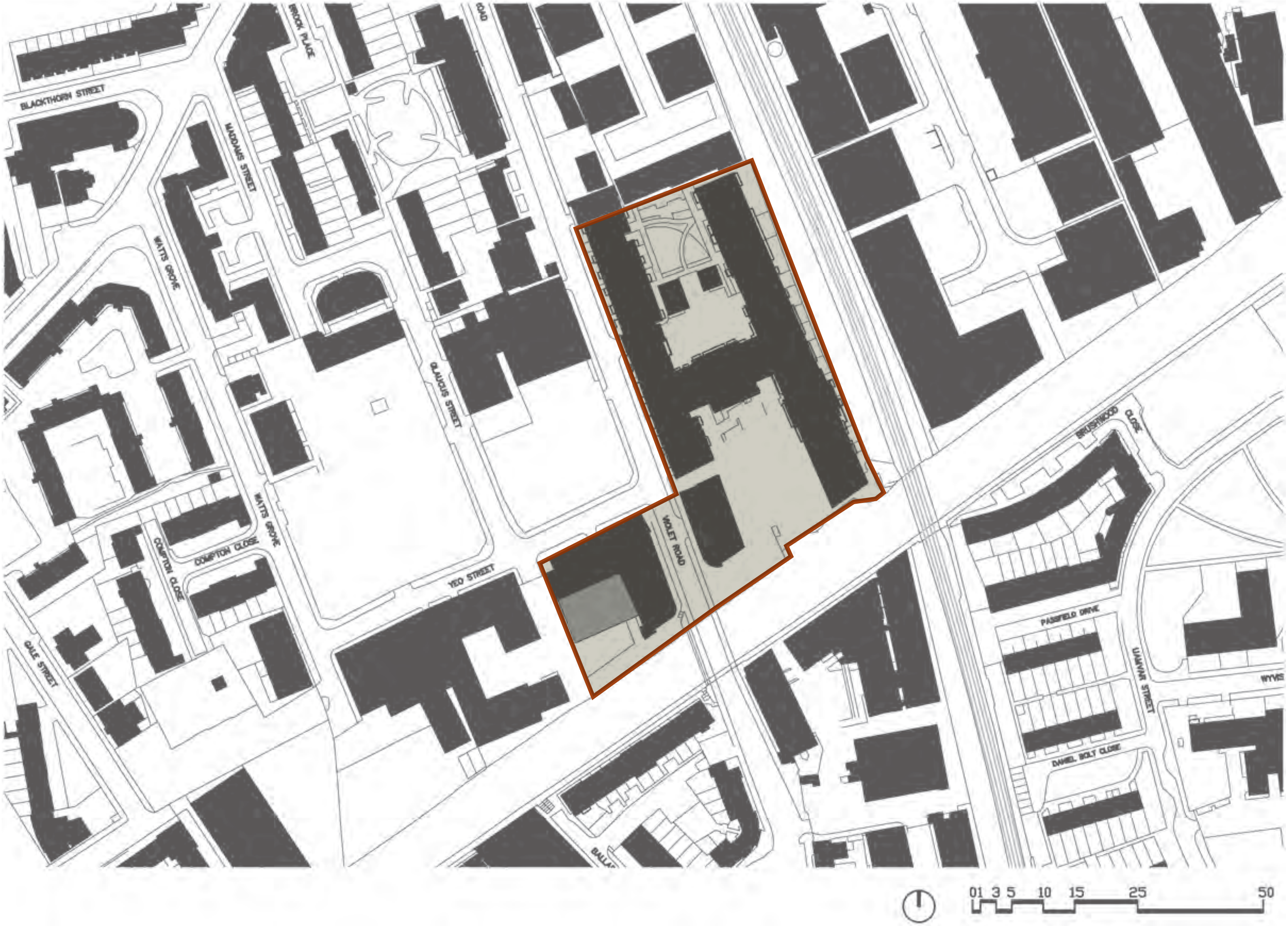


Apartments and houses
Third Floor Site Plan



B02 Caspian Wharf

Architect:	KKM Architects
Client:	Berkley Homes
Year:	2005 - present
	Redevelopment - 2007-
Dw/ha:	366
Hr/ha:	878
Plot Ratio:	2.65
Site Area:	1.14ha
No. dwgs:	416
Building Height:	4-13 storeys
PTAL:	2


BLACKTHORN STREET
BROOK PLACE
MADDAMS STREET
WATTS GROVE
GLAUCUS STREET
COMPTON CLOSE
YEO STREET
VIOLET ROAD
GALE STREET
BRUSHWOOD CLOSE
PASSFIELD DRIVE
UAMVAR STREET
DANIEL BOLT CLOSE
01 3 5 10 15 25 50

Ground Floor Site Plan

Third Floor Plan

B03 St Andrew's

Architect:	Allies and Morrison (Block A)	
	Maccreanor Lavington (Block B)	
Client:	Barratt Homes and Circle Anglia	
Year:	2006-	
Dw/ha:	265 (Block A)	320 (Site)
Hr/ha:	736 (Block A)	920 (Site)
Bedspaces/ha:	772 (Block A)	1080 (Site)
Plot Ratio:	2.74 (Block A)	2.76 (Site)
Site Area:	0.76ha	3.01ha
No. dwgs:	195	964
Building Height:	3-25 storeys	
PTAL:	2	


RAINHILL WAY
DEVAS ROAD
WILLIAM GUY GARDENS
MALTINGS CLOSE
CRESCENT
TWELVETREES
REEVES ROAD
REEVES ROAD
REEVES ROAD
DEVAS STREET
EMPSON STREET
EMPSON STREET
BLACKWALL TUNNEL NORTHERN APPROACH
0 1 3 5 10 15 25 50

Ground Floor Plan

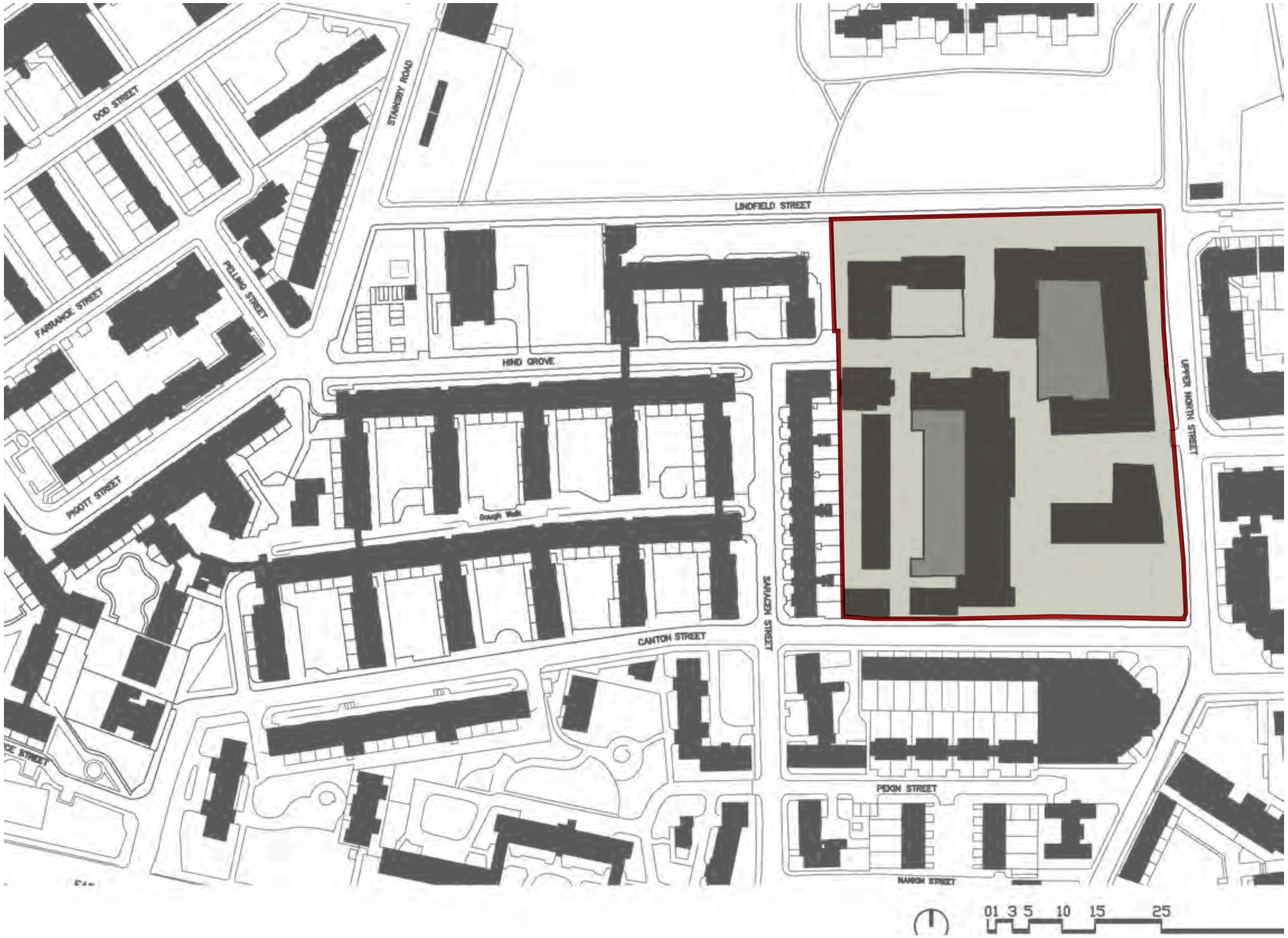
First Floor Plan

St. Andrew's

Site Axonometric

B04 New Festival Quarter

Architect:	Stock Woolstencroft
Client:	Bellway Homes
Year:	2010 -
Dw/ha:	254
Hr/ha:	728
Plot Ratio:	2.61
Site Area:	1.93 ha
No. dwgs:	490
Building Height:	4-14 storeys
PTAL:	3



DOD STREET
STAINSBY ROAD
LINDFIELD STREET
PELLING STREET
FARRANCE STREET
HIND GROVE
PIGOTT STREET
Dough Walk
UPPER NORTH STREET
SARACEN STREET
CANTON STREET
PEKIN STREET
NANKIN STREET
01 3 5 10 15 25

Ground Floor Plan

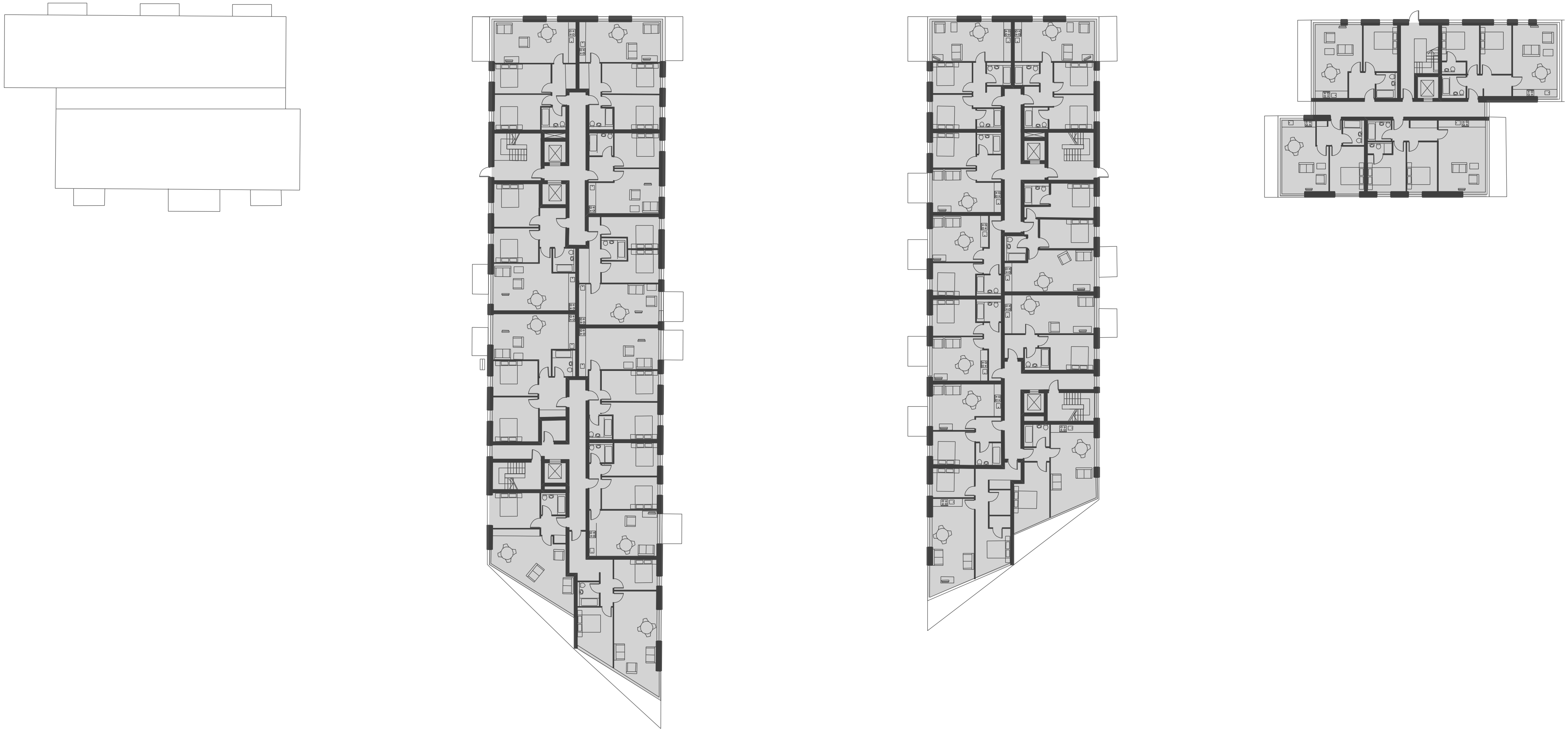
First Floor Plan

B05 Abbott's Wharf

Architect:	Jestico + Whiles
Client:	Telford Homes and East Thames Group
Year:	2002-2005
Dw/ha:	329
Hr/ha:	881
Bedspaces/ha:	
Plot Ratio:	2.99
Site Area:	0.61 ha
No. dwgs:	201
Building Height:	4-14 storeys
PTAL:	1b


THOMAS ROAD
Limehouse Cut
COTALL STREET
COTALL STREET
DOD STREET
STAINSBY ROAD
BARTLETT CLOSE
0 1 3 5 10 15 25 50

Ground Floor Plan



First Floor Plan

Abbott's Wharf
Site Axonometric