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Coding urban design: Constructing a wireframe for a place-focused urbanism

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ABSTRACT

This paper explores the nature and use of coding in urban design, both conceptually and as a tool for delivering a greater attention to place-focused urbanism. It discusses how these practices have been used on both sides of the Atlantic before conceptualising this role in the light of different 'model' coding prescriptions and processes. The paper draws from two major pilot programmes, 17 years apart, that examined the use and potential of codes in England, alongside evidence on the spread and effectiveness of coding in the country. The work is particularly relevant internationally as the only known large-scale and longitudinal evaluation of coding practices in urban design. Ultimately, the evidence points to the value of codes as a distinct urban design governance tool that can establish a 'wireframe' of essential urbanistic elements with the potential to optimise place value.

1. Introduction

1.1. Coding (two types)

Today, the term coding is most often associated with information technology, with the activity of programming software, websites, apps, and the like. Load the terms 'code' or 'coding' into a search engine and page after page of search results will reveal an almost exclusive focus on computing. In a broader sense, however, the term coding simply means the assigning of a code to something for the purposes of classifying it and codes can be found everywhere: in science, nature, genetics, literature, art, security, human language, fashion, social interaction, law, public policy, and, of course, the built environment.

In the world of computing, 'code' refers to the set of instructions written in a particular programming language. Coders may innovate by writing new, previously undefined pieces of code, but will always work within the rules of languages and will often take sequences of code from a pre-existing source where it is proven to perform a particular function. These 'software design patterns' are then strung together to create new products.

Likewise, urban development follows recognisable languages which are most obvious in the architectural forms and styles that vary from place to place and through time (Fig. 1) and which, until the 20th Century, predominantly defined a street-based urbanism (Cowan, 2021: 85). Increasing in scale from architecture to the more expansive and complex field of urban design, these can be understood as pieces of code.

They might involve new and innovative elements, but more-often-than-not are constituted from well-established codes already in use elsewhere.

Just as programming languages are defined by syntax (form) and semantics (meaning) (Mitchell, 1996), codes in the built environment can also be conceptualised to constitute two elements that equate broadly to form and meaning. First, a series of 'components' that together constitute the physical kit of parts that will define a particular place. These sit alongside 'parameters', or instructions for use to ensure that the key relationships between the components are correct.

In the past the choice of components and the parameters dictating their use would have been largely automatic; it was just how things were done in localities where technology and governance practices had not 'advanced' enough to do things any differently (Guise & Webb, 2018: 43). Today, however, more-often-than-not, external policy and regulation (see 3.1.2) will impose codes on projects that may be generic rather than place specific. Likewise, developers can employ a wide range of modern construction methods and urbanistic approaches which encompass systems of codes that are very different from local vernacular traditions, leading to an almost infinite range of possibilities. The result, some argue, is the need to limit choices through imposing a designed code with the potential to generate some coherence and an appropriate responsiveness to local conditions (Sorkin, 1993).

However imposed, all human-made environments, when broken down into their component parts, will constitute recognisable codes and it is how they are put together that gives rise to particular distinctive

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'urbanisms'. In turn these might be described in stylistic terms (e.g. avant-garde, traditional, etc.), by their relative urbanity (e.g. urban, suburban, etc.), or in terms of their response to their localities (e.g. contextual, contrasting, etc.). Whatever their origin, such codes are brought together to create new places in a manner that responds to external factors (client instructions, contextual qualities, site constraints, community engagement, local policy / regulations, budget, etc.) and a defined design and / or development processes (briefing, visioning, iterations and refinements, testing, and so on). Arguably it is the combination of codes and how they react to these external factors that determines the nature of the places that are ultimately produced (Barnett, 2011).

In computing, despite sharing much of the same code, applications can be innovative, elegant, functional and appealing, or alternatively unremarkable, crude, dysfunctional and unnecessary. In the built environment, the selection of the right codes, in the right places and combinations will determine whether they generate attractive, fulfilling, and sustainable places or unattractive, alienating and unsustainable ones (Chang et al., 2022). A particular component may typically lead to poor urbanistic outcomes, for example blank facades at street level, but if modified by the right parameters relating to its use, the impact can be ameliorated, perhaps by wrapping big box formats or ground floor parking with active uses (Llewelyn-Davis, 2000: 43).

The logic behind the increasing use of 'coding' as a deliberate activity of code generation and a particular sub-set of urban design governance practices (Carmona, 2016), reflects a broad belief that the intelligent and sensitive pre-determination and subsequent application of the right codes in the right places is likely to increase the chances of better design outcomes being achieved (Choy, n.d.). But, as Dovey, 2016: 194) notes, "One person's right might be another's travesty. Codes are forms of striation that stabilize territories, bringing order and identity to the city. They are social in origin, subject to agreement and negotiation, the outcome of contestation and negotiation". In other words, they are political, designed entities, and therefore inevitably

subject to opinion and challenge.

In relation to the built environment, the term 'code' has been used to capture almost any type of design-based regulation or standard that might shape urban areas (Ben-Joseph, 2005; Marshall, 2011). In this paper codes are more specifically defined as: *A distinct form of design guidance that stipulates in an illustrated, directive, and precise manner the three-dimensional components of a particular development or place and the parameters for how these should relate to one another, without prescribing the overall outcome* (Fig. 2). It follows that 'coding' is the process of generating codes.

Unpacking this a little further, 'design guidance' has been defined as a "generic term for a range of tools that set out design parameters with the intention of better directing the design of development" (Carmona 2011a: 288). In the case of codes, four key terms nuance this: 'three-dimensional', 'illustrated', 'directive' and 'precise'. While not every element in a code will be all (or perhaps any) of these things, when applied to the whole code, they point to a form of guidance that is likely to be more prescriptive than most, and articulated by predominantly graphic rather than written means.

Just as computers following a programme will track the logic path established in its coding, so (in theory) should the users of coding in urban development. This can be done either through applying codes to a site or place through the creation of a masterplan, or discrete architectural, landscape or infrastructure intervention that follows the code. Or it may involve using the code to articulate further and in detail an already established design vision such as that represented in an urban design framework. The former reflects a 'vision defining' role and the latter a 'vision delivering' one, a difference that will be discussed further in Section 3.2.4. In both, and as reflected in the definition of codes used in this paper, codes are emergent in the sense that choices about how they are applied, and how they are supplemented by the articulation of non-coded elements, can lead to very different design outcomes (Carmona et al., 2006a).

In both worlds (urban and IT), the creativity and technical mastery of



Fig. 1. The urbanistic language of Elizabethan London (a) was quite different to that of Georgian London (b) just as Georgian London and Georgian Bath (c) had their own distinctive qualities born of the materials used, the first being predominantly brick and stucco and second predominantly Bath stone. Each can be viewed as the consequence of a unique combination of urbanistic codes (image: Matthew Carmona).

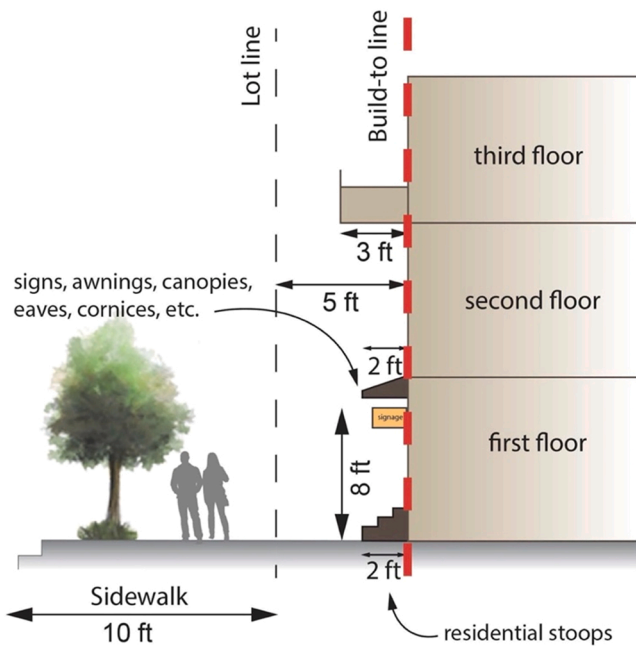


Fig. 2. In this example code prepared for San Jose in Northern California (image: Malakiman et al., 2020) the principles of lot (plot) and build-to line and the relationship with the street are clearly, succinctly, and graphically presented.

coders in knowing how and when to apply codes is likely to be critical, including how to adapt existing codes and create entirely new ones when necessary. But there will also be many fundamental principles that simply have to be followed to create anything that makes sense at all. In computer programming this means, for example, understanding how to use and manipulate variables, data structures and syntax. In urban design it is likely to relate to some of the well understood and widely accepted normative principles of place-focused urbanism such as an integrated street structure, clear public / private interfaces, the integration of natural elements into built space, and so forth (Tabb, 2021). Theorists, practitioners, and activists have been arguing in favour of these sorts of qualities since at least the mid-twentieth century turn against Modernism and, more recently, against what is often viewed as unsustainable suburbanisation (Leinberger, 2008).

As they are pre-defined in a code, such elements will inevitably limit the choices and freedom of designers and developers as regards how they choose to design and develop (Tiesdell & Adams, 2004). The trade-off is that in doing so they help to ensure that a defined set of public design aspirations are met as part of the larger place-shaping process. The aspiration being that the resulting project is more likely to be successful by achieving at least a minimum level of acceptability for regulatory approvals. This might be described as a 'safety-net' approach. From there to the next level of achieving an inspiring, innovative, or exceptional design will most likely require more than a code (by itself) can achieve, including an exceptional client and design team with a determination to build on the defined (coded) parameters through a creative design process (Carmona 2009a). The code, in such a scenario, can act as a 'springboard to excellence'.

1.2. This paper – purpose and structure

This introduction has set out, in principle, some of the roles of coding in urban design. To explore this further the paper draws from evidence of different types – historic, qualitative (interview-based), quantitative (survey-based), and outcome-based – to examine the use of coding both conceptually and as a tool for delivering a more place-focused urbanism. For the purposes of this paper and in the interests of space, this means

the creation of design outcomes that maximise 'place value'. In other words, the codes facilitate the optimisation of social, economic, environmental and health outcomes through the way they shape the design of places (Carmona 2019a).

Unlike IT, where the coding of new application is a given – nothing will work without them – in the urban realm the creation of codes as an explicit tool (or phase) of practice is hit and miss. Codes are always applied, but the deliberate stage of designing them to elevate large-scale development outcomes in the public interest is often missed out (Cowan, 2021: 175–6). In such a context the paper asks how can codes be used as a positive wireframe for a more place-focused urbanism? To do so it draws extensively on practices from England over the last twenty years to examine what works and what does not and what lessons can be learned for wider international application.

The paper is in six parts. Following this introduction, the next two parts examine the nature and history of coding. First, the notion of coding as it relates to urban design is discussed and how practices have developed and been used on both sides of the Atlantic. Second, a wire-frame analogy for coding is articulated as a useful means to conceptualise the tool in the light of different 'model' coding prescriptions and processes. The paper then turns to practice in England to investigate coding processes in greater depth. First, the common findings from two nationally sponsored coding pilot programmes are discussed, before, next, evidence on the effectiveness of coding in England is drawn together, including the results of a series of national surveys. Finally, conclusions are drawn out that link the various conceptual, historical, and practice-based accounts and in doing so reveal twenty principles for code production of relevance internationally. The paper concludes that by following the principles, the potential exists to deliver a robust wireframe for a place-focused urbanism.

2. Coding, a practice with long and widespread roots

2.1. Europe and North America

In Parts 2 and 3 of this paper, the nature of coding is discussed conceptually, and, before that, historically as regards the development and range of practices used internationally. There is now a long history of using codes of the type defined in 1.1 in Europe and North America, and emerging practices in rapidly developing countries such as Kazakhstan, Saudi Arabia, India, and Gabon. In these places and others, the reliance up to now on blueprint masterplans is increasingly seen as not sufficiently reflective of public design aspirations or responsive to changing local circumstances (Macdonald & Wilmot, 2022; Parolek et al., 2018).

2.1.1. Coding in the USA

In the USA, 'form-based codes' are increasingly widespread as an alternative to the Euclidean zoning practices that have dominated in the post-war period and that many argue have led to the spread of formless suburban sprawl through their emphasis on regulating land uses as opposed to urban form (Barnett & Beasley, 2015: 97–8). The US-based Form-based Codes Institute (set up in 2004 by leading consultancies to promote the use of codes) defines form-based codes as "a land development regulation that fosters predictable built results and a high-quality public realm by using physical form (rather than separation of uses) as the organizing principle for the code" (Fig. 3).

As a regulation rather than a guideline the Form Based Codes Institute contend that form-based codes offer a powerful alternative to conventional zoning (Anon, 2023b) (<https://formbasedcodes.org>). Reflecting on this trend, Washburn (2013: 109) argues that form-based coding works best when stripped back to its essentials and suggests that the 1916 New York zoning ordinance was the original and best form-based code ever written: "It's simple: you take the width of your street and multiply it. This gives you your base height. From there, a regulating line angles back from the street. When that line reaches

FUTURE URBANIZATION PLAN	1. Sector	Conservation Sectors			Urban Growth Sectors															
	2. Sector Type	Preserve Open Space Sector O1	Reserve Open Space Sector O2	Conservation Community Growth Sector (CC) G1	Controlled Growth Sector G2	Intended Growth Sector G3	Infill / Retrofit Growth Sector G5													
REGULATING PLAN	3. Level of Urbanization*	None	Low	Low	Medium	High	Medium (Existing)													
	4. TDRs	Sold to G3	May Sell to G3	May sell to G3	May buy or sell in G2	May buy from O2	May opt into program													
STREET PLAN	5. Place Type <i>Place Types are allocated by Sector. Appropriately scaled Pedestrian Sheds & permitted D zones are shown.</i>	Conservation Easement 	Parcel By Parcel Development 	Conservation Community 	Hamlet (D3) 	Hamlet (D3, D4) 	Village (D3, D4) 	Activity Node (D3) 												
	6. Place Type (Rendered)																			
STREET PLAN	7. Zoning Districts	Conservation Zones			Urban Zones															
		D1	D2	D3	D4	D5	PD													
STREET PLAN	8. Street Type	Conservation Street Types			Urban Street Types															
	9. Abbrev/Type RR - Rural Road BC - Bike / Cartway GW - Greenway OA - Oak Allee ND - Neighbor Drive MS - Main Street	RR	BC GW OA	RR	BC GW OA	RR	BC GW OA	BC GW OA	ND	MS	BC GW OA	ND	MS	BC GW OA	ND	MS	BC GW OA	ND	MS	
STREET PLAN	10. Frontage	Conservation Frontage Types			Urban Frontage Types															
		Thoroughfare	Road	Street & Scenic St.	Ave. & Scenic Ave.	Thoroughfare	Road	Street & Scenic St.	Ave. & Scenic Ave.	Thoroughfare	Road	Street & Scenic St.	Ave. & Scenic Ave.	Thoroughfare	Road	Street & Scenic St.	Ave. & Scenic Ave.	Thoroughfare	Road	Street & Scenic St.

Fig. 3. The Daufuskie Island Code for Beauford County SC, includes this image setting out how the code is structured based on a series of physical types and contexts. The code is based on the model *SmartCode* that will be discussed in 3.2.3 (image: Beauford County Council 2010).

twenty-five percent of your lot, the sky's your limit".

The New York example demonstrates that codes are not just focused on residential development, nor necessarily on traditional forms of urbanism, and nor are they limited to guiding defined development projects. They can relate to whole cities, and beyond. Today, however, form-based codes are most closely associated with the New Urbanist movement in the USA. By June 2019, *Borys et al. (2019)* had surveyed 728 codes across the country that met the criteria of the Form-based Codes Institute, the vast majority (91%) of which had been adopted since 2001. The survey therefore captured an increasingly rapid uptake of an approach that, at the time, was 38 years old.

For *Talen (2011: 532)*, adopters of the approach are leveraging the legal authority of formal regulation while shaping it to place-making. They are also taking advantage of the various open-source tools made available by key New Urbanist thought leaders to encourage the uptake of codes. The best known of these are *SmartCode* (see 3.2.3), the Library of codes (<https://formbasedcodes.org/codes/>) (*Anon, 2023b*) and various associated standards for practice that are summarised in *Table 1*.

2.1.2. Coding in Europe

In Continental Europe, the use of coding systems is also long established, in Modern times dating back to the evolution of planning in

Table 1

The Form-based Codes Institute defines Standards of practice for Form-based codes (column 1) and best practices for form-based codes (column 2) (Anon, 2023c) (<https://formbasedcodes.org/standards-of-practice/>).

A form-based code must include	An exemplary form-based code should
1. A detailed physical plan and clear vision , which has been developed and adopted through an inclusive community engagement process.	1. Be effectively coordinated with other applicable policies and regulations that control development on the same property.
2. A statement of intent and purpose , which ties the code to the vision or plan and sets parameters for development of and a framework for waivers and exceptions.	2. Be designed and programmed to be regularly updated, convenient for public distribution, and understandable to all members of the community.
3. Building form standards with specific requirements for building placement and building frontages that will shape public spaces.	3. Produce walkable, identifiable neighbourhoods that provide for daily needs to be accessible through multiple transportation options.
4. A regulating plan that establishes a specific set of standards for each zone shown on a regulating plan.	4. Ensure parking requirements, if included, are compatible with pedestrian-scale urbanism.
5. Clear and objective standards with limited or no discretionary review.	5. Promote racial equality, social and economic inclusion, and cultural diversity.
6. Pedestrian scale thoroughfare standards that promote and/or conserve an interconnected street network and pedestrian-scaled blocks.	6. Clearly describe the administrative procedures for project approval in easy-to-understand language, with efficiency in the number of steps, and options for flexibility that still provide results consistent with the vision or plan.
7. Predictable physical outcomes , which are determined by standards and parameters for physical form—build-to lines, frontage type requirements, and open space features—rather than standards with highly unpredictable physical outcomes—floor area ratio and density—which result in a high-quality urban form and public realm, while still allowing for variety in the size and shape of urban spaces and the design of buildings.	7. Include definitions of all technical terms in language that is understandable to everyone who uses or is affected by the code.
8. Common-use language, graphics, and diagrams , which are unambiguous, clearly labelled, and accurate in their presentation of spatial configurations and relationships.	
9. Diversity of uses and housing types incorporating standards that encourage this diversity within a walkable distance	

Europe, although in different forms codes go much further back than that (Walters, 2007: 83–86; Carmona et al., 2023: 2). Particularly influential have been the German zoning practices that inspired the 1916 New York zoning ordinance, and which have since evolved into the binding land-use plans (Bebauungsplans) that cover allocated development sites across Germany. These are drawn up by municipalities in accordance with legally binding stipulations for urban structure set out in municipal-wide land-use plans (Flächennutzungsplans) and in the form of regulatory plans for large development sites. Using a nationally standardised notation, they cover matters such as building line, buildable areas, green locations, street alignments, and building heights and form (e.g. roof type) (Stille, 2007).

'Regulating Plans', of this type, are used internationally, to translate codes spatially, typically taking the form of a two-dimensional plan. They work in two ways. First, by simply dividing up locations (from whole municipalities to key sites) into defined areas where different combinations of codes will apply (akin to zoning) and second, at the level of individual development sites, by setting out where codes should apply, such as setback distances on an urban block (Fig. 4). They can be simply defined as *the spatial expression of codes in plan form for key sites or defined areas*, and often sit alongside other graphic and written codes.

Coding in various guises and with varying levels of authority and consistency has also been used in Austria, Belgium, France, Italy, the Netherlands, Sweden and the UK. European examples, include schemes often referenced for their sustainable design credentials, including Vathorst in Amersfoort and Hammarby Sjöstad in Stockholm (Schippacasse & Müller 2020; Carmona, 2021). In these schemes codes have typically been used in a vision-delivery role (see 1.1) for successive development phases, alongside and to deliver an overarching urban design framework (masterplan). In Hammarby Sjöstad, for example, each phase of this publicly led scheme was accompanied by a site-specific code as part of the package provided to guide private development partners. In France and Italy, typo-morphological approaches to the regulation of development are long-standing, establishing three-dimensional codes for larger areas in which incremental development is envisaged. In France, for example, as part of the commune-wide Plan Local d'Urbanisme (Kropf, 2011).

Pisano et al. (2019) note how increasingly techniques of what they refer to as 'rule-based design' (coding by another name) are being used experimentally in a vision defining role (see 1.1). Examples include Wijnhaven Island in Rotterdam, Nieuwe Zuid in Antwerp and Wienerstrasse in Linz. Wijnhaven was constructed from the late 1990 s onwards without a formal masterplan, but instead with a series of simple code based rules relating to factors such as tower slenderness, overshadowing, views and ground-level articulation. Together these have shaped and coordinated developments on its multiple plots.

2.2. *The journey in England, from rigid rules to discretion and back again*

In the UK, localised but 'generic' coding (not created for a specific site or place) can be traced back to medieval times but become routine as a need to address the negative side-effects of the industrial revolution. Notably, the Public Health Act of 1875 imposed a duty on local authorities to regulate new housing through the use of byelaws (local laws) leading to what became known as 'byelaw housing'.

2.2.1. *Byelaws*

Byelaws were crude but effective means of regulating for matters such as sanitary standards, density, and layout, giving rise to a set of house types that still make up a large part of the English housing stock (Fig. 5). Looking at this state of affairs thirty years after the Act, Raymond Unwin, in his treatise on 'the art of designing cities and suburbs' referenced early planning in Germany in an argument for modifying the English byelaws to achieve greater flexibility.

Unwin (1909: 387) acknowledged "the good work" that byelaws had done in "checking the worst evils of overcrowding and bad building", while recognising their limitations. He argued, "from the point of view of good architecture ... Forms are distorted; the roof is exaggerated or depressed; lines of space and height cut the buildings at awkward angles; street corners are spoiled by spaces being left between the buildings". For him, however, the fault lay not in the presence of restrictions per se – "very much of the beauty of buildings involves working within defined limitations" – but instead in their rigidity. Unwin concluded there was a difference between natural restraints such as those relating to the cost and strength of materials that are defined but flexible, and the action of building byelaws which are like "an unbending line or plane against which the builder pushes his development and which moulds it into something relentlessly uniform".

Unwin's concerns characterise a tension that has existed ever since and wherever codes are deployed. This involves the tensions, on the one hand, between the rigidity of rules to ensure compliance with issues of a defined (albeit contentious – Sheydayi & Dadashpoor, 2022) public interest and, on the other, the desire for flexibility to avoid homogenisation and allow variety and innovation in design (Dovey, 2016: 194–198). For Unwin (1909: 387) this required that rules had "something of the elastic character which belongs to natural restraints". He suggested, for example, that while the height of a building may need to

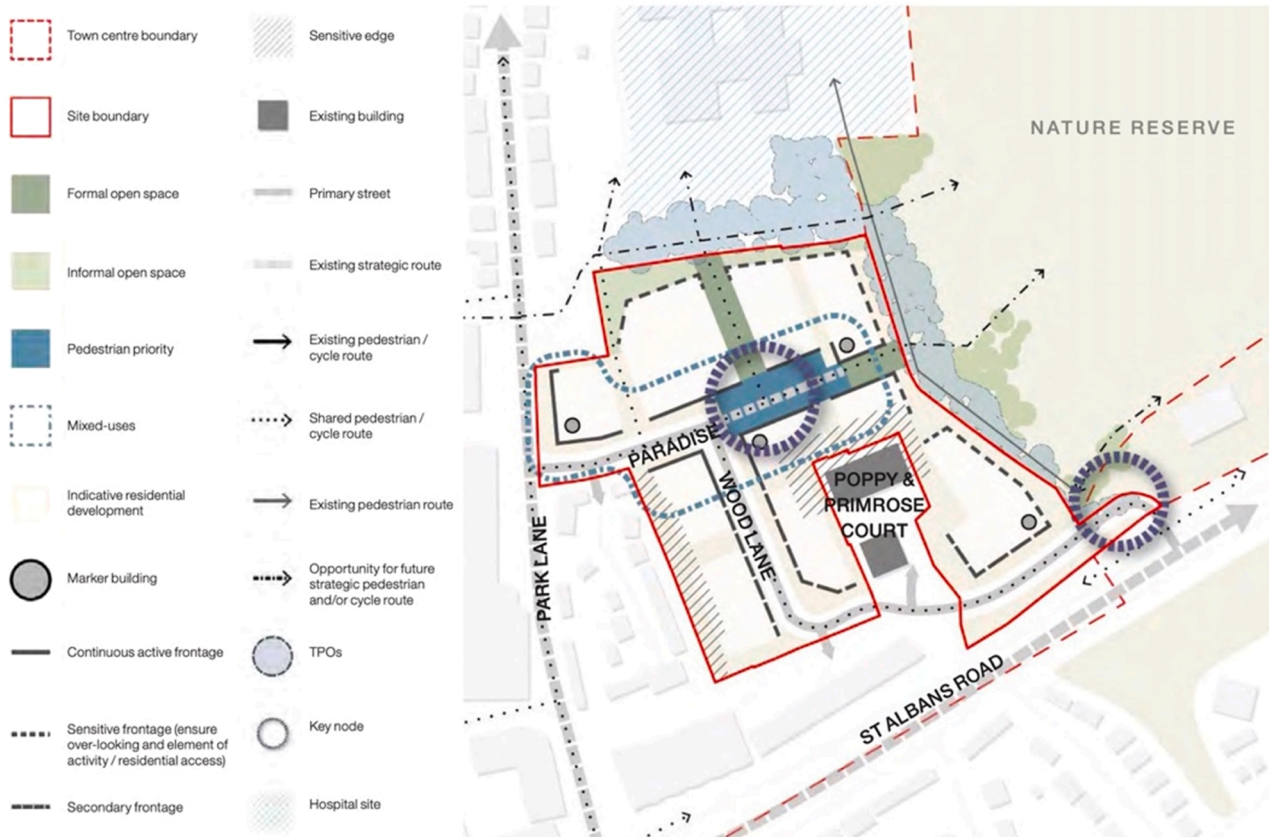


Fig. 4. Regulating plans translate codes into a two-dimensional plan, for example here in the Paradise site Design Code, Hemel Hempstead, Hertfordshire (image: Dacorum Borough Council).



Fig. 5. Byelaw housing in Stoke-on-Trent (renovated circa 2010) (Image: Matthew Carmona).

be strictly limited “a little give and take, a little averaging of one part with another, may be permitted” to avoid the “rigid form that results from ... arbitrary rules”. This, however, required a degree of discretion in interpretation that byelaws could not provide, much like modern day as-of-right zoning when in a pure form (Baba, 2011: 125–129).

2.2.2. Design guides

The journey in England from rigid rules to a system based on discretion (albeit not in everything) and gradually back again illustrates these tensions well. From 1909 onwards, local coding care of the by-

laws was gradually replaced as successive acts of Parliament ushered in a new system based on the discretionary interpretation of policy. Unfortunately, this did not deliver the transformations in quality that Unwin had hoped for, largely because the rigidities of byelaws were replaced by a vacuum in local public design aspirations. This was particularly the case when it came to the design of housing delivered by the market (as opposed to social housing) (Davies, 1998) where new development was managed through the most basic local planning policy (open to almost complete interpretation), by generic ‘amenity’ (space between dwellings) standards, and by rigid and often crude highways standards defined by upper tier county level authorities (Huxford, 2021). The situation gave rise to increasing criticisms from the 1950s onwards from the likes of Gordon Cullen (1961) and other stalwarts of the growing townscape and conservation movements, and from the early 1970s onwards to a new spate of authority-wide residential design guides.

The most famous of these – the 1973 Essex Design Guide – provided a bitter critique of the approach adopted at the time by so many local planning authorities in England (Fig. 6) and established what Walters (2007: 91) has referred to as Britain’s “primary example of design coding” (before more recent efforts). The guide intended to break away from a slavish adherence to highway standards by advocating new forms of site planning based on urban design principles, while also venturing advice on the treatment of elevations. Indeed, it was through this focus on detail that the guide received its most damning criticism from developers and architects alike, even though the ‘Essex Vernacular’ quickly gained popularity – sometimes (perversely) far beyond the bounds of Essex itself (Chapman and Larkham, 1992: 7). As Mel Dunbar (the assistant County Planner for Essex) warned: “The guide was never intended to be a recipe or pattern book. It’s a design tool!” (Best, 1978: 950).

The model, and its attempt to define a more contextual design

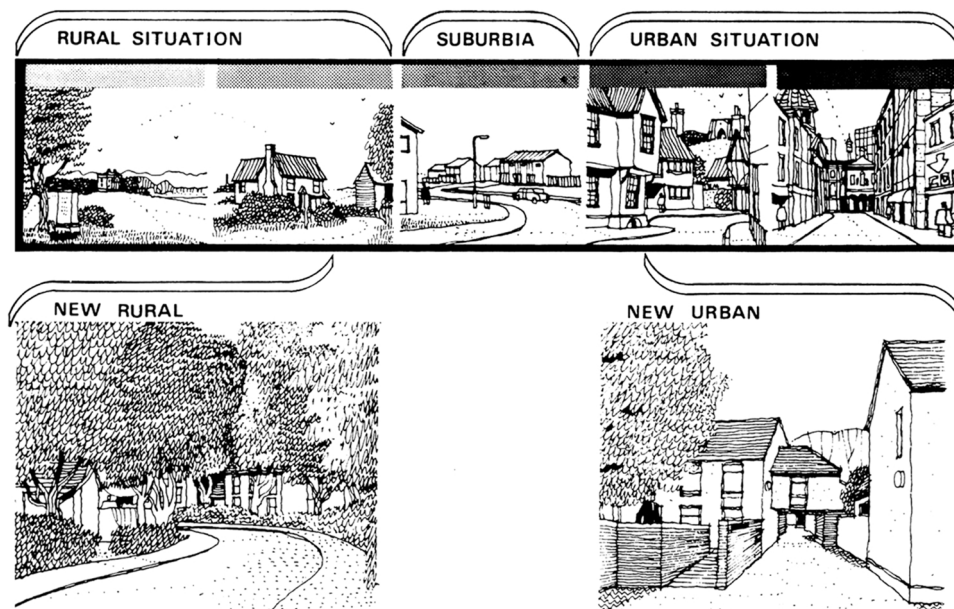


Fig. 6. The Essex Design Guide of 1973 denounced 'suburbia' in favour of 'New rural' (landscape dominated) or 'New urban' (townscape dominated) layouts (the reference to new urban predated that of New Urbanism in the USA by over a decade) (Image: Essex County Council, 1973).

framework for Essex was nevertheless picked up and reflected by numerous imitators; only a minority of which based their authority-wide design guides on a similar tailoring to locality. *The Architects' Journal* at the time was consequently full of complaints that the planning profession was overstepping the bounds of their professional responsibilities, the result – they argued – being a strangling of creativity. Such comment was answered, equally stridently, by proponents of such guides who – reflecting Raymond Unwin's views (see 2.2.1) – argued that some constraints could actually encourage more imaginative solutions rather than stifling them (Sim, 1993: 123–30). In fact, as a major study on the content and use of residential design guidance in the 1990s demonstrated (Carmona, 2001), when planning authorities came up against the country's hugely powerful volume housebuilders, the space for imaginative design, of any type, was typically limited. Instead, when discretionary and generic residential design guides (covering whole local authorities rather than specific sites or areas) were interpreted through the lens of the volume housebuilders standard product lines, their guidance was more-often-than-not ignored or otherwise severely watered-down.

2.2.3. Development briefs

In an attempt to overcome such problems and to raise design ambitions in relation to specific sites and development opportunities, the most proactive local authorities increasingly prepared what were variously called 'development briefs' or 'design briefs' for key sites (Carmona, 2001: 22–27). Typically, these took the form of written statements of planning and development expectations, often with some graphic content to illustrate issues such as expected entrances and exits to sites, key site constraints and features, and occasionally to suggest an indicative design layout.

Initially briefs were promoted by national Government. In 1976 they issued *Development Brief, Advice Note 1* to encourage their use, although this national guide was poorly conceived and was not widely disseminated (there never was an advice note 2 or 3) (Turner, 1994: 290). Despite the absence of effective national guidance on how to prepare briefs, by the 1990s these tools had become the most common form of site-specific design guidance, with their preparation favoured by local planning authorities "as an effective means to deliver contextually-specific design solutions to individual sites" (Carmona, 2001: 158; 271).

Views varied considerably on the use of development briefs, with Owen (1979 in Turner, 1994) referring to them as "potentially the most effective positive instrument of local physical planning", while later government funded research suggested that briefs too often had a negative rather than positive impact on design quality. The authors advised that "site-specific design guidance should only be necessary where there are grounds for modifying general policies or standards, or where there are resources on or around the site which require specific attention or protection" (DETR, 1998: 8–11, 18). The negative tone of the research reflected the generally poor quality of briefs that its analysis revealed, many of which were often prepared with little or no design content at all. But it also downplayed the potentially positive role of briefs as represented by some of the best practice examples that the work also identified.

Whether good or bad, development briefs were, at best, aspirational guidance and whether site promoters and developers embraced or ignored them was in large part at their discretion, although the weight attached to them in decision-making could be enhanced if formally adopted (DoE 1997, Annex A). The wide variation in practice, as illustrated in Fig. 7, nevertheless points to a perennial problem in English local planning authorities relating to the absence of resources and design skills capacity to fully engage with a site-based approach to the production of design guidance (see 5.2). The result is a system that has tended to favour the production of more generic design guidance for a larger spatial scale (Carmona, 2001: 287), rather than the sorts of site-specific plans that characterise, for example, German planning (see 2.1.2). Local specificity and the combination of graphic and written content in development briefs nevertheless ensured that they were the closest thing in the English planning toolkit to the types of form-based codes that had started to be used in North America or the regulatory plans being used in Continental Europe in the 1980s and 90s. The most sophisticated briefs (which were relatively rare) were akin to early 'design codes', the next tool to come on the scene.

2.2.4. Design codes

When the New Labour government of Tony Blair came to power in 1997, part of their agenda for change involved a new national emphasis on design quality (in large part to facilitate the delivery of more housing in urban areas). New tools for delivery were sought.

The Urban Task Force, chaired by Richard Rogers, was tasked to map

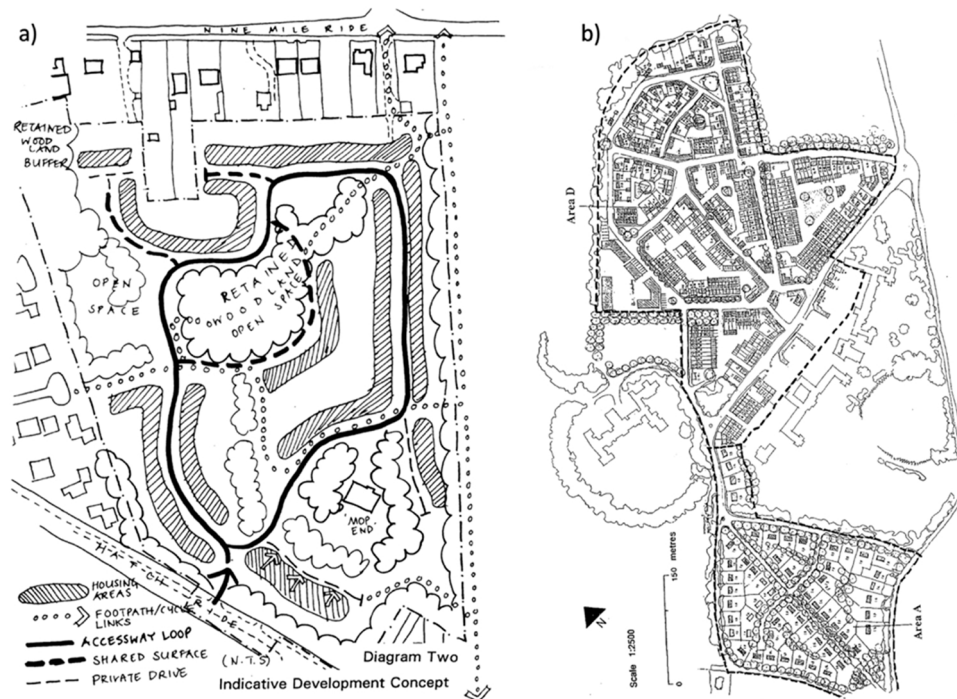


Fig. 7. Development briefs in the 1990s varied hugely in their relative design sophistication, with indicative design layouts (when included) that ranged from relatively crude ‘back of an envelope’ sketches (a) to fully worked up masterplans (b) (images from Carmona, 2001: 235, 301).

out a path to an urban renaissance in English cities and looked to Continental Europe for its inspiration, notably at the use of what they classified ‘spatial masterplans’ which had guided projects such as the Barcelona Olympics. At the same time advisors to the then Deputy Prime Minister, John Prescott, encouraged him to look across the Atlantic at the use of form-based codes, and in 2003 he visited Seaside in Florida, then the posterchild of the New Urbanists. The idea of design codes was soon harnessed, building also on a small number of more visual and directive guides being produced in England at the time, notably the *Guide to Development in Hulme*, that had been published in 1994 by Hulme Regeneration Ltd and Manchester City Council. Like development briefs, design codes were viewed as a site-specific tool, prepared to accompany the three-dimensional spatial masterplans that the *Urban Task Force* (1999) had recommended.

The Government instructed their newly created advisor on design – the Commission for Architecture and the Built Environment (CABE) – to run an eighteen-month pilot programme starting in June 2004 to test design codes. The work included a full-scale monitoring and evaluation (Carmona & Dann 2006a) (see Part 4) and eventually the publication of a new national practice guide: *Preparing Design codes, A Practice Manual* (Carmona & Dann 2006b). This defined design codes as “A set of illustrated design rules and requirements which instruct and may advise on the physical development of a site or area. The graphic and written components of the code are detailed and precise and build upon a design vision such as a masterplan or other design and development framework for a site or area”.

Echoing the experience with development briefs, after the practice guide had been published, there was little concerted effort to promote its use, or the use of design codes generally, and following the demise of CABE in 2011, a period of national retrenchment on design quality followed (Carmona 2019b). Consequently, it wasn’t until 2018 that design codes received their first mention in national policy, in the *National Planning Policy Framework*, now at the behest of a very different (Conservative) government, newly sold on the potential of coding.

Concerned at the low pace of housing development in England and advised by the right wing think tank Policy Exchange (Airey et al., 2018) that an emphasis on better – more ‘beautiful’ – design, could help to

reduce opposition to new development in the country, in 2019 the Building Better Building Beautiful Commission was set up, co-chaired by the traditionally minded philosopher Roger Scruton. Their report led to an ill-fated Planning White Paper, published in 2020, which advocated for a transition from England’s policy-based discretionary planning system to one based on as-of-right zoning. These ideas quickly died a death, following a political backlash from Conservative Members of Parliament buoyed by their constituents’ concerns that such a system would mute voices against unpopular housing developments, but the emphasis it gave to the use of design coding survived, spearheaded in 2021 by the publication of a *National Model Design Code* (to be discussed in 3.2.4).

This time the UK Government set about promoting design codes more actively: first through a new design code pilot programme and associated monitoring and evaluation (Carmona, Clarke, Quinn, & Giordano, 2022); second, through a concerted programme of national promotion fronted by a newly created Office for Place; and third, through further endorsements in the *National Planning Policy Framework* (NPPF). In 2021 the NPPF was revised with the requirement that: “To provide maximum clarity about design expectations at an early stage, all local planning authorities should provide design guides or codes”. This was justified with the assertion that “Design guides and codes provide a local framework for creating beautiful and distinctive places with a consistent and high quality standard of design” (MHCLG 2021a: para 129).

In 2023, further proposed policy revisions identified design codes as “the primary means” for assessing and improving the design of development (DLUHC 2023: para 135), building on provisions in the Levelling-up and Regeneration Bill working its way through Parliament. This proposed an obligation on local authorities across England to produce and adopt design codes as part of their formal development plan. Consequently, by 2023, codes had reached a heightened status and prominence on the British planning scheme that no forms of design guidance had enjoyed since the hegemony of the byelaws. The impact of this remains unknown but the journey had come full circle, with design codes representing a decisive move away from discretion and back towards a locally defined yet more systemised and prescribed approach to

the governance of design.

3. Models and processes of coding

3.1. Theorising codes

Before considering what the evolving practices in the UK mean for code production in the fourth and fifth parts of this paper, and what lessons can be collectively learned in the sixth, the discussion first steps back to establish a common conceptual basis from which to consider coding. Across North America, Continental Europe and the UK, codes are used in similar ways, albeit in very different systems, essentially as delivery mechanisms for securing defined physical design quality outcomes:

- In North America, form-based codes exist at different scales. First, as a root and branch mandatory replacement for, or parallel and optional alternative to, a city-wide zoning ordinance. Second, as what is referred to as a ‘floating-zone code’, or a code associated with the delivery of a particular planned unit development (suburban development). In each case they establish physical parameters to replace what some see as crude as-of-right regulations applying to an entire municipality.
- In Continental European planning systems, regulating plans of various types and associated codes (either generic or specific) typically define the urbanistic parameters for developments at a site-specific scale. These sit as part of the lower-tier (local) planning arrangements, underneath and subject to conformity with a higher-tier strategic spatial plan.
- In the English planning system, design codes reduce policy discretion by establishing clearer design parameters for decision-makers over

and above the more generic policies found at the national scale or in local development plans and the authority-wide design guides of the type discussed in the previous section of this paper. Typically, they have been site-specific tools designed to provide greater certainty in a system still characterised by a good deal of regulatory discretion.

Systems have generally (although not always) been on a journey from more generic to more specific forms of coding, with steps along that road representing a greater potential for local refinement and adaptation to the contextual circumstances of sites or places. In each case this narrows the ‘opportunity space’ (Bentley, 1999) within which developers and designers operate to define a more coherent urban design structure (the sorts of positive restraints envisaged by Raymond Unwin, see 2.2.1) while, ideally, still leaving scope for what has been characterised as “a rich variety of distinctive and memorable interpretations” (Wiltshire 2022).

Typically, this is part of the design governance infrastructure put in place to help guarantee the delivery of publicly defined objectives through zoning and planning systems. Sometimes codes are put in place by landowners or developers wishing to coordinate different phases of large development projects that will be designed (and perhaps developed) by different parties and built out over an extended period. Well known examples of such practices include the Canary Wharf estate in London (Carmona, 2009b) or the early New Urbanist experiments with form-based codes such as Kentlands in Maryland (Fig. 8). More recent UK examples include the work of large Master developers such as Urban&Civic, Skanska and Grosvenor in the English South and Midlands. According to Philips (2022), these companies use codes not only to weave together different phases of a site that will be designed and delivered in detail by different parcel (phase) developers, but also as a marketing tool to demonstrate to prospective purchasers of property the

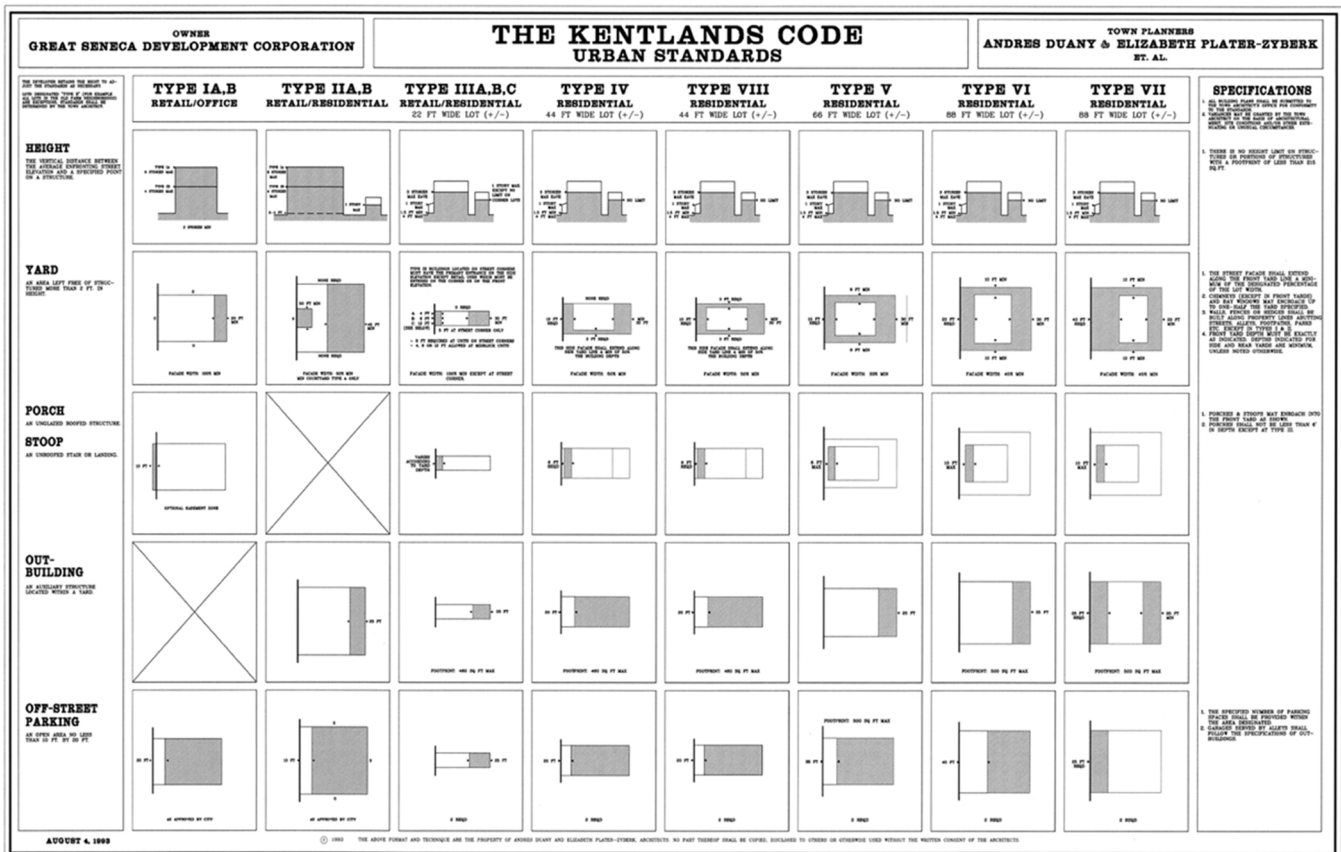


Fig. 8. The Kentlands Urban Code emerged from a series of charrettes to guide the development of former farmlands in Montgomery County MD, by the developer Joseph Alfandre into 1400 new homes and range of facilities for the new community (image: DPZ Architects).

overall design vision and their commitment to its delivery.

3.1.1. A wireframe for development

Returning to the association between coding in the world of information technology and that in the built environment, ‘software architecture’ refers to the fundamental structural choices inherent in any piece of software. Once set, these are difficult to change, but more importantly they dictate how the software operates and how all the constituent parts relate to one another and function together. Coding in the built environment can be seen in a similar light, as the means to define the ‘architecture of urbanism’, not in the sense of designing buildings but in the sense of laying down the underpinning structure of places.

As already alluded to (see 1.1), in the recent past such processes were largely automatic, with the structure of places, from their layout to their architectural expression, established by vernacular materials, traditional construction technologies, the need for proximity and convenience to workplaces and social facilities, the human scale and that of the horse and cart, and the very hierarchical configuration of society. All this set natural limitations (in Unwin’s terms) on the forms of urbanism that predominated prior to the 20th century. Today, however, in an era where technologies (physical and virtual) dominate lives, predefined limits on the structure of places no longer exist, unless development is taking place within an already heavily structured built fabric, such as an area of heritage value, or is created afresh through an urban design governance tool (Carmona, 2017).

Such a structure can be equated to a ‘wireframe’ – to offer another information technology analogy. Wireframes are used as a schematic rendering of a computer interface to demonstrate functionality, features, content, and user flow without specifying the visual design of a product (Angeles, 2009). They are used in website construction, in CAD and graphics renderings, and in any products requiring some form of human-computer interaction (Kongi 2009). Wireframes demonstrate desired outcomes as well as process.

In fact, the term was taken into IT from the artistic realm where artists sometimes use a skeletal framework to represent three-dimensional shape and volume, notably sculptors who sculpt with soft materials and use a metal wire armature to frame forms before layering

them with other media. The wireframe positions and (at least initially) supports the structure being created, defining its meta-shape but not the final treatments that are applied to the piece (Fig. 9). Likewise, in urban development, codes (in theory) define the publicly significant components of a proposed urban environment – those that maximise place-value (see 1.1) – by:

- Shaping – through the choice of individual urban design components such the pallet of buildings and block types, materials, or public realm elements, so that, as the ensemble fits together, there is a coherent relationship of components to each other and to a growing whole.
- Positioning – of urban design components in relation to each other through parameters that establish appropriate and desirable relationships, such as street walls that adequately define and contain space while allowing room for sustainable movement, street trees and social activity.
- Supporting – the creation of something that is greater than the sum of the parts by nurturing (over time) how new places come into being in such a way that they are not partial, piecemeal, or fragmented but instead are integrated and coherent, exhibiting what Christopher Alexander (1987) famously described as ‘wholeness’ at all stages of their development.

Used in this way, a code establishes a type of ghost wireframe that exists only conceptually and on paper, but nevertheless shapes what can happen where and how. This notion also captures the emergent nature of urban codes (see 1.1) that specify the parts, and their relationships, but not the whole of what is being created.

Such a wireframe has the potential to contain all the ingredients for what William Whyte (1958 in Talen 2012: 201) characterised as “a social fabric of stifling monotony”, just as it might also contain the ingredients for a sustainable, inclusive and fulfilling place-focused urbanism. But rather than focusing on these larger urbanistic considerations, much attention has instead focused on the association between coding and the neo-traditional outputs of the New Urbanist movement in the USA (Kelbaugh, 2008). As a consequence, codes have more-often-than-not been associated with the stylistic predilections that

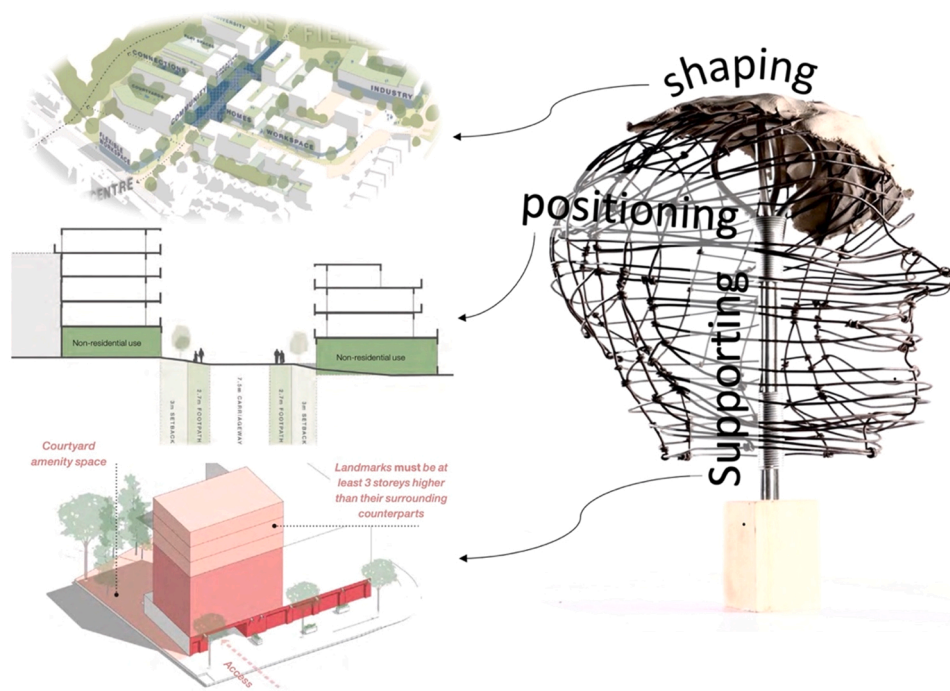


Fig. 9. Wireframe as an analogy for coding (Image: Matthew Carmona).

often accompany such developments. Just as the choice of a programming language in computing does not determine the nature of the project being coded, in the built environment it is not the tool that defines the outcomes. Instead, it is the content – the components and parameters – that are loaded into the code.

Speaking from the perspective of a master developer, Philips (2022: 163) notes “A good code is a filter through which only well-resolved and compliant proposals will pass, but it should also be expressive of the overall design vision”. The vision may be ‘traditional’ in feel (as is often favoured in the USA) or contemporary (as is typical in continental Europe – Fig. 10). More significant is likely to be the potential for codes to coordinate site or area-wide strategies that have nothing to do with style: connections and movement, sustainable drainage, green space and biodiversity, public realm quality, and so forth. Ultimately, codes are a designed product and will be value laden just like any strategic planning framework (Paterson, 2012) to which they relate, or architectural project that they may help to deliver (Mazumdar & Mazumdar, 1994).

3.1.2. Coding by scale and in combination

Turning to the scale and sequential implications of coding (Fig. 11). Where coding is practiced, typically some form of spatial planning at a ‘strategic’ (e.g. city-wide) scale will also be practiced. At this scale, strategic-level design decision making is occurring, typically in relation to factors such as the distribution of development, infrastructure, the mix of land uses, and so on, with concrete outcomes only envisaged in the loosest possible terms (Fig. 11a). At the other end of the scale spectrum, individual ‘projects’ in the form of buildings, pieces of infrastructure and landscape, or elements of the public realm are designed in three-dimensional detail and are subject to a range of regulatory processes from planning / zoning consent to building / construction permits, to highways adoption (gazetting, expropriation, etc.) (Fig. 11a).

While the project scale is the most detailed level of design and ultimately defines what is seen and experienced on the ground, project-level design is not necessarily the most important level at which design occurs. This is because, as was noted in 3.1.1, by setting the wireframe within which the ‘place’ is defined and matures, the intermediate level, or what can be called place-design, has the potential to define the most important relationships in which the greatest public interest resides. Issues such as connectivity, access to green space and nature, the distribution of uses, variety of building forms and types, walkability, public realm quality and so forth are defined at this level (Fig. 11a). Despite its importance, place-level design is often missing in contemporary

development practices because, while place creation is not possible without projects, project creation is possible without place-level design.

Place and project-level design may be delivered in one big bang through a detailed blueprint masterplan (Fig. 11b). Such approaches have been criticised because of the association with what Falk (2011: 37) refers to as ‘big architecture’ projects through which designers, incorrectly assume that “if you can visualise everything, you have solved the main problems of development”. He quotes Garreau (1991: 435) who defines masterplanning as “that attribute of a development in which so many rigid controls are put in place, to defeat every imaginable future problem, that any possibility of life, spontaneity, or flexible response to unanticipated events is eliminated”.

Countries such as Denmark and The Netherlands have long retained a clear distinction between establishing the urbanistic parameters of places (through forms of coding) and that of masterplanning, the latter being far more akin to the concrete realities of project design (Mayhew, 2022). By contrast, whether driven by public or private interests, codes, of all sorts, at this mid-level of design, are indirect in their impact, establishing the decision-making environment within which others will subsequently design final schemes (Carmona, 2021: 49). Wilshire (2022) likens this to the role of “a jazz soloist improvising new melodies within the chord changes of a well-known show tune”.

Equally, strategic, and place-level design can be unified in a single detailed strategic level tool (or tools) (Fig. 11c), such as that which the New York Zoning ordinance has become. A century after its original 35 pages were published (see 2.1.1), the ordinance extended to 900 pages covering a very wide range of detailed coding, nuanced across the city according to local contextual circumstances, and enforced through complex formal regulatory processes (Carmona, 2011b). While born of a very different planning system, the approach is akin to practices in England from the 1970s onwards when authority-wide residential design guides and county level highways standards guided much local design decision making (see 2.2.2).

McDonald & Wilmot (2022: 32) argue that the challenge, in an uncertain development environment or where projects are being built out in phases over long periods of time, is to deliver a more flexible approach that nevertheless has the potential to add both certainty and quality. It is this that the use of place-level codes attempts to achieve either by themselves (Fig. 11d); acting together with a masterplan (Fig. 11e); or used in a staged manner (Fig. 11f). This use of codes in combination implies the use of place-level codes, either with strategic coding above and / or with project level coding below, the latter for smaller development parcels or at the plot level (see Fig. 25).

3.2. Model coding prescriptions and processes

Moving from a conceptual examination of codes to ‘ideal’ models for their creation, experiences in the UK can be further contrasted to those in the USA. In the UK, the *National Model Design Code* (MHCLG, 2021b) represents the most recent of the model codes, but it did not appear in isolation. In 2018 the UK Government had embarked on a renewed drive to positively influence the design of housing development in England, beginning with a commitment to produce a “common overarching framework for design” (MHCLG, 2021b: 1). This was published in 2019 as a *National Design Guide* with the subtitle: *Planning Practice Guidance for Beautiful, Enduring and Sustainable Places*. Most of the guide constituted an articulation of ten characteristics of well-designed places (Fig. 12), intended as a “structure that can be used for the content of local design policies, guides and codes” and as “a series of tests for assessing whether a place is well-designed or not” (MHCLG, 2019: 7; 4).

The *National Design Guide* represented a significant move away from the austerity-driven policy of the previous six years that had focused on stripping away national level design guidance and the infrastructure to deliver it, notably the Commission for Architecture and the Built Environment (see 2.2.4) (Carmona, 2013). It was followed two years later by the *National Model Design Code*, also with the ten characteristics at its



Fig. 10. Borneo Sporenburg, Amsterdam, in this development, the code allowed considerable architectural freedom within a unifying framework. The code defined by West 8 controlled height to the eaves, number of stories, height of the first storey (4.5 m) the roof (it should be flat), and the pallet of materials (Image: Matthew Carmona).

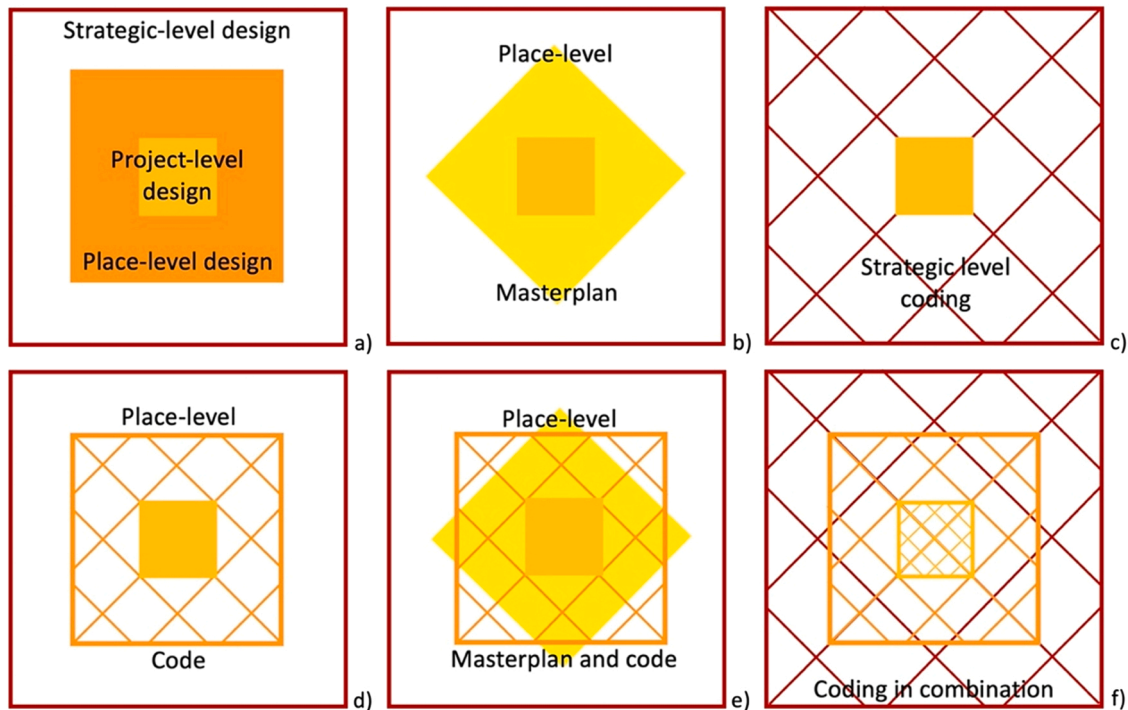


Fig. 11. The use of coding by scale and in combination.

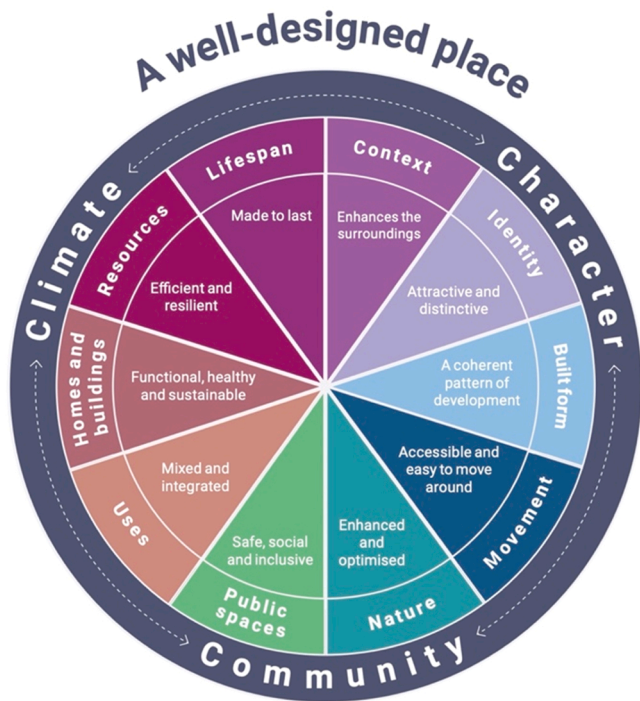


Fig. 12. Visual representation of the ten characteristics of well-designed places contained in the English *National Design Guide* (Image: MHCLG, 2019).

heart, but now articulated to a level of detail and graphic sophistication that had not been seen before in English national planning guidance (MHCLG, 2021b).

3.2.1. Normative frameworks and codes in urban design literature

Internationally, there have been no shortage of attempts to establish a seemingly universal sets of principles in urban design. Raymond

Unwin’s *Town Planning in Practice* (see 2.2.1) was, in effect, an early design guide featuring twelve chapters with titles ranging from ‘Of the arrangement of main roads, their treatment and planting,’ through ‘Of plots and the spaces and placing of buildings and fences’, to ‘Of formal and informal beauty’ (Unwin 1090). The flowering of urban design practice in the mid-20th century was blessed with further critical contributions that included Kevin Lynch’s (1981) *A Theory of Good City Form*, in the USA, or *Responsive Environments* (Bentley et al., 1985), in the UK. These frameworks for urban design continue today through books such as Alexander Garvin’s *What Makes a Great City* (2016), *Soft City* by David Sim (2019) or *Shaping Neighbourhoods* from Barton et al. (2021).

Some argue that normative frameworks of this nature reflect a perpetual weakness at the heart of urban design as a discipline, that it is too focused on its idealised recipes for success. Inam (2011: 257), for example, has concluded that “Urban designers have long been obsessed almost solely with issues of urban form, much to the detriment of innovations in other critical aspects”; such as the mechanisms of public decision-making, the interface with private real estate development, or aspects of community engagement. Cuthbert (2011: xix) agrees, arguing that “our understanding of the production of design outcomes must change from a modernist, Beaux Arts obsession with form, the Eureka Principle and the cult of master/disciple to one where the organic production of urban forms and spaces are inseparable from economic and social processes”.

These are not new concerns. Referring to one of the most widely cited and highly regarded of the normative frameworks – *A Theory of Good City Form* – Manuel Castells (1983: 336) draws attention to Lynch’s own caveat that the ‘magnum opus’ (Castells’ words) omitted a complementary theory of how cities come into being to sit alongside the normative theory of good form. Sorkin (2011: 176) argues that such obsessions have been perpetuated from the 1933 Charter of Athens to the 1996 Charter of the New Urbanism, tools that, in his view, focus on defining a “universal, ‘correct’ architecture”. His own model *Local Code* (Sorkin, 1993), by contrast, recognises the relative position of urban development on the Earth’s surface as the starting point for a more contextual, climate appropriate, form of coding. This is reflected in the code’s subtitle: *A constitution for a city at 42°N latitude*. The work goes on

to define a Bill of Rights for the new city (the right to free movement, to tranquillity, safety, etc.) and to articulate a complex array of interconnected principles for components that include: 'Habs' (habitable spaces), 'Party Walls' (places shared by Habs), 'Nabes' (clusters of Habs), and 'Nets' (connections). Each are carefully defined and articulated purely in a textual form.

Sorkin's work is part of a related tradition of code creation for purely intellectual purposes. Christopher Alexander, like Sorkin, both criticised and engaged with code production. Most famously, in 1977 *A Pattern Language* (Alexander et al., 1977) set out a sequence of graphic and written codes, with the intention of establishing a model code, or, perhaps more grandiosely, a new language of urbanism. The book set out 253 patterns, beginning with patterns for strategic design and ending with interior design, although Alexander et al. (1977: xiii) stressed no pattern was an 'isolated entity'. Instead, "Each pattern can exist in the world only to the extent that it is supported by other patterns: the larger patterns in which it is embedded, the patterns of the same size that surround it, and the smaller patterns which are embedded in it.

Late in his life-long search for natural and enriching patterns of urban growth of which *A Pattern Language* was only a part, Alexander was particularly critical of form-based codes. He argued "you cannot change the soul of a person by putting on lipstick. Nor can you do this with architecture". Writing with colleagues he noted: "The products of the new form-based codes have so far still been, essentially stylistic. Although they also contain certain practical benefits for living, they are fundamentally making changes only in the appearance, not in the underlying substance or social-spatial fabric of the communities they create" (Alexander et al., 2008: 5–6). The answer to the limitations of form-based codes, it was suggested, is to be found in a further model type, the 'Generative code'.

3.2.2. Generative codes

Rather than articulating a set of normative principles, these codes encompass a system of explicit steps, for creating such a fabric. Thus "It defines the end-product, not by specifying the end-product itself, but by defining the steps that must be used to reach the end product" (Alexander, Schmidt, Hanson, Alexander, & Mehaffy, 2008: 5–6). They argue, "Unlike a process which defines the end product, and then leaves the getting there to the developer, the processes initiated by a generative code assures that the end product will be unique each time it occurs and will be unique in just the ways that matter". As envisaged by Alexander, Schmidt, Hanson, Alexander, & Mehaffy (2008), such tools have at their heart the fundamental participation of end users in the process of creation through a unique and individual process for every development born of working with rather than against the place and its users. They also always imply 'unfolding' a place sequentially and in such a manner that the neighbourhood being created emerges naturally and with 'life'.

Again, here, it is worth re-stating the difference between the tools being used and the content that they contain (see 3.1.1), or the processes that guide their production and use. The use of codes (of whichever type) does not per se imply a particular outcome because the processes underpinning them can vary so markedly, as does the nature of the individual codes themselves. Mehaffy (2011: 493), who worked with Alexander on generative coding, argues that "the collective generative code we have today is well calibrated to produce large quantities of sprawl". Generative coding, just like form-based codes, design codes or typo-morphological regulation of any form can deliver a wide range of outcomes. Others have argued for a greater focus on the process of urban design alongside its products (Carmona, 2014), but along with process goes prescription of some form, and for anything other than very small developments, it is likely that some systemisation will be required in that (Marshall, 2011: 335–340).

Perhaps because they deny the real estate industry a clearly defined product to sell or planning systems the certainty of a clearly defined end state, the approaches advocated by Alexander during his life were not widely adopted for the generation of actual development, despite their

obvious and continued interest for theorists (Carmona, 2021: 126). Although, in an unexpected crossover from the world of built environment to that of Information Technology, Alexander's idea of pattern languages was picked up in the 1990s by software engineers and heavily informed thinking around software design patterns and later the development of systems architecture and wikis (https://en.wikipedia.org/wiki/Pattern_language)(Anon, 2023a).

While building the optimum model coding process is clearly a truly worthy aspiration (judging by those who have attempted it), the real and more impactful challenge may be to build the optimum coding process that can be realistically delivered through the market and associated urban design governance mechanisms. As Alexander, Schmidt, Hanson, Alexander, & Mehaffy (2008) teach us, this is likely to encompass process as well as outcome-based prescriptions, implying that the wireframe established by a code needs its own instruction-manual setting out the processes for how to build it.

3.2.3. The SmartCode

In the USA, *SmartCode* provides a very different type of 'model' code, this time as a form-based zoning template produced by Duany Plater-Zyberk & Company. The authors suggest "The template is intended for local calibration to your town or neighborhood" and, at whichever scale it is used – across strategic, place and project scales (see Fig. 11) – delivers a normative vision that "keeps settlements compact and rural lands open, literally reforming the sprawling patterns of separated-use zoning" (<https://smartcodecentral.com>) (Anon, 2023d). The approach is particularly suited to the creation of whole municipality 'mandatory' or 'parallel' form-based codes, respectively: formally adopted as a replacement to conventional zoning; or sitting alongside conventional zoning as an optional alternative route through which to obtain consents. The alternative, a 'floating' code, is typically used in a hybrid situation alongside a conventional ordinance, either for a defined sub-area (perhaps a sensitive location) or relating to a key development opportunity (Ragwala, 2012).

SmartCode is based around the idea of a transect, taking the form of a theoretical cut across a settlement from the urban core, through various degrees of suburbanisation, to rural hinterlands, based on the premise that different physical design responses are necessary at different positions along the line, and that local ordinances should reflect this (as illustrated in Fig. 3). It is available as an open-source tool, along with various spin-offs – *The Transect Code* and the *Neighbourhood Conservation Code* – and a range of interpretive resources from the Centre for Applied Transect Studies (<https://transect.org/codes.html>)(Anon, 2023e). Each of these are, in essence, templates, sometimes blank sometimes partially filled, and at other times more directive from which municipalities can choose, modify and adopt.

The Transect has been extensively theorised and tested (Duany et al., 2021), although has also been the subject of consistent criticism that its simple smooth density profiles, as represented graphically in the Transect, fail to adequately represent the complex realities of real urban settlements. In contrast to generative codes, the *SmartCode* variants also contain few details of the process by which the various templated should be adapted and adopted in different localities. Duany Plater-Zyberk & Company (2003: xiii), authors of the original version, suggest that "calibration should be done in the context of a public charrette with the advice of urban designers, architects, landscape architects, planners, civil engineers and land use attorneys familiar with the *SmartCode*".

3.2.4. A National Model Design Code

Like Generative Codes, the English *National Model Design Code* primarily describes a process, although in this case a process to produce design codes rather than places. Like the *Smartcode* this is underpinned by a strong normative framework in the form of a detailed articulation of the ten characteristics of well-designed places already discussed (see Fig. 12). It was this process that the second coding pilot programme (see 2.2.4) aimed to test, and which is unpacked in some detail in Part 4 of

this paper. The process (represented in Fig. 13) is divided between three phases: ‘analysis’, ‘vision’ and ‘code’. While it is left open as regards the scale at which codes should apply – authority-wide (strategic-level) or area-wide / site-specific (place-level) – overwhelmingly the drive is towards the first of these, as advocated in national policy, and confirmed in the Levelling-up and Regeneration Bill with its obligation on local authorities across England to produce and adopt authority-wide codes.

In England, up until that point, the term design code had been associated with the sorts of place-level codes produced for specific sites or areas (analogous to American floating-zone codes), typically in relation to a defined development (or sequence of them) and often produced by developers or their consultants rather than by a local authority team or their consultants (Carmona and Giordano, 2012). Reflecting this dominant practice, in 2019 design codes were defined in the *National Design Guide* as “A set of illustrated design requirements that provide specific, detailed parameters for the physical development of a site or area” (MHCLG, 2019: 3). It notes “The graphic and written components of the code should build upon a design vision, such as a masterplan or other design and development framework for a site or area”.

Two years later, a simpler and broader description was contained in the *National Model Design Code* (NMDC) which characterised design codes as “a set of simple, concise, illustrated design requirements that are visual and numerical wherever possible to provide specific, detailed parameters for the physical development of a site or area” (MHCLG, 2021b, para.5). For the first time, the ‘area’ in question enlarged somewhat to include everything from a neighbourhood up to a whole district / borough or even county-wide municipality – the strategic-level design scale, as represented in Fig. 11c. This fundamentally changed the nature of design codes because first, they were being prepared for very large territories with very varied characteristics that might potentially encompass everything from a high-density town centre to low density suburbs and extensive rural areas with many small settlements. And second, they needed to be prepared in the absence of the design vision called for in the *National Design Guide*. In effect they were becoming ‘vision-defining’ rather than ‘vision-delivery’ tools. In such a process, rather than the content of masterplans for sites subsequently informing and being delivered through codes (as represented in the top half of

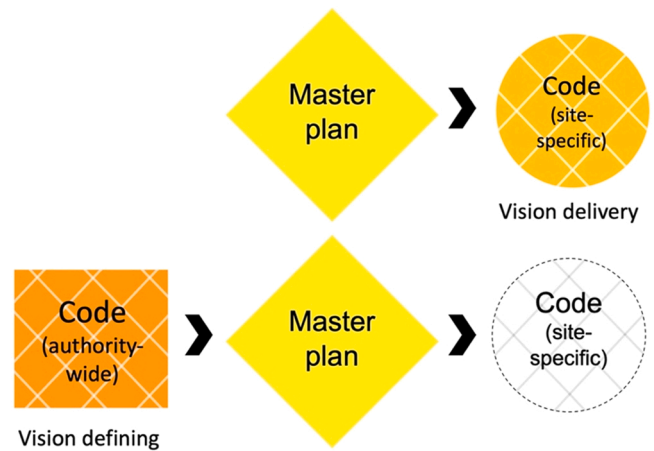


Fig. 14. The *National Model Design Code* envisages a move from a dominant vision delivery mode to a new vision defining mode and a new much larger scale of application for coding (Image: Matthew Carmona).

Fig. 14), masterplans will be shaped by the codes (the bottom half of Fig. 14).

If English local authorities fully follow the *National Model Design Code* process, ultimately, they will cover their whole territories with coding. The process envisages that this will be based on an analysis of ‘area types’ (areas of distinctive character, whether positive or negative) with codes responding to the particularities of those different area types. To illustrate this, the *National Model Design Code* offers ten model area types ranging from ‘high rise city’ to ‘rural settlements’, covering a wide range of density scenarios (Fig. 15). Unlike *SmartCode*, however, where codes are arranged along an idealised transect, in the English model code the types are simply examples that could be applied wherever the types are found. This reflects the complexities of English (or European) urbanism which does not lend itself to the simple smooth density profiles represented graphically in the Transect (even if its interpretation is more sophisticated – Duany et al., 2021).

In essence, the *National Model Design Code* advocates a move away from the English discretionary traditions towards a typo-morphological form of decision-making closer to practices found in parts of Continental Europe (see 2.1.2). The change also necessitates a huge national investment in coding and associated analysis that early commentators felt was unlikely to be deliverable given national resource and urban design skills shortages (Kochan, 2021). This became clear in the same month that the model code was published when *The Design Deficit*, a report from the Place Alliance noted that “urban design and related skills in local authorities, remain at a low ebb and far below where they need to be in order to address the ambitious national agenda on raising the design quality of new development” (Carmona and Giordano, 2021: 2).

The emphasis on authority-wide coding also left the *National Model Design Code* somewhat deficient in its demonstration of how coding could be applied to areas or sites. Instead it gave coding a new and larger remit than the sorts of site-specific (place-based) coding practices that had been used up to that point in England, and which research has shown to be effective (as will be discussed in 5.2). Whether this broader remit is either deliverable or effective remains an open question, but if authority-wide codes simply replicate the sorts of generic residential design guides that have been used (and often ignored) in England from the 1970 s onwards (see 2.2.2) then they are unlikely to prove much more effective. Rectifying the gap in knowledge, to some degree, and more specifically the absence of detailed learning from practices elsewhere, the following parts of this paper now turn to a detailed evaluation of the experience of coding in England.

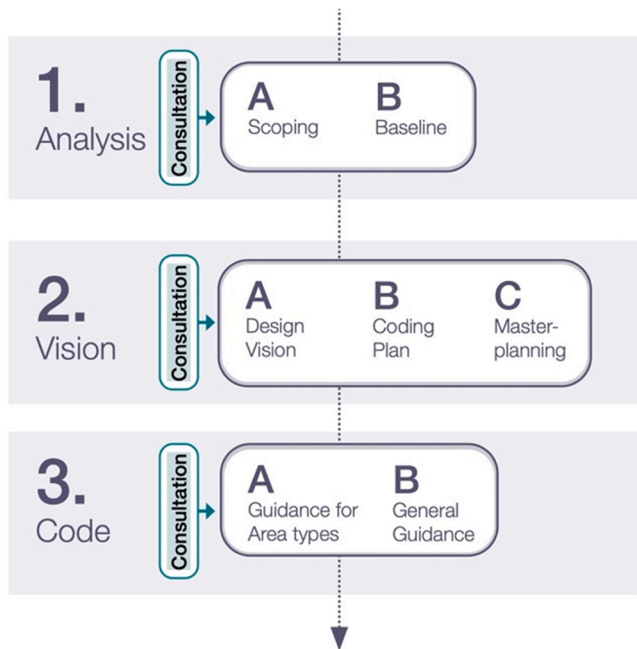


Fig. 13. The coding process advocated by the *National Model Design Code* (Image: MHCLG, 2021b).

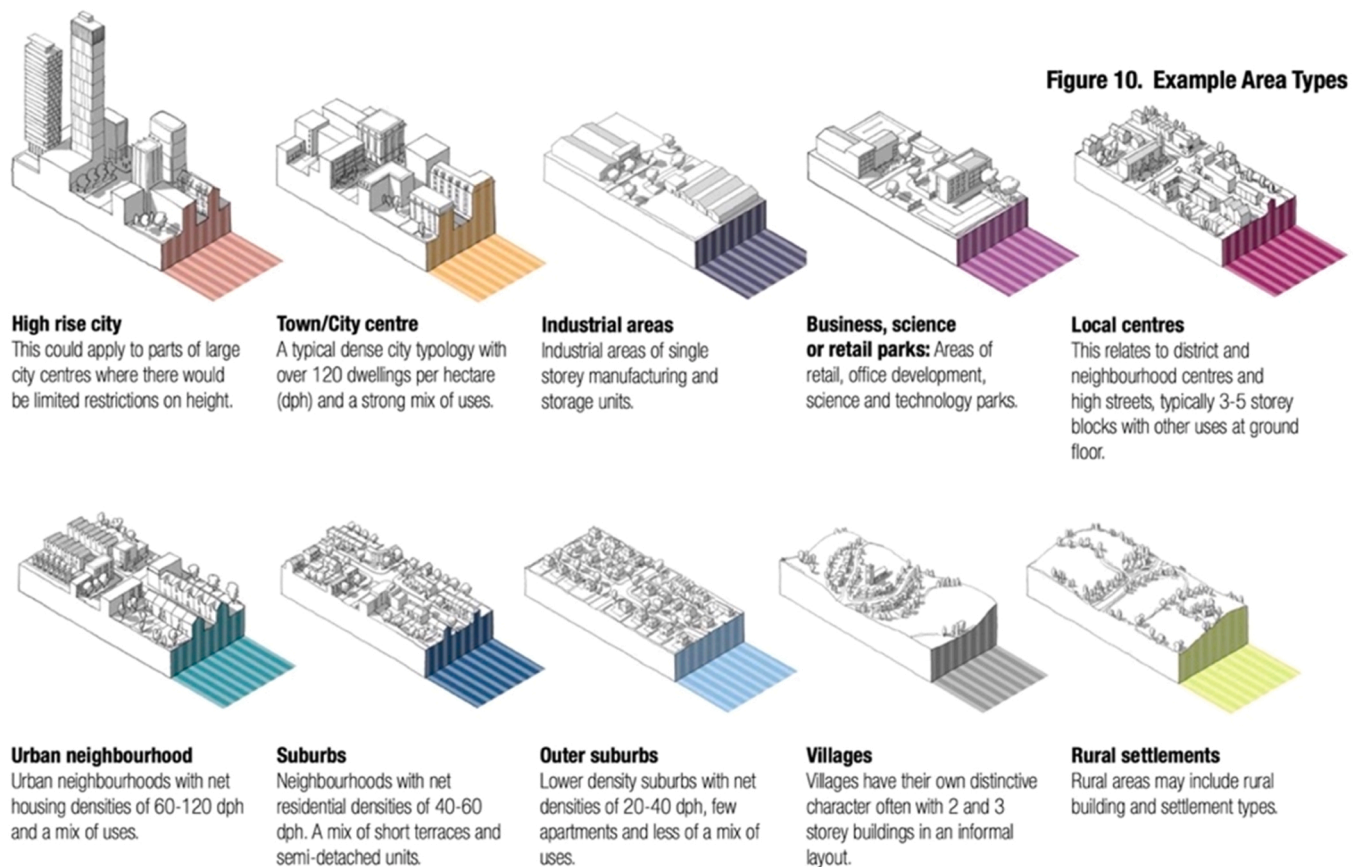


Figure 10. Example Area Types

Fig. 15. The ten example area types contained within the *National Model Design Code* (image: MHCLG, 2021b).

4. Experiments in England (17 years apart)

4.1. Evaluating the pilot programmes

The fourth and fifth parts of this paper step away from examining coding in an historical, comparative, and conceptual mode, to looking more specifically at the practicalities, processes, and experiences of using design coding. Despite the widespread advocacy of codes and their mainstreaming in different guises in Europe and North America, there have been remarkably few systematic studies of their use in practice. In this regard the two rounds of design code piloting in England introduced in 2.2.4, that took place between 2004 and 2006 and 2021 and 2022, represent an important attempt to understand these tools. While the specificities of the English policy context are in many respects unique, the commonalities between coding practices in the UK and elsewhere (see 3.1) mean that lessons can be read across. Moreover, as few large-scale longitudinal research programmes have focused on systematically understanding the entire process of creating and using codes, the results have relevance internationally. The opportunity is therefore taken in this fourth part of the paper to examine and compare these episodes and to draw out lessons of relevance both to the UK and to coding practices more broadly.

Both episodes were evaluated, seventeen years apart, by research teams led by the current author, and used similar methodologies. Each pilot programme involved three work streams:

- i) Pilot selection and funding: Funding was provided from government to facilitate each programme. In the first, funds were directed through the enabling programme of the then Commission for Architecture and the Built Environment (CABE). Pilot teams were chosen based on known examples of major projects of

different sizes and regional spread, and ‘encouragement’ (sometimes unwanted) from Central Government to be involved in the pilot programme. In the second set of pilots, a payment of £ 50,000 went directly to each pilot team which were all led by one or more local authority. The second set of pilots were chosen following an open national call for expressions of interest, with selected cases reflecting a representative range of regional, socio-economic, and local contextual circumstances.

- ii) Support and mutual learning: Following selection, each pilot team embarked on the work that they were being funded to do (production of a code or part thereof). Alongside and facilitating their work, pilot teams were supported by a significant programme of learning and information exchange, organised respectively by CABE in 2004/06 and by the Department for Levelling up, Housing and Communities (DLUHC) in 2021/22. Both packages of support were designed to inject each pilot programme and the pilot teams with a common set of background knowledge, as well as to allow the sharing of experiences and approaches and mutual learning. In both cases this took the form of a sequence of pilot workshops that ran through the duration of the two testing programmes. The support programmes were vital as few of the chosen pilot teams had direct experience of producing codes.
- iii) Monitoring and evaluation: A qualitative research approach was adopted for both pilot programmes using semi-structured interviews conducted in two parts, prior to code production and at the end of each pilot programme. Fig. 16 shows these interviews diagrammatically for the most recent pilot programme, which itself was largely based on the earlier evaluation programme. As the figure indicates, both sets of interviews covered the four critical stages of coding, beginning with a focus on inputs and

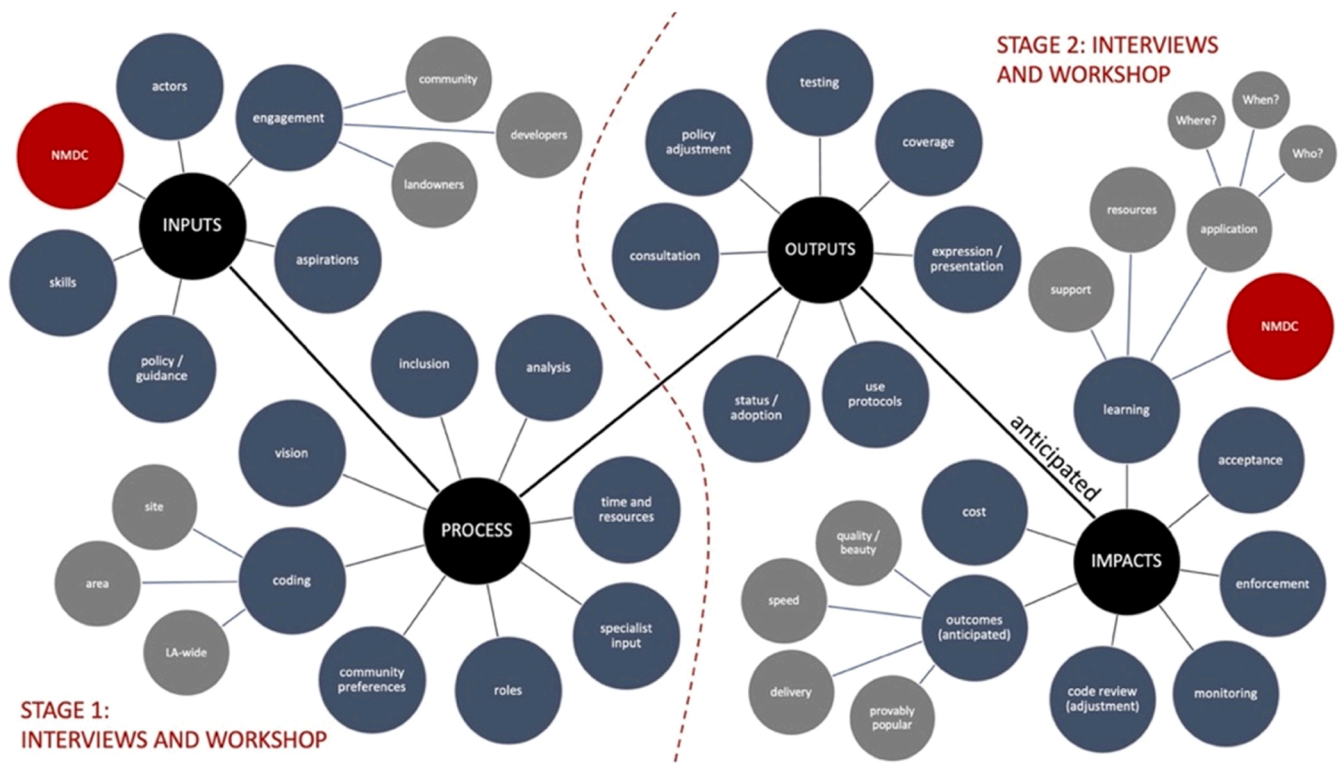


Fig. 16. Diagrammatic representation of the pilot programme interview structure (Image: Matthew Carmona).

processes in the first set of interviews and moving to outputs and impacts in the second. There was some crossover in content of the interviews to understand the development of thinking. In both programmes the interviews were conducted with mixed groups of stakeholders, including representatives from consultant teams, development interests, local authority officers, and occasionally local politicians. Audio recordings were made and transcripts were prepared and analysed comparatively.

Twenty six sets of interviews were conducted for the first pilot programme and thirty for the second, with interviewees often grouped but sometimes interviewed separately. Interviews ranged from an hour to two hours to complete, and across the two programmes around 200 interviewees were engaged in the process. Evidence from the interviews was supplemented by analysis of the interim and final reports from pilot teams (the production of which was a condition of their receiving government funding). In the first pilot programme a selection of pilot team meetings were attended and recorded in a ‘fly-on-the-wall’ manner. In the second, presentations and discussions given at the pilot workshops were recorded and analysed. Finally, the systematic content analysis of the codes and other outputs produced by the pilot teams was completed and fed into the analysis.

Despite the similar approaches to the two monitoring and evaluation exercises, the nature of the testing programmes differed in six ways:

- **The pilot window:** The first pilot programme involved an eighteen month programme with pilot authorities given the time to develop, adopt and (in some cases) test design codes. The 2021–22 programme was much shorter – just six months – and pilot teams often focused on a particular stage in the coding process rather than on the whole process. The second programme was followed up with a third round between 2022 and 2023 with around 25 pilots and a 12-month programme funded by £1million from Government. This time, however, no explicit monitoring and evaluation was included in the programme.

- **The scale of coding:** The first programme focused on testing site-specific design codes (and one area-based code) while the second, reflecting the methodology in the *National Model Design Code* and developing national policy, sought to test site-specific, area-based and authority-wide coding. Both programmes tested coding across a series of urban, suburban (edge of settlement) and new settlement locations and across a mix of socio-economic and regional contexts.
- **Guiding the testing process:** The first programme tested a largely unknown tool, albeit one with a clear antecedence in the UK as discussed in Part 2.2 of this paper. It finished with the production of *Preparing Design Codes, A Practice Manual* (Carmona & Dann, 2006b) to guide future practice. The second round began with the new *National Model Design Code* and focused on testing its ‘model’ process. It concluded with a series of online case studies to share experiences prepared for the new Office for Place (<https://www.local.gov.uk/pas/topics/design-codes/national-model-design-code-pilot-case-studies>)(Anon, 2023f).
- **The numbers of pilots:** The first pilot programme involved nineteen cases (Table 2), but only seven of these were full pilots involving a two part interview process. Eight were ‘Advanced’ cases where design codes had already been produced, independently of the pilot programme, and four were classified as ‘Non-code’ tools, not design codes but other forms of detailed design guidance. Advanced and non-code studies only had one round of interviews. The second programme included 15 pilot teams (Table 3), each testing design codes, although only eight produced actual codes during the funded testing window.
- **Pilot leadership:** The first pilots involved a range of sites being promoted by private landowners and developers and by a range of public / private partnerships looking to coordinate large multi-phase projects. The second pilots were all local authority-led teams, typically without private development partners. They were looking to establish design codes as regulatory tools, either covering a whole local authority; a regeneration area featuring multiple sites; or in relation to single large sites allocated in a development plan.

Table 2
The 2004–06 pilots by scale, context, and focus.

Local authority (and region)	Scale	Context	Focus ('lift pitch' version)
1. Hastings (South East)	Area-based	Urban	Three sites along the Ore Valley, an area in need of regeneration and owned by a variety of mainly public bodies (pilot)
2. Aldershot (South East)	Site-specific	Suburban / rural	Site released by the Ministry of Defence and owned by Defence Estates and planned for an urban extension (pilot)
3. Cirencester (South West)	Site-specific	Suburban	Kinghill South large site owned jointly by a private developer and Cotswold District Council (pilot)
4. Ashford (South East)	Site-specific	Suburban	A former military site – Ashford Barracks – owned jointly by two volume housebuilders (pilot)
5. Newcastle (North East)	Site-specific	Urban	Walker Riverside, owned by Newcastle City Council, and focusing on revitalising an existing community (pilot)
6. Swindon (South East)	Site-specific	Suburban	Southern development area, to be developed as a public/private partnership between a national housebuilder and Swindon Borough Council (pilot)
7. Rotherham (Yorkshire & Humber)	Site-specific	Urban	Town centre river corridor regeneration scheme, owned by a fragmented series of private developers (pilot)
8. Telford (West Midlands)	Site-specific	Suburban	Lightmoor site owned by English Partnerships and the Bournville Village Trust with proposals aimed to reflect the Bournville Garden Village ethos (advanced)
9. Northampton (East Midlands)	Site-specific	Suburban	Upton, mixed use urban extension. 350 residential units, a school and a number of shops. Land owned by English Partnerships (advanced)
10. Royal Docks (London)	Site-specific	Urban	Residential-led, mixed-use development with support facilities and infrastructure (advanced)
11. Greenwich (London)	Site-specific	Urban	Greenwich Millennium Village on a site owned and promoted by English Partnerships as the first Millennium Community (advanced)
12. Hulme, Manchester (North West)	Site-specific	Urban	Redevelopment of 1960's Hulme estate as a public / private City Challenge joint venture on land was owned by Manchester City Council (advanced)
13. Letchworth (South East)	Site-specific	Suburban / rural	Fairfield Park development in the grounds of a listed Victorian hospital building owned by a consortium of developers (Advanced)
14. Harlow (East)	Site-specific	Suburban	First phase of a major urban extension, promoted by the private landowner (advanced)
15. Aylesbury (South East)	Site-specific	Suburban	Urban extension to Aylesbury with a mixed-use town centre promoted by the landowner, a private trust (advanced)

Table 2 (continued)

Local authority (and region)	Scale	Context	Focus ('lift pitch' version)
16. Greenhithe (South East)	Site-specific	Suburban	Large site owned by a single volume housebuilder (non-code)
17. Portishead (South West)	Site-specific	Suburban	Large site owned by a single volume housebuilder (non-code)
18. South Cambridgeshire (East)	Site-specific	Suburban	Greenfield new settlement, including two schools, a supermarket, library, doctor surgery and a business centre, owned by a developer consortium (non-code)
19. Newcastle (North East)	Site-specific	Suburban	Mixed greenfield development including a business park and residential (non-code)

- The role of external consultants: In the first programme, pilot teams did not receive any direct funding, instead projects were singled out where codes or similar tools were already in preparation or where stakeholders could be persuaded to incorporate a code into their existing programme of work. The funding was used to pay external consultants (around 20) who were already employed as CABE 'enablers' as part of their well-established enabling programme (Carmona et al., 2017: 219–223). Enablers were tasked to work with pilot teams to advise and assist them in the production of codes. Assistance took different forms depending on the pilot and the team already assembled. In the second programme funding was paid directly to the pilot teams (local authorities). Most used the funding to pay for external consultants to produce codes on their behalf while a minority funded an internal workstream within the pilot authority

Despite the differences and the gap of seventeen years, the two pilot programmes were compatible in many ways, with regard to: the design challenges faced by pilot teams in the localities in which they were working; their aspirations for coding; the nature of the codes produced; and the choice of coding to meet the challenges. Space does not permit a detailed examination of the research findings which are reported in detail elsewhere (Carmona, Clarke, Quinn, & Giordano, 2022; Carmona and Dann, 2006a). Instead, the focus in this paper is on collective learning across the 34 cases that were evaluated. In the sections that follow, comparative findings relating to the four stages – inputs, process, outputs, and impacts – are unpacked and discussed.

4.2. Inputs to coding – planning the wireframe

The first stage evaluated related to inputs into the coding process. These range from the broad motivations of the coding teams to the skills and capacity to create codes, and the organisation and leadership to deliver them.

4.2.1. Motivations and ambition

In both 2006 and 2021 there was a broad agreement that the preparation of design codes represented a tangible demonstration of commitment to achieving design quality in the form of an enhanced focus on place, sometimes with the intention to establish a 'springboard to excellence' but more often a 'safety-net' below which quality should not fall (see 1.1). The diverse motivations for engaging in coding expressed in 2021/22 and captured in Table 4 capture this well.

The availability of in-house urban design expertise fed into this level of ambition and ranged from well-resourced teams to no internal design expertise at all, with all teams sharing a perception that more needed to be done and that design outcomes were too often substandard. The situation was well illustrated by the testimony of one local authority with a

Table 3
The 2021–22 pilots by scale, context, and focus.

Local authority (and region)	Scale	Context	Focus ('lift pitch' version)
1. Leeds (Yorkshire & Humber)	Authority-wide	Urban / suburban	Testing area types at the city scale
2. Buckinghamshire (South East)	Authority-wide	Suburban / rural	New design guide focused on common design problems across the county
3. North West Leicestershire (East Midlands)	Authority-wide	Suburban / rural	Review existing district wide design guide and take stock
4. Mid Devon (South West)	Authority-wide	Rural	Testing the value added by coding key sites over and above their generic design guide (including Cullompton and Culm Garden Village)
5. Newcastle (North East)	Area-based	Urban	Regeneration area with five smaller sites in a sensitive historic context (Ouseburn Central)
6. Sefton (North West)	Area-based	Urban	Applying code to an area of opportunity / urban regeneration to maximise the opportunity (Bootle town area)
7. Herefordshire (West Midlands)	Area-based	Rural	A county-wide model to be adopted and adapted by neighbourhood plan groups within their neighbourhood plans
8. Portsmouth 1 (South East)	Site-specific	City centre	To inject quality and attract investment into the city centre (Debenhams site)
9. Dacorum (East)	Site-specific	Town centre	Town Centre sites with a focus on gauging popular design qualities (Hemel Hempstead)
10. Portsmouth 2 (South East)	Site-specific	Urban	Estate renewal site, establishing a model for other sites (Horatia and Leamington site)
11. Southwark (London)	Site-specific	Urban	Coding in a highly dense and complex opportunity area location (Hatcham Road site)
12. Guildford (South East)	Site-specific	Suburban	Brownfield Regeneration (Weyside Urban Village), community testing of an existing code
13. Colchester and Tendring (East)	Site-specific	Suburban	Setting a strategic brief for a major development – garden settlement (Tendring Colchester Borders Garden Community)
14. Hyndburn (North West)	Site-specific	Suburban	Major development, garden village project (Huncoat Garden Village)
15. Nuneaton and Bedworth (West Midlands)	Site-specific	Suburban	Low density suburban site to learn the lessons and lift the quality of development borough-wide (Arbury)

sizable urban design team in-house and authority-wide design policy and guidance already in place. Despite their advantages, the team felt hamstrung in achieving the quality of development that they would like to see because, as they noted, “The planners are having to make concessions all the time whether it is on materials or general appearance or place making aspects”, and “currently developers wear the authority down”. This authority, like others, was hoping that the use of design codes would put them on the front foot by providing clearer expectation to developers.

In 2006 the greater diversity in how pilot teams were constituted

Table 4
Motivations for coding as expressed by the pilot teams in 2021/22.

Motivation	Rationale
Raising levels of design quality	
Raising the level of ambition	securing the highest possible design quality outcomes through a clear and deliverable vision that acts as an exemplar locally
Coordinating outcomes	achieving a coherent approach across large sites with multiple developers or by establishing consistent urbanistic parameters in areas of gradual change
Addressing repeated problems	common design problems often raise the greatest challenges. In the pilots these included dealing with high buildings, public realm design, dealing with density (high and low), integrating landscape, highways design and responding to character
Delivering more predictable design outcomes	
Robust delivery	reinforcing existing ineffective policy and guidance to make delivery aspirations more tangible and predictable in their quality – “Having a process that holds developers to account”, “something that is set in stone”
Proactivity	moving beyond past <i>laissez faire</i> approaches to design quality and towards proactive planning with a stronger vision of design quality – “setting out our stall in advance”
Making design more tangible	simplifying and replacing the patchwork of policy and guidance and bringing challenging issues such as character and “what it looks like” to the fore in decision-making
Raising expectations locally	
Creating a local culture of design quality	systematically raising expectations so that developers and communities know what is expected – “We are not going to be just passing and approving any kind of proposal”
Engaging the public	cutting through to and enthusing the public by clearly identifying their preferences and demonstrating that the authority is going the extra mile to secure design quality – “A great opportunity to be really visual with the public, to portray the type of place the council wants to develop”
Engaging local politicians	addressing a local political priority in some places and in others demonstrating to councillors that an investment in planning resources can deliver better outcomes, even in economically challenged locations
Delivering more effective governance of design	
Streamlining decision-making	addressing under-resourcing through a clear set of rules and protocols that offer consistency, clarity, and certainty – “a go-to, practical tool for officers to refer to in order to determine planning applications”
Making time to innovate	using coding to carve out time for thinking about how new agendas can be addressed such as health and well-being and zero carbon, ultimately allowing the thinking to feed upwards into local plan revision
Remaining in control	getting ahead of national policy changes and avoiding having to rely on national guidance when negotiating design by having local guidance in place

(bringing together private and public partners) meant that coding processes were used as a means to help build a consensus within teams over the design vision. Developers were also motivated to raise the value of their investments through better place-making, and to secure the necessary regulatory approvals in a timely manner. This, they hoped, would stem from a more certain and consistent decision-making process when codes were in place. Local authorities were less concerned with speed, but nevertheless saw potential efficiency gains in a smoother process of development management (the process of deciding individual planning applications), particularly during the later phases of a development.

During this earlier pilot programme, codes were firmly associated by almost all interviewees with an ability to coordinate outputs from different development teams across large sites, in other words with the ‘supporting’ function of codes as theorised in the tripartite roles depicted in Fig. 9. The belief was that they could support the growth of new places which were more integrated and coherent over multiple phases of the long-term development projects. By 2022 national policy changes had

broadened this, with teams now seeing the potential of codes across the place and strategic design levels represented in Fig. 11. Three types of code were envisaged:

1. Site-specific design coding, used to optimise the responsiveness of development to local conditions and character. Most teams looked to code at this scale as it was where they believed they could have most impact and where, they perceived, the real problems lay.
2. Area-based coding was used to capture multiple smaller sites within an area of uniform character that could benefit from a shared set of design parameters. In the pilots this typically meant post-industrial areas with several sites in need of regeneration.
3. Authority-wide coding, where pilots felt the need was to tackle common authority-wide design problems and, in the fullness of time, coordinate area-based and site-specific codes when produced. An authority-wide approach was seen as necessary in some locations because of the absence of capacity to take a site-specific approach.

With this new focus on impact at a larger scale, and on local authorities taking the lead, also came a new perspective on codes as ‘vision defining’ rather than ‘vision delivery’ tools (see Fig. 14). During the first pilot programme, codes were being prepared following and in order to implement a masterplan or existing urban design framework for a site, but in 2022 many of the design codes were being prepared in advance of such an agreed site-based vision, even when the codes focused on single site, rather than a larger area or the authority at large.

In the better-established role of codes as delivery tools, a masterplan or more flexible urban design framework typically served the important function of defining the street hierarchy and identifying separate neighbourhoods as regards their densities and patterns of land use, open space, and building types. These were subsequently coded with different block forms, building envelopes, street treatments and architectural and landscape characters. Codes of this type varied considerably along a continuum from those that significantly developed the core principles of a largely conceptual physical vision, to those that primarily articulated (in a technical sense) the principles already established in a detailed masterplan or other vision.

Experience in 2006, and confirmed in 2022, showed that if produced prior to such a site-based vision, codes tended to be more generic and strategic in content, focusing on key design principles rather than on their detailed implementation. This created both challenges and opportunities; challenges with regard to how codes are interpreted and enforced, and opportunities by defining a clear public design agenda early in the development process prior to developers buying sites with unrealistic ‘hope values’ and advancing their own proposals.

4.2.2. Skills and capacity

Both pilot programmes confirmed that a steep learning curve was required to produce design codes (despite their mainstreaming nationally since the late 2000’s – see 5.2). With remarkable consensus on what was required, local authorities across the two pilot programmes were clear about the diverse range of knowledge and skills required to code (Table 5). In most cases they were also clear that they were not set up to deliver this in-house.

Key skills lacking included urban design expertise, graphic communication, viability assessment and digital engagement. In 2021/22 this was addressed by commissioning external specialist assistance that ranged from 60 to 200 days of external professional input, per code, across the six-month programme. In 2006, reflecting the production of codes later in the development process, the research showed that an optimum coding process involved appropriate coding skills / awareness in four key places: in the landowner / master development team, in associated design team(s), and in the local authority planning and highways departments. At the time local authorities struggled to properly resource the necessary ‘proactive’ engagement in coding and, if anything, the situation has deteriorated since.

Table 5

The range of knowledge and skills that the pilot teams identified were necessary for effective coding. The two lists show considerable overlaps suggesting that skills and knowledge profiles have remained largely static in the years between the two pilot programmes.

Type	Knowledge and skills 2006	Knowledge and skills 2022
Primary, disciplinary, knowledge and skills	<ul style="list-style-type: none"> • Urban design • Landscape • Masterplanning • Highways • Planning • Cost / project management • Development, marketing 	<ul style="list-style-type: none"> • Urban design • Landscape / public realm • Architecture • Highways / infrastructure / transport • Planning (policy and regulation) • Project management • Viability and delivery (marketability)
Secondary, specialist, knowledge and skills	<ul style="list-style-type: none"> • Consultation approaches • Ecology • Sustainability / energy efficiency • Construction literacy • Social awareness • Market knowledge and practices 	<ul style="list-style-type: none"> • Engagement approaches • Ecology / SUDs / arboriculture • Energy (zero-carbon) • Construction • Engineering • Heritage and conservation • Accessibility
Generic and technical knowledge and skills	<ul style="list-style-type: none"> • Communication • Visualisation and presentation • Analytical skills • Political awareness • Consensus building / collaborative working • Leadership and vision • Negotiation and diplomacy 	<ul style="list-style-type: none"> • Communications (traditional and digital) • Graphics and visualisation (2D and 3D) • Analytical skills • Political awareness • Multi-disciplinary working • GIS

Overcoming skills, capacity, and organisational barriers to preparing design codes in-house will be a necessary investment for authorities who don’t wish to rely on developers to produce design codes. The pilots confirmed that this requires the commitment of resources early in the development process, with the 2022 monitoring and evaluation exercise suggesting that stakeholders frequently underestimated this. While accepting the need to be more realistic in the future, interviewees were clear that:

- This investment needs to be seen within a context of the use of codes in connection with major development proposals for which such an up-front investment is to be expected
- Each code is to a large degree unique and involves a learning process, and so building appropriate processes to pass on knowledge within local planning authorities will be important
- The true costs will only become apparent after the full development process has been worked through.

Significantly, however, the earlier pilot programme showed that where codes were being implemented on site (the Advanced codes in Table 2), schemes were delivering enhanced sales values and increased land values when compared to comparable schemes in the local market. When off-set against the up-front investment required to produce the codes, this determined the value added by coding, at least in crude economic terms. The qualitative evidence gathered from private development interests suggested that the outcome was positive, and for commercial partners, codes seem to more than pay for themselves over the long-term.

By contrast, public sector partners worry that the cost of their own input is unsustainable given resource constraints in the sector. They also recognise that many potential ‘sticking-points’ are being resolved during the coding processes that would otherwise need to be tackled during development-related negotiations, either at the pre-application or

development management stages. They accept that the move to a ‘vision-defining’ role may simply be re-distributing the time and resources required from the public sector – effectively front-loading it – rather than significantly adding to it, although this does not make it easier to afford.

4.2.3. Organisation and leadership

With site-specific codes being produced by teams with a range of public and private partners, a strong commitment to partnership working within coding teams was identified in 2006 as a pre-requisite for successful and efficient coding, although the case studies confirmed that the decision to adopt a coding process did not, by itself, generate successful partnership working. Instead, the experiences showed that code production needed to be supported by all key stakeholders from the start if its potential was to be realised with genuine partnership working achieved, as represented in Fig. 17. Unfortunately, the pressure that some teams were put under (by Government) to be involved in the 2004/06 pilot programme meant that this goodwill was sometimes absent. In 2021/22, the absence of land and development interests from almost all the pilot teams meant that these relationships were not tested, although the front-loading of public sector design ambitions was designed to reduce tensions further along the development pipeline.

In order to secure the up-front investment as part of an overall proactive approach, government organisations needed to demonstrate strong place-making leadership from chief executive, service director

and political levels. In turn this helped to unlock the resources (and therefore skills) issues that confronted authorities. Often, successful examples of coding seemed to be characterised by one party or another being strongly motivated to achieve quality, acting in effect as a design champion (see Fig. 17), and persuading other parties to sign up to that vision. This leadership came variously from landowners, developers, local authority officers or code designers. When it was absent an overly time and resource intensive coding process sometimes followed.

Critical amongst public interests who needed to be engaged with coding were highways authorities. With their narrower regulatory agenda in England (approving and adopting road and footpath layouts and specifications), they were often reluctant to engage with design coding teams, preferring instead to stick to their own vehicle-centric and generic highways standards (see 2.2.2). Compounding the situation, some local planning authorities were reluctant to challenge this, particularly in 2021/22. Given the critical (often negative) role of highways authorities in England and the opposing desire that coding should lead to a more place-focused design process, a failure to address this disconnect in aspirations and engagement did not bode well.

Across the years, coding was never seen as a fool-proof solution to delivering high quality urban design. Instead, as the most prescriptive level in the hierarchy of design policy and guidance available to municipalities in England, codes were and still are seen as fitting within a policy hierarchy which cascades from more general policy in the formally adopted development plan to the more detailed design parameters contained in design codes. Providing policy hooks in the plan

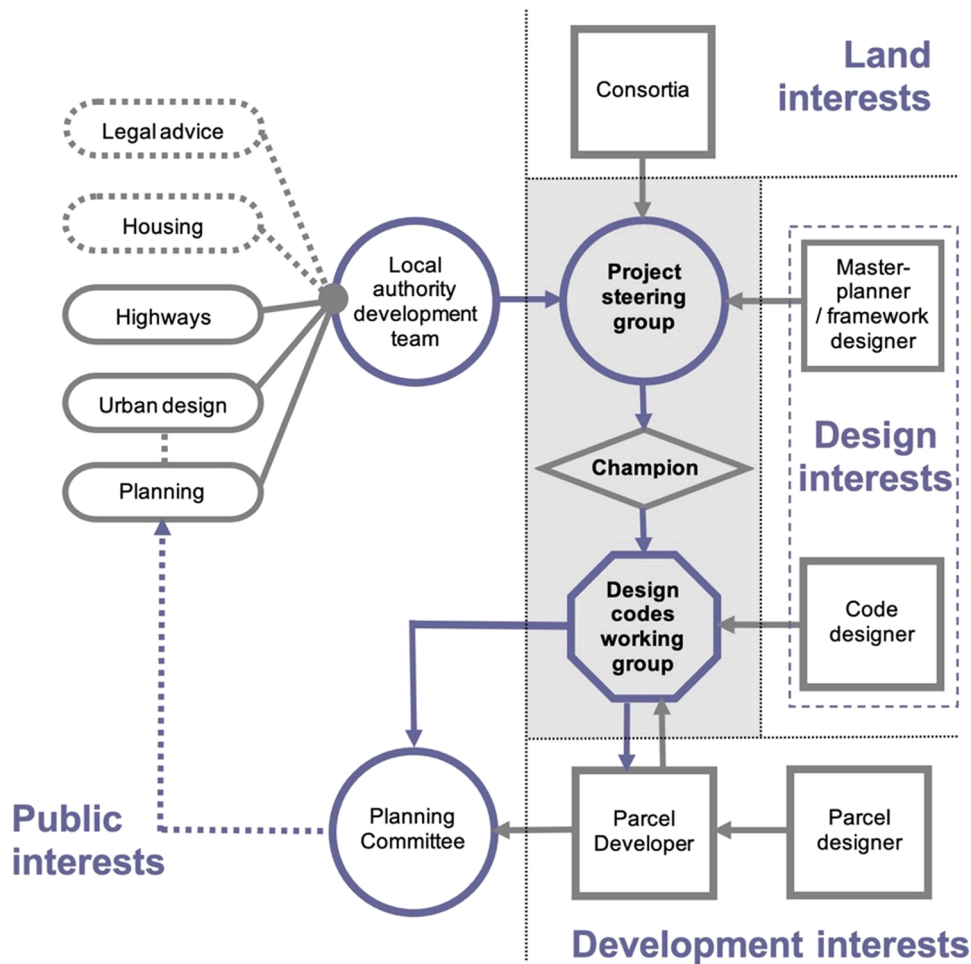


Fig. 17. Idealised relationships to manage a successful site-based coding process as envisaged following the 2004/06 design code pilots. The diagram shows an idealised decision-making structure to facilitate smooth decision-making with a ‘champion’ at its heart, the role of whom was to lead the process (Image: Matthew Carmona).

for coding, for example by requiring that codes be prepared for certain types of development, gives the resulting design codes added status. This applies whether they are adopted as part of the development plan or as a supplementary document to it, or alternatively whether they submitted by a developer with a planning application and thereafter formally become part of the approved development proposals. The question of the status of codes is picked up again in 4.4.4.

4.3. The process of coding – constructing the wireframe

The second stage of coding focuses on the coding process itself. Just as the 2021/22 pilot programme began with a recommended coding process (see Fig. 13) so did the earlier programme, although this time purely theoretical and to guide the monitoring and evaluation rather than the pilot teams (Fig. 18). While, coding projects in 2004/06 broadly followed this idealised process, the more recent pilot programme, with its greater variation of coding outputs (by spatial scale), suggested that a single one-size-fits-all coding process is unrealistic. Instead, the pilot teams were broadly and successfully able to adapt the process recommended in the *National Model Design Code* to local circumstances, picking and choosing and adapting stages accordingly. Despite this, different delivery constraints meant that some locations were inherently more complex to code than others, including areas with low market values or where existing housing estates were being renewed, as was the case in Portsmouth (Fig. 19). Pilot teams were mindful that they needed to be realistic about what they could achieve through coding, while always trying to remain positive and ambitious – perhaps combining safety-net and springboard to excellence ambitions (see 1.1).

4.3.1. Analysis and area types

One of the key stages of the recommended *National Model Design Code* coding process is that of analysing local context to generate area types (see 3.2.4). It is envisaged that local authorities will seek to undertake detailed analysis across their jurisdictions which they will subdivide into areas of distinct and recognisable character and represent that in a coding plan (Fig. 20). The analysis would then provide the basis for coding of areas of similar character across their territories. The *National Model Design Code* also implies that coding at a sub-authority-wide scale, for defined areas and large sites, could benefit from area types.

Because they were conducted across different scales, the 2021/22 pilots provided a good opportunity to test this approach. Contrary to the national guidance, they revealed that the use of area types is not always appropriate, notably in relation to coding conducted for areas of unified or negative quality, for site-specific coding, and in relation to authority-

wide codes that were dealing with generic principles, rather than coding adapted to closely defined area types. It was concluded that municipalities considering authority-wide coding first need to determine if they wish to create area types at a very detailed level, or if they will instead opt for higher-level, more flexible guidance, or coding for only strategic-level design issues such as location and proportion of green space, transport links, and so forth (see Fig. 11).

A wide range of analyses can feed into identifying area types or (at a smaller scale) characterisation, and the pilots revealed that this needs to capture the fine-grained complexity, variation and constraints that distinguish many urban areas. In this regard the qualities of areas may overlap and mix, and more sophisticated approaches may need to use different overlapping layers of character, represented, for example, in GIS, rather than defining self-contained and bounded areas across the board. Indeed, few areas have hard obvious borders where one character starts and another stops. Instead, in England's historic towns, cities and villages, qualities fuse together and inter-relate in complex ways (Fig. 21). This finding represented another reason why some of the recent pilots opted against covering their municipalities with boundary-to-boundary area types. It echoes critiques of the use of transect-based coding in the USA (see 3.2.3).

Those producing authority-wide guidance during the 2021/22 pilots typically opted to produce more flexible guidance that covered their entire municipalities, in part because of the constraints of the piloting timetable which allowed experiments with area types, but not the completion of comprehensive coding based on the results. The resource implications of replicating area type analysis across whole local authority areas were also seen as a major barrier and so most pilots ignored this aspect of the model process. As one authority commented “A local authority might be able to produce a high level more strategic code but as soon as the code becomes more detailed and focuses on specific issues, the task becomes more challenging as there may not be the technical information to underpin it”.

Whether leading to the identification of area types, or not, both pilot programmes confirmed the importance of a deep analysis and understanding of character. But the scale at which to conduct this analysis varied relating to the scale across which design coding was to be conducted and used. Typically this has been at the site or area-wide scale.

4.3.2. Engagement

Beyond contextual analysis, the *National Model Design Code* methodology places a significant emphasis on engaging with local communities and wider populations during the code production process. Yet this was in stark contrast to the findings of the earlier pilot study. At that

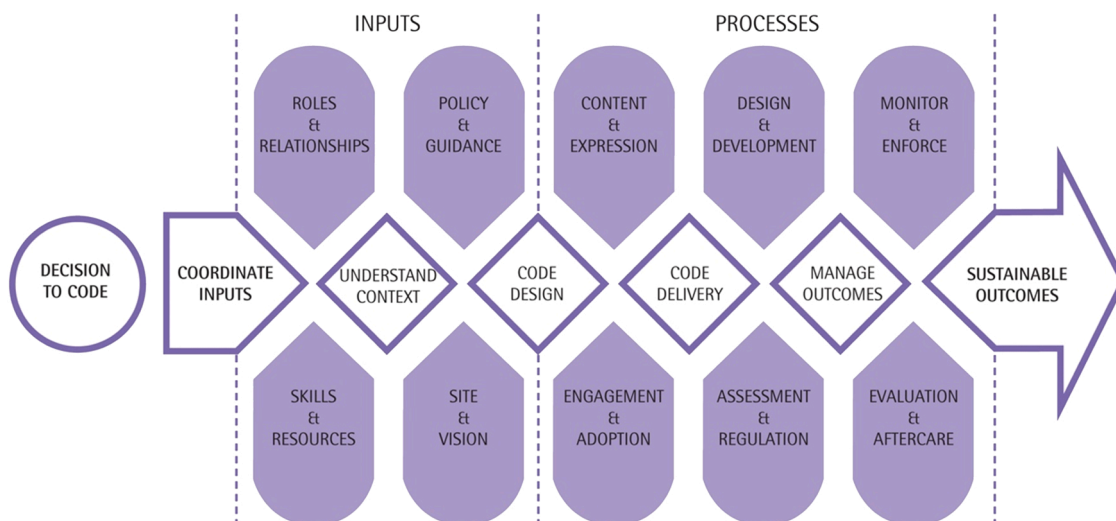


Fig. 18. The hypothetical coding process that guided the 2004/06 monitoring and evaluation (image: Carmona & Dann 2006a).

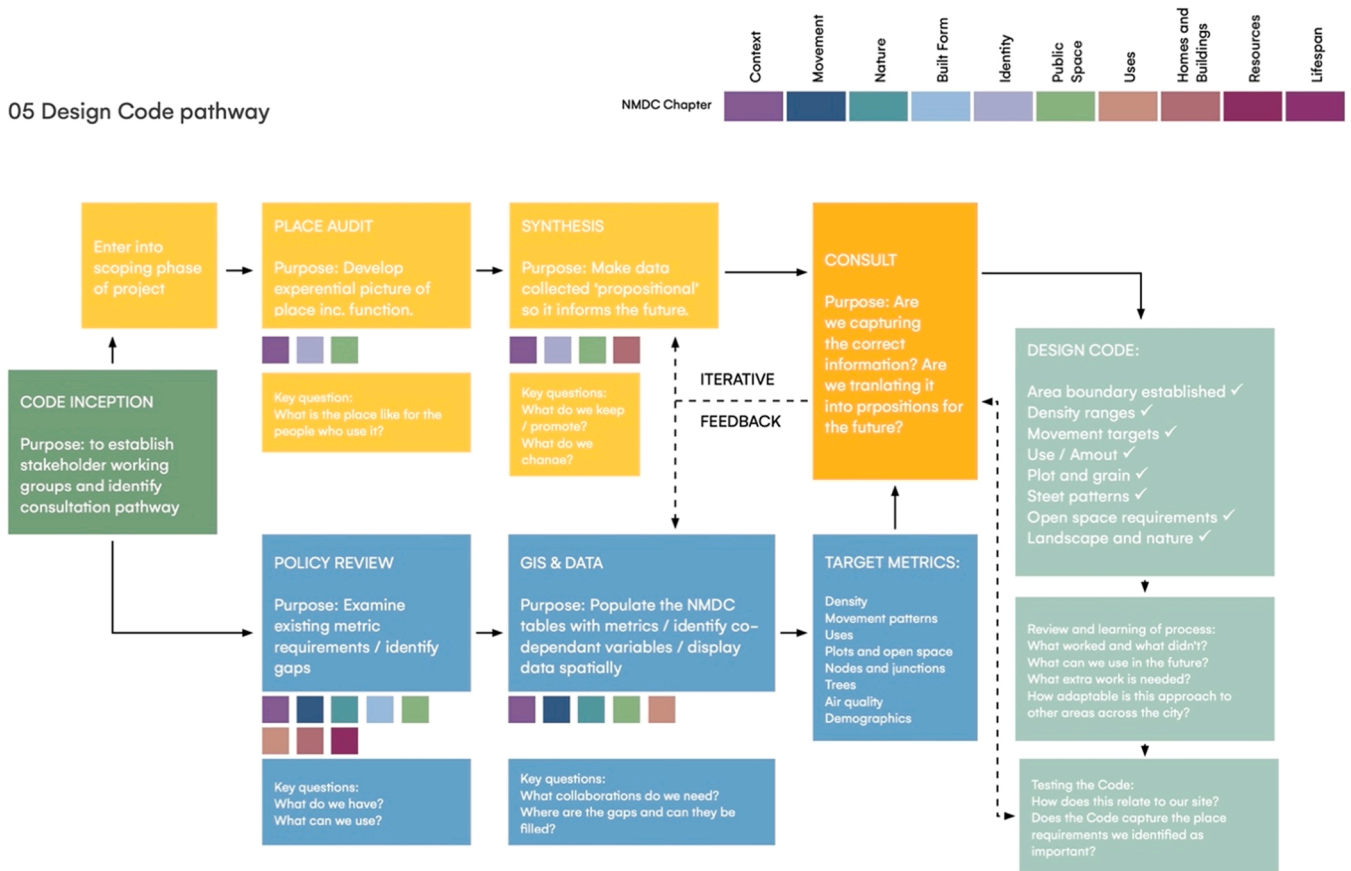


Fig. 19. The City of Portsmouth pilot team focussed on designing a process for coding social housing estate renewal projects which included significant time auditing and understanding these complex socio-physical environments (image: Portsmouth City Council).

time analysis had concluded that, if expressed in non-technical language and in an accessible format, the core principles contained in codes could be ‘consulted’ on as the key ideas underpinning the physical vision. However, because site-specific design codes are largely technical documents, full-scale community consultation or more fundamental engagement is both difficult and can be counterproductive. Instead, the 2004/06 pilot programme suggested that community engagement should occur prior to coding when the physical vision for a site is being defined.

While these findings largely hold for the second set of pilots, the emphasis on codes with a vision-defining rather than vision-delivery role led to a different relationship. In many of these cases, because there was no pre-existing vision, code production was to some extent fulfilling that role. In these circumstances there was clearly value in early engagement with communities, but also recognition that this is a time-consuming process during which trust is only gradually built with communities, many of whom may have previously been intrinsically opposed to development in their localities. The challenge is therefore, how to engage communities at this earlier stage in documents that can be quite technical.

To do this, a wide range of creative means were used to involve the public and stakeholder groups. Among these, community planning events with a focus on establishing a broad physical vision were seen as particularly valuable in building a consensus around the idea of coding and in establishing momentum towards that goal. This was followed by processes designed to keep communities informed about the ongoing activities of code drafting and refinement, with formal public consultation also occurring during code adoption (see 4.4.4). Overreliance, in some cases, on single forms of passive engagement during the 2021/22 pilots led to low response rates and to more basic (less informed) insights

on community preferences. By contrast, combining traditional and technological means of interactive engagement around issues of genuine public interest (the big design decisions rather than the technical detail) tended to facilitate wider and more inclusive community engagement.

Interviewees emphasised that engagement goes beyond simply asking what people like or dislike and at its best is a journey of education (in both directions) across stages of analysis, to vision defining, to code writing and even testing of design codes. They confirmed that communities were primarily interested in whether codes would be enforceable, and that their future trust in the process was likely to be dependent on that. As one interviewee commented “It is not massively difficult to produce a code per se. What is difficult is bringing everyone along with you”.

In facilitating such processes, the value of existing local networks to tap into local lay knowledge was shown to be invaluable. However, the critical role of professional expertise to guide and interpret community preferences should not be underestimated given that constraints and opportunities may not always be apparent to communities. The pilots suggested that the need is to balance local knowledge and professional support.

In 2021/22, when more strategic (pre-design vision) codes were being produced, pilots had often failed to engage with development interests, although most teams recognised the importance of doing so and many were planning a process of market ‘testing’ before publication of their codes. They understood that viability represents a major constraint on the mix of uses and housing typologies that different markets would support, and that handling developer pressure on these issues was necessary. The later pilots were particularly keen for coding to raise the design quality bar prior to development interest materialising on sites, while for the earlier pilots there was a strong sense that it

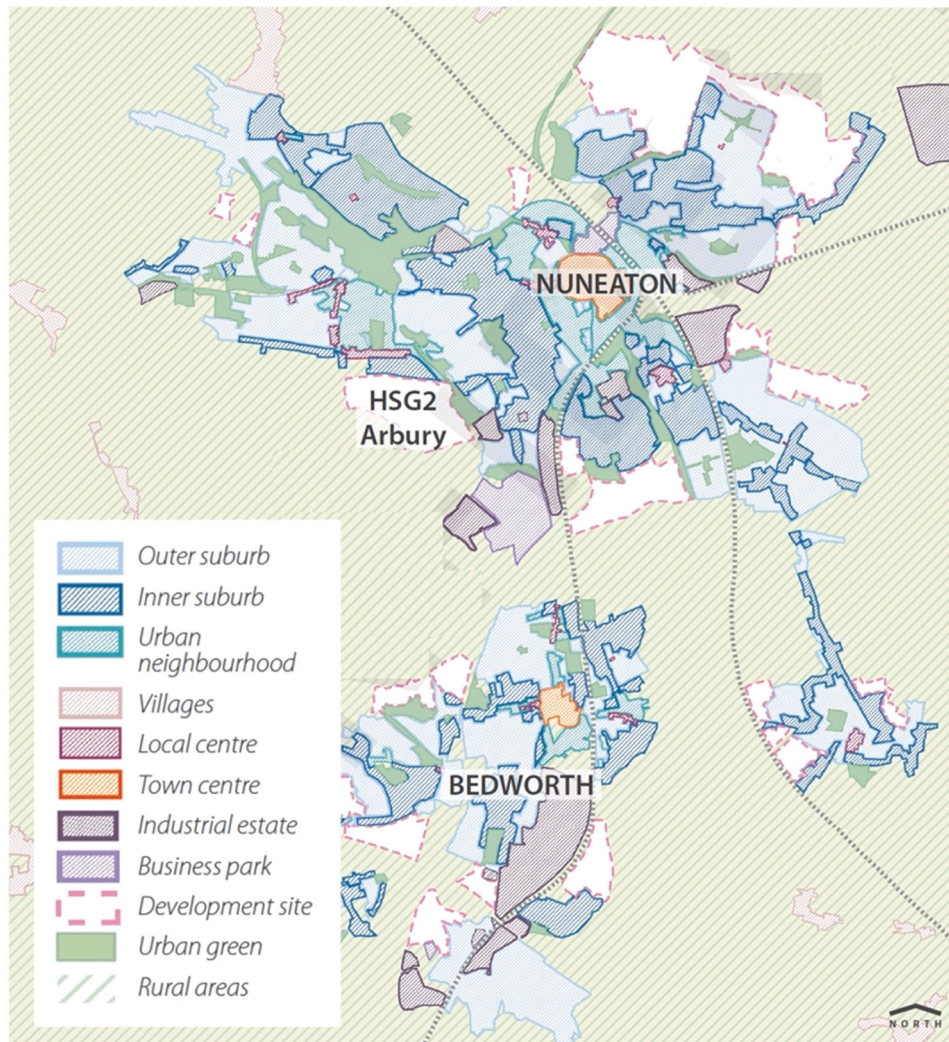


Fig. 20. Area types were identified in the Borough of Nuneaton and Bedworth who considered preparing an authority-wide design code following the pilot programme. However, based on the challenges faced coding for a single large site, the team decided that “anything broader wouldn’t be that meaningful”. They concluded that each of the large sites allocated in the local plan should be subject to a dedicated design code (image: Nuneaton and Bedworth Borough Council).

is better to engage developers early in the coding process rather than afterwards. By not doing this, the 2021/22 pilot teams ran the risk that local development interests might oppose their codes, causing friction later in the development process.

Where there was a failure to engage key technical and development stakeholders in code production, trust could be quickly undermined, both in the code production process and ultimately in the codes themselves. The highways authority, as already noted (see 4.2.3), is a key technical stakeholder that, given their potential influence on final outcomes, should be involved from the start of the coding process. The 2004/06 pilots showed that early involvement of highways colleagues could help to overcome resistance to up-dating highways standards, as well as frequent problems in agreeing appropriate standards for public realm adoption (Fig. 22). The later pilots revealed that highways authorities were not always prepared to engage constructively in coding.

4.3.3. Coding in combination

In both pilot programmes, interviewees were clear that a hierarchy existed from the fundamental design qualities relating to factors such as the form, layout, and use of new development to those that are more concerned with detailed delivery and can be dealt with later in the development process. The former need to be prioritised early as they fundamentally impact on the viability of developments and site

promoters need to be aware of these consequences. Some of the recent pilot teams noted that this implied a staged process for large sites or for area-based coding where detailed codes for different phases of development should build upon and develop the principles contained in a more strategic overarching code for the site or area (coding in combination, as represented in Fig. 11f).

In recognising and helping to tackle authority-wide design problems, it was also recognised that authority-wide codes would be of value in the absence of capacity to take a site-specific approach, but also that they could help to coordinate area-based and site-specific codes. The Explanatory Notes (para. 46) to the Levelling-up and Regeneration Bill for England published in 2022 (see 3.2.4) supported such an approach by suggesting that authority-wide codes can act “as a framework, for which subsequent detailed design codes can come forward, prepared for specific areas or sites” (Fig. 23). The 2021/22 pilots confirmed that this should be adopted as standard practice by authorities when drafting their new authority-wide design codes. This could be done by including a simple requirement that a site-specific design code be prepared for every major housing application, building upon, and delivering the provisions in the authority-wide code.



Fig. 21. In historic settlements area types layer and overlap in complex ways that are difficult to code, as modelled by Mid-Devon (image: Mid Devon District Council).



Fig. 22. At Upton, the existing highway standards were out of date in the mid 2000 s when the Upton design code was being prepared and were largely superseded by those in the code. Highway officers later applied the principles agreed at Upton to other sites in the County of Northamptonshire (image: Matthew Carmona).

4.4. Outputs from coding – populating the wireframe

Codes, it has been argued, have the potential to shape the character and quality of places by the selection and positioning of urbanistic components to support the successful growth and evolution of places (see 3.1.1). Codes themselves, as a product, also need to be carefully

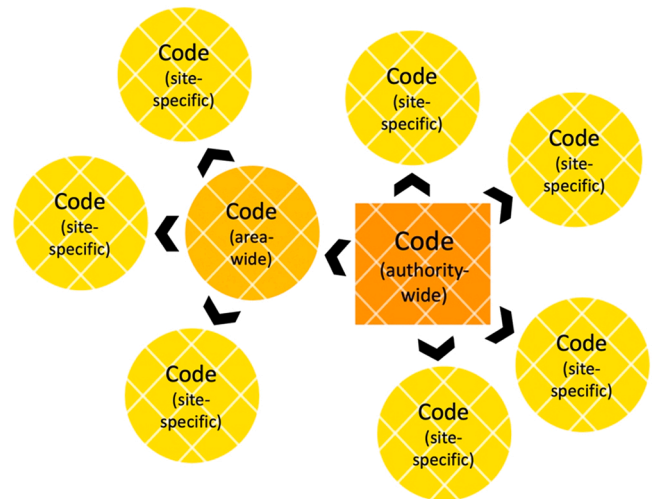


Fig. 23. Authority-wide codes as a framework for site-specific codes (image: Matthew Carmona).

shaped through a design process that positions content in a useable and logical manner so that it can later support the work of professionals charged with interpreting the codes and creating built form. The third coding stage therefore concerns outputs from the coding process, notably a fully designed and articulated code.

4.4.1. Prescription and flexibility

The balance between prescription and flexibility, according to the pilots, depended on what was being coded and the context. In the 2021/22 pilots, issues seen as critical such as heights, quantum (density), uses, parking (including parking ratios vs. front garden space), dimensions for bin access, and access for pedestrians and cyclists, tended to be more rigidly coded. Aesthetic issues, by contrast, were treated with greater flexibility, particularly where visual variety was favoured as an outcome of the coding.

The key audiences for site-specific codes were perceived to be parcel developers and their designers, as well as development managers in local authorities. Coding teams were often adamant that any design guidance that allows too much interpretation by these audiences would lead to conflicts that would ultimately need to be resolved through time-consuming negotiations. Therefore, the aspiration was for codes that were deliberately prescriptive and inflexible tools, primarily meant for a professional rather than lay audience. Teams were mindful, however, that some qualities are more amenable to expression as fixed target metrics than others. Examples highlighted by pilot teams included density ranges, movement targets, land use mixes, plot and grain, street patterns and profiles, quantum of open space and tree planting, boundary treatments, and energy use.

Some argued that a danger of over-prescription in design guidance (of any form) is the inflexibility it engenders in those responsible for its implementation and regulation. Reflecting concerns long voiced in the literature (see Parts 2 and 3), pilots were concerned that this could undermine creative responses to places, if applied too rigidly, and instead required some of the elastic character demanded by Raymond Unwin (see 2.2.1). They concluded that negotiation should be possible on the basis of codes, particularly if alternative schemes promise benefits over and above those offered by the code. Various solutions to this dilemma were utilised by pilot teams, including:

- A menu of alternative coding options for components in order to show a range of acceptable design solutions
- Focusing on performance-based coding, rather than outcome-based coding, by establishing parameters that specify the desired performance (e.g. that access to homes should be step free), without defining how that should be achieved (e.g. by a level threshold access)
- Paring down the code to essential – non-negotiable – components and parameters only and leaving other elements open for negotiation, or subject to other forms of guidance.

The issue of the length and detail of codes was often conflated with their flexibility. As one interviewee commented, “The value of the message is inversely proportional to its length”. Another that “Clarity normally requires detailed prescription”. But perhaps the challenge was summed up by a third: “It is not easy to have something succinct and concise, but which also contains enough detail that a developer knows exactly what you need them to do”. To deliver this, pilots in 2021/22 attempted to be clear and inflexible on ‘essential’ coding parameters – the ‘must haves’ – and flexible elsewhere (as will be discussed). The approach echoed conclusions reached following the earlier pilots where the relative balance between prescription and flexibility was given consideration not just for the code as a whole, but also for each individual coded element. The result was a simple four quadrant framework to help position coded elements correctly along two axis that together define relative prescription (Fig. 24).

Because coded projects are often large scale and developed across extended periods of time, codes also need to be flexible enough to deal with changing circumstances over the long-term. In this regard pilot teams tended to believe that code principles should not be set in stone, but instead capable, through due process, of negotiated interpretation, for example when conflicts become apparent. This also implies a willingness to update codes in the light of the experience of their use

Complex	Elements such as building colour, requiring careful justification but not critical to delivering the overall design vision	Complex yet critical elements for which a range of alternative solutions are possible, such as the position and type of active frontage
Simple	Aspirational elements such as lifetime homes standards for which other sources of guidance are the primary sources of advise	Critical elements that are nevertheless straightforward to prescribe, such as a building line on a plan
	Aspirational	Essential

Fig. 24. Positioning coded elements for relative prescription: detail (left) against flexibility (bottom) (image: Carmona 2009a: 2659).

(particularly if covering large areas). The Advanced codes examined during the first pilot round confirmed that codes do evolve throughout their use, being either formally or informally evaluated based on experience of their use, and then revised. Some pilot teams proposed formal review dates even before their codes were formally adopted.

Echoing the idea of codes used in combination (explored in 2021/22, see Fig. 11), an alternative favoured in some of the 2004/06 coding pilots was the use of code supplements, or mini codes (sometimes described as development briefs, see 2.2.3) for each new parcel as and when they came forward for development. Likewise, ‘Plot passports’ are used in some self-build schemes to interpret site-wide coding principles for individual projects or plots (lots) (Fig. 25). These approaches can – as appropriate – refine, up-date and interpret the main strategic or place-level code, and thereby avoid the need for a complete review.

4.4.2. Coding components

The codes produced by both sets of pilots reflected a broadly comparable set of design aspirations: mainly ‘traditional’ street-based urban design with perimeter blocks, better integration with surroundings (than has often been the case – Carmona et al., 2021), and a high quality public realm. In the 2004/06 codes, streets were typically coded as a series of generic hierarchical types with different profiles and standards, and parking courts within the interior of urban blocks were favoured as the dominant means of taming the impact of parked cars on the street scene. Codes for built form components and parameters were often extensive, serving aesthetic, urbanistic and functional purposes, including the



Fig. 25. Plot passports are being used at Graven Hill Village, Buckinghamshire, to guide the design of self-built plots. These offer a good degree of architectural flexibility within a common urbanistic wireframe provided by the village design code (image: Matthew Carmona).

pursuit of natural surveillance. Open space issues, by contrast, were usually coded based on specific spaces clearly identified in the masterplan, and issues of land use and unit mix were rarely coded at all. Instead, in some schemes (Fig. 26), the adaptability of buildings to different uses was prioritised, alongside attempts to influence unit sizes and types.

Local character was seen as a fundamental concern for communities and for local politicians if they were to embrace a more systemised, rather than negotiated, approach to design decision-making. In defining their response to character, pilots tended to prioritise tangible issues such as landscape, density, height and building line as what they understood to be the enduring qualities of places. They avoided being too prescriptive on purely aesthetic concerns or on what they perceived to be less tangible concepts such as beauty. As one planning officer noted: “the code aims at creating something which is appropriate, which has local identity, character that is distinctly from here, and those elements are obviously important parts of the idea of beauty. These elements of the code are supporting that aspiration but in themselves cannot guarantee it”. Another concluded: “The local area is not very characterful” and argued instead for a new and more positive character to be defined and imposed through the code.

Within this response to character, the evidence from both rounds of pilots showed that coding for architectural design is both possible and popular. Typically based on an analysis of local context, such matters are often advisory but are sometimes mandatory, whilst the styles pursued through coding range from historic / traditional to contemporary. However, different character areas are usually defined more by urban design controls than on the basis of architectural style.

Coding for sustainability was seen as particularly challenging at the time of the first coding pilots, with codes being high on aspiration but low on content focussed on addressing these issues (although research has since shown that coded schemes tend anyway to be more sustainable – Talen, 2013; Garede & Kim 2017; Garde, 2018). Coding for health issues was off the radar as an explicit agenda of the earlier codes.

In the intervening years practices have changed and sustainability concerns in particular have been mainstreamed. Despite this, in 2021/22, pilot teams still struggled to deal with some of the more technical and construction-related principles included in the *National Design Guide*, notably those relating to the ‘resources’, ‘homes & buildings’ and ‘lifespan’ characteristics articulated in the national guide (see Fig. 12). These categories were seen as straying into other non-planning regulatory competencies, notably those relating to transport and highways matters and Building Regulations (construction standards). Health and

well-being, was seen by some as potentially overcomplicating coding.

Recognising these gaps, since the publication of the *National Model Design Code* the [Royal Town Planning Institute \(2022\)](#) has published research and a set of model codes at authority-wide and site-specific scales, examining how design codes can contribute to net-zero and nature recovery. In its field, the Office for Health Improvement ([Office for Health Improvement, forthcoming](#)) has published a draft companion guide to the *National Model Design Code* on health improvement and disparities. These new guides offer a steer on some of the more challenging aspects of codes for coding teams. They also reflect both the significance that is being attached, at the national level, to the production of codes and the broad and ever more complex agendas that are being loaded into their production. Other issues that the later pilot teams struggled with included:

- Contextual variation, given the variety of contexts in some areas and what to code and what to leave as background information
- Site edge conditions where the character could dramatically change
- Detailed architectural design issues, including those relating to fenestration or materials with significant impacts on viability
- Beauty (as already noted), which for some “felt very uncomfortable to start talking about”, but which tended to resolve itself by moving beyond a narrow aesthetic view of the subject to a broader more holistic concern relating to the ‘beauty of place’, or character.

It is also possible to code for desirable and rigorous design process as well as for desirable design product, and pilots were keen to do this to encourage developers and their design teams to follow what they believed to be ‘good’ urban design practices. As one team argued “we have got to strongly codify the design process because often the product is wrong because the process is wrong”. They noted “The applicants are not doing the basics, for example developers failing to visit sites and prepare an opportunities and constraints report before attempting a layout” (Fig. 27). Doing so, they argued, can give development managers in local planning authorities the confidence to encourage activities such as character analysis and community engagement at an early – pre-application – stage in the development process. It also goes some small way to meeting the concerns of those advocating for Generative Codes (see 3.2.2).

4.4.3. Articulating codes

The articulation, presentation and expression of design codes was a particular focus of discussion and debate in both pilot programmes.



Fig. 26. In Newhall, Harlow, coding encouraged housing typologies that allowed for adaptable ground floors that could be converted to non-residential uses, particularly on the primary routes through the development (image: Matthew Carmona).

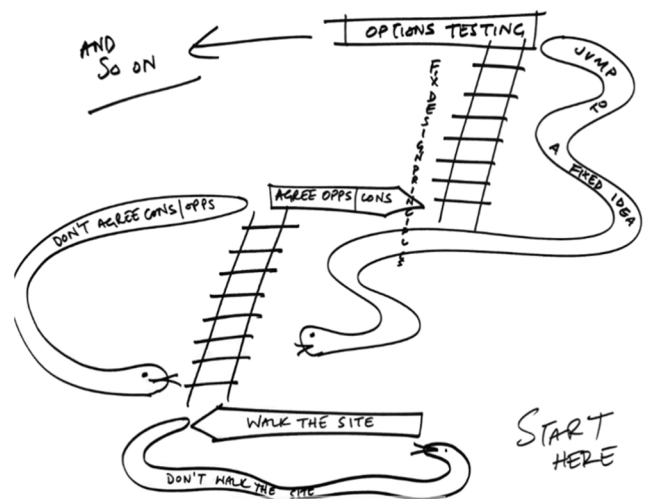


Fig. 27. Design process snakes and ladders, drawn by a pilot team member during one of the 2021/22 pilot workshops to illustrate some of the basic processes to be followed (image: Buckinghamshire County Council).

Those responsible believed that the needs of community and professional audiences are typically compatible. They suggested that each of these potential audiences benefit from digestible, readable, precisely worded and attractive design codes, avoiding overly long explanations whilst containing enough detail to support decision-making and graphically emphasise the ‘must have’ components and parameters. To achieve this a testing exercise involving end-users of codes was considered valuable in helping to refine the content and particularly the expression of codes, including where jargon undermines comprehension. Several approaches were being adopted to achieve this:

- Code-breaking: involving constituting a specific ‘code-breaking’ workshop at which a range of stakeholders, including local developers, legal experts, designers and others seek to test out a code in order to reveal its strengths and weaknesses prior to a subsequent refinement process
- Testing against project submissions: by utilising either live applications for planning permission made during the code preparation process or using historic or dummy applications to put codes to the test and see how they perform
- Testing with planning officers: typically involving a dedicated workshop to tap into the everyday project evaluation and regulatory expertise of development management officers in local planning authorities
- Testing with the community: where community input was central to code preparation, an ongoing role for the community in testing codes

was considered possible at each stage of code production, both to test the content of codes and to sense-check them

- Market / viability testing: focusing on the costs of the design aspirations built into coding. This can be tested either through working with development partners, or by testing internally within authorities, for example by involving council officers in local authority property teams.

No single format for codes was apparent, and instead codes were structured, expressed and presented to reflect local circumstances. While, in practice, text often dominated the codes that pilots were producing, the consensus – across both programmes – was that diagrams, tables of requirements, detailed plans, sketches and precedent illustrations should articulate as much of the content of codes as possible. To avoid copy-cat solutions, it was believed that photographs should be clearly illustrative rather than representing what is acceptable.

Related to this, in 2021/22 there was a strong emphasis on pilots using clear language and graphics protocols to help readers comprehend the relative importance of different elements within codes. Thus, critical issues, it was suggested, should be expressed as ‘must haves,’ meaning they are mandatory, while ‘should haves’ are expected not advisory, and ‘could haves’ are optional. As one interviewee noted: “if you say it ‘should’ have, and it is only recommended, developers won’t do it”. The delivery of ‘must haves’ were nevertheless often caveated with ‘should’ or ‘could’, and whether expressed graphically or textually, it was

C8 : SERVICING

Off-street, under-croft servicing yards to be provided within each development site as per the AAP masterplan. These yards must comply with:

- A clear height of 4.5m to allow all servicing vehicles access
- Entrance gates to be as narrow as possible, using a minimal amount of frontage
- Vehicle sweep paths to allow for large trucks and Refuse removal vehicles
- Allow shared access between neighbouring properties
- Internal road width to be min.6m, allowing for vehicles to pass each other when parked or loading



GROUND FLOOR SERVICE PLAN

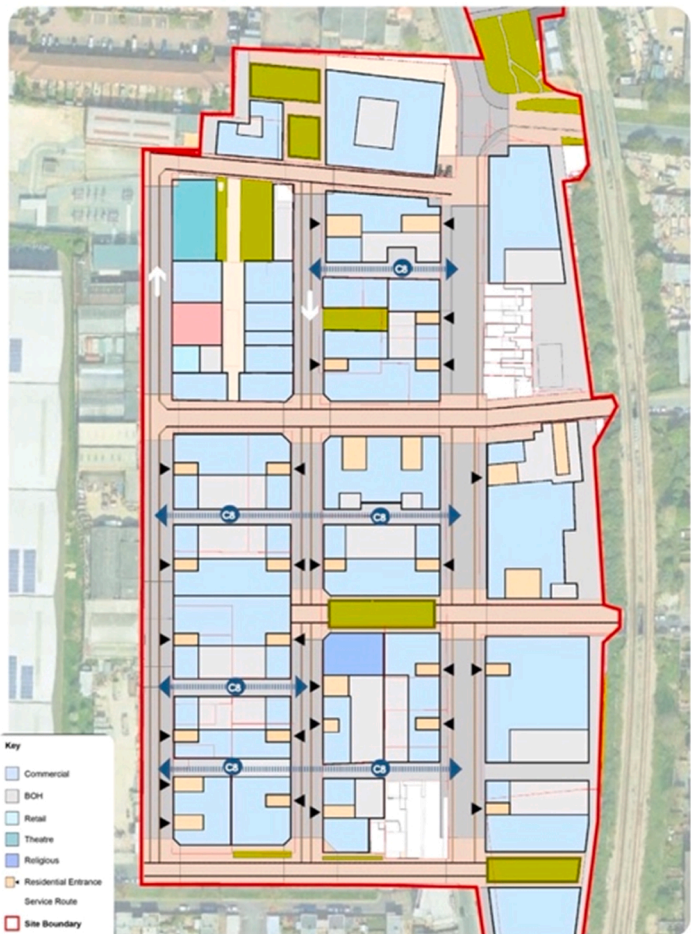


Fig. 28. In the London Borough of Southwark, the delivery of a servicing yard for industrial uses under buildings was a “must comply with the following requirements” mandatory element of the *Hatcham and Ilderton Roads Design Code*. But how to secure it in each case was left to a pre-application meeting when, according to one officer “you set out priorities and then you set out how they could respond to meet those priorities” (image: London Borough of Southwark).

generally agreed that aspirations should be readily apparent, and not crowded out with detailed discussion (Fig. 28). The aspiration was codes that are clear and unambiguous to all users of the code, showing how they should be interpreted and delivered in any given circumstance.

Detailed analysis of the content of the 2004/06 pilots suggested the following practices can help to achieve such unambiguous codes:

- Codes beginning with a succinct guide to their use, and with an explanation of how they relate to the physical vision
- Codes systematically and gradually breaking down elements of the built environment for users, moving from strategic to detailed concerns
- Enough detail offered in codes to give clarity and certainty, although precision to legal standards is not required (codes that are too succinct can be open to greater interpretation)
- Specific code parameters briefly justified to explain their relevance
- Ambiguous aspirational statements avoided
- 2D illustrations, often combining annotated plans and sections (especially sections of street types), to obviate the need for 3D images
- Careful cross-referencing between different elements to aid in-code navigation
- Consistency of page layouts, attention to document structure, and clear numbering of pages and sections.

At the site-specific scale, some pilots in both pilot programmes brought their key ‘must haves’ together into a framework or regulatory plan (see Fig. 4) to make their application and significance crystal clear and to reduce code volume. An alternative was the regulatory matrix

used at Fairfield Park during the first round of pilots (Fig. 29), a format strongly reminiscent of the early New Urbanism codes (see Fig. 8).

4.4.4. The status of codes

Once written, pilot teams were keen to maximise the status of their codes in the subsequent decision-making processes, and within the English regulatory process a wide range of approaches were available in order to achieve this:

1. adding a condition to an outline planning application (an initial principal application) as part of the formal development management process that a design code will be required as part of a later reserved matters application (giving consent to detailed design considerations)
2. codes being submitted, considered and given permission as part of a formal planning application
3. informal adoption of codes for development management purposes (via a resolution of a local authority)
4. formal adoption as supplementary planning guidance to the development plan
5. adoption as a formal part of the development plan (e.g. an Area Action Plan)
6. formal recognition of codes for highways purposes by highways authorities
7. use of development agreements (legal agreements between local authority and developer) legally tying in the use of a code as part of the development management process

	BLOCK SIZES				STOREY HEIGHTS		SET BACKS	NOTES	
BLOCK CODE 1	Terrace	Semi-detached			2 1/2 storey	2 storey		Built form around principal square will consist of shops and flats in addition to housing. The elevational form of shops & flats should follow the regulation pattern for houses. A key feature taller than 2½ may be permitted (see key grouping 2) To create a formal rhythm, units of the same size should be used to form blocks. A haphazard arrangement of different sizes will not be acceptable.	
BLOCK CODE 2	Terrace	Terrace	Semi-detached	Semi-detached	Semi-detached	2 1/2 storey	2 storey		This code is used in areas where a formal arrangement of built form is required. Buildings marking the boundary of the 'urban park' should reflect the detail of the listed building with defensible space defined with walls and railings. To create a formal rhythm, units of the same size should be used to form blocks. A haphazard arrangement of different sizes will not be acceptable.
BLOCK CODE 3	Terrace	Semi-detached	Semi-detached		2 storey	single storey		The block located next to the school and community building may benefit from the inclusion of some single storey units to reflect the size & scale of these buildings.	
BLOCK CODE 4	Terrace	Semi-detached	Semi-detached	Detached	2 1/2 storey	2 storey		Terrace forms with some semi-detached should be the principal forms used. Some detached units may be acceptable but should be used primarily as corner plots.	
BLOCK CODE 5	Terrace	Terrace	Semi-detached	Semi-detached		2 storey		Terrace forms with some semi-detached should be the principal forms used, especially along the east-west pedestrian route to denote where it passes through the higher density urban area of the development.	
BLOCK CODE 6	Semi-detached	Semi-detached	Detached		2 1/2 storey	2 storey		Semi-detached and detached units should be the principal forms used. Especially along the east-west pedestrian route to denote where it passes through the medium & low density green fringe of the development.	
BLOCK CODE 7	Terrace	Semi-detached	Semi-detached			2 storey		Wide fronted cottage type units with low eaves will form this set piece along the diagonal link to the central square.	
BLOCK CODE 8	Semi-detached	Semi-detached	Semi-detached	Detached		2 storey		Narrow fronted semi-detached & detached units should be used to define the planted avenue that runs north to south. A combination of wide & narrow fronted semi-detached units and detached units should enforce where the diagonal links run through the lower density areas of the development.	
BLOCK CODE 9	Semi-detached	Detached				2 storey		Principal forms making up the arcadian nature of the development fringe will consist of detached & semi-detached units with deep front gardens to allow for adequate vegetation & tree planting.	

Fig. 29. Fairfield Park, Bedfordshire, used a regulatory matrix to define and fix key design components (image: Central Bedfordshire Council).

8. using public sector land ownership (when possible), to insist on the production and use of codes as part of the briefing process for potential development partners
9. ... and various combinations of the above.

If intended as public documents and as a material factor in the making and deciding of planning applications, then formal adoption (4. and 5. on the list) was the approach favoured by pilots to enhance the status of codes. Pilot teams were clear that with each step down the list the status of the resulting code would increase but at the expense of the time, resources and risk required to get through the process and the ease with which codes could later be revised.

4.5. Anticipated impacts from coding – using the wireframe

Turning to the fourth and final stage of coding – the impact from the coding processes – in both pilot programmes these were anticipated rather than real given the short periods of testing. Actual outcomes from coding in England are discussed in Part 5 of this paper, but the pilot teams were clear about their expectations and some process related impacts were already identifiable during code development.

4.5.1. Project assessment

Assessment of proposals against codes can take several forms as summarised in Table 6. Design codes, it was argued, give planning officers in development management roles the tools they need to become active place shapers, enabling their work to be informed by a vision of future design expectations. But assessment of schemes against design codes can also be successfully undertaken by development interests, including landowners, funders and master developers and by design professionals working on their behalf.

Occasionally a working group of key regulatory, funding and landowner / master developer stakeholders were brought together to make collective evaluations of different development phases against the code in an ‘integrated assessment’ process (see Fig. 17). This had the benefit of ensuring that one coordinated set of comments on schemes was delivered to the developers of individual development parcels. By contrast, where ‘separate assessment’ processes were undertaken – for example local authorities and master developers making their own independent judgements about compliance – parcel developers could

Table 6
Making assessments against the code, four types.

	Strengths	Weaknesses
Integrated assessment	<ul style="list-style-type: none"> • A one-stop-shop approvals process • One coordinated set of comments • Encourages on-going dialogue between key stakeholders 	<ul style="list-style-type: none"> • Can be time consuming and resource intensive for parties involved in the assessment
Separate assessment	<ul style="list-style-type: none"> • Efficient for parties involved in assessment • Ensures stakeholder priorities are uncompromised 	<ul style="list-style-type: none"> • Parcel developers can feel trapped in the middle of separate uncoordinated processes
Devolved assessment	<ul style="list-style-type: none"> • Ensures consistency of assessment • Can overcome skills and knowledge gaps • Allows some on-going adaptation of the code through the way it is interpreted 	<ul style="list-style-type: none"> • If funded by land-interests, danger that schemes may be sold on leading to an absence of responsibility • May create a disconnection between stakeholders and the code
Self-assessment	<ul style="list-style-type: none"> • Encourages parcel developers to focus directly on the code in order to determine their own compliance • Will be valuable in the future as part of an LDO process 	<ul style="list-style-type: none"> • Danger of a less rigorous assessment • May require an additional compliance check by other stakeholders • Will focus on achieving minimum standards, not on higher objectives

sometimes feel trapped in the middle is assessments didn’t entirely align.

The first pilot programme suggested that the process of landowner teams and / or their representatives assessing the compliance of parcel designs against codes, prior to a formal planning application being made, could be particularly effective. Sometimes the original code designers were retained to make such evaluations in a form of a ‘devolved assessment’. This was seen as helping to ensure consistency while overcoming potential skills and knowledge gaps between code designers and development management staff. For their part, planning officers often felt that they needed up-skilling to administer codes, and this sometimes required that development managers were assisted by those with specialist design skills, either inside or outside local authorities, as well as, potentially, by a local design review panel. This was seen as particularly necessary in relation to those elements of design codes where greater flexibility (and discretion) was required.

Compliance checklists, performance targets against the code and process-related guidance (Fig. 30) of the types already discussed (see 4.4.2) were all used to encourage development managers to challenge poor quality schemes. They helped to raise levels of confidence when making assessments and to evaluate proposals in a timely and objective fashion. To aid regulators, some pilot teams also established a ‘statement of compliance’ to be submitted by applicants alongside their development proposals as a form of ‘self-assessment’ against the code. In 2021/22, new technology to automate such processes was explored. As one interviewee explained: “The idea is that you click on it and it sets the codes that you really need to comply with ... a digital tracker that could be sent to the applicant to determine whether and how they have complied with the code”.

4.5.2. Monitoring delivery

Codes were perceived by those interviewed to be robust tools for controlling design that are difficult for developers to challenge. But any code will be fatally undermined if enforcement of their provisions through the delivery of projects on site is weak. Post-approval enforcement was considered difficult and time-consuming by most pilot teams, with those responsible resigned to the fact that unless problems are identified during construction and before the sale of a dwelling, then it is unlikely that breaches will be enforced. Unfortunately, the complexity of many codes (from both pilot programmes) suggested that they would be difficult to enforce without retaining the original code designers to do the job, which is relatively possible.

Some of the codes produced in 2004/06 were monitored by landowners and their consultant teams, with enforcement via development / land sale agreements; a mechanism that proved particularly effective at ensuring compliance. By contrast, cases relying on local authority monitoring and enforcement processes alone were less successful. Fortunately, the experiences of the Advanced codes, examined during the first tranche of pilots, suggested that the very presence of codes helped to ensure that breaches were kept to a minimum. For public realm issues, the sanction held by highways authorities to refuse to adopt street works was also particularly effective at ensuring compliance, although only when highways authorities were fully on board with the provisions in the codes.

Recent research in the UK has shown that the implementation of any design guidance can all too easily be undermined if processes are not in place to consistently focus on delivering quality outcomes; from inception through to completion (Hickman et al., 2021). However, a perceived benefit of coding has been the ability to challenge the status quo of housebuilding by intervening earlier in the development process (see 4.2.1). The first pilot programme demonstrated that codes can fulfil this challenge role through a number of means:

- As an important feed into the design / development procurement process, notably as part of the parcel (phase) briefing process or as the basis for a limited design competition

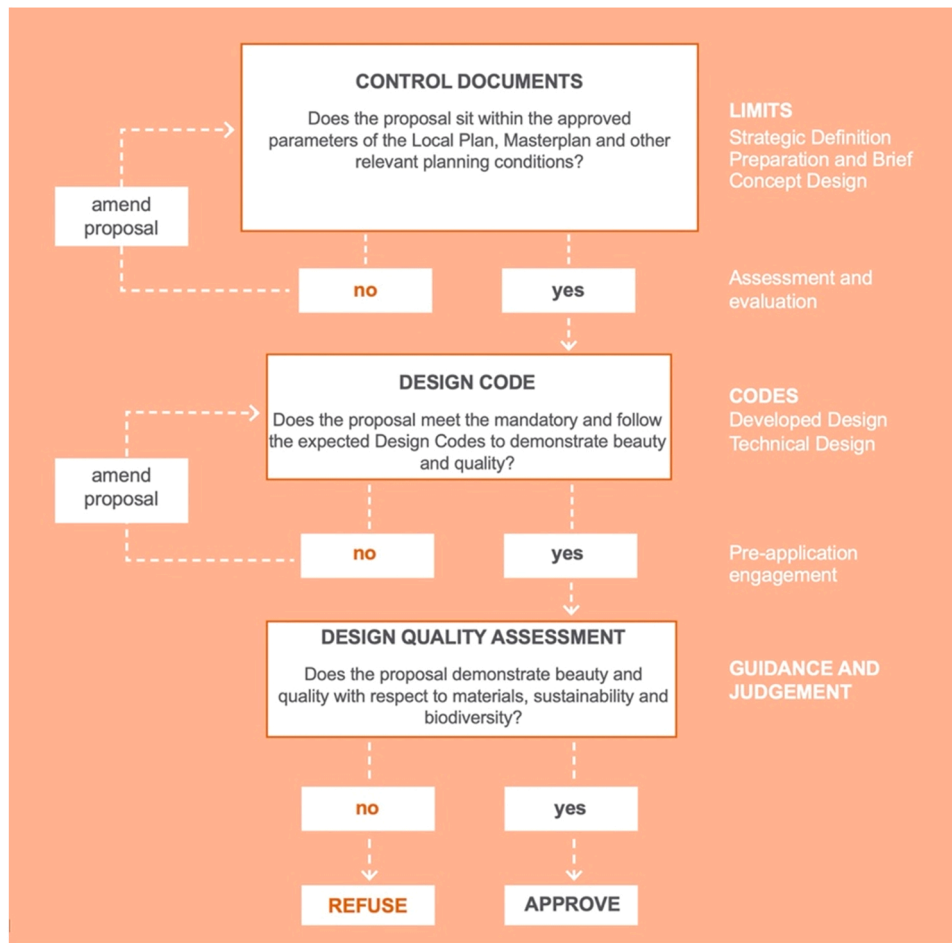


Fig. 30. The Huncoat Garden Village Design Code sets out an evaluation process in which the design code sits alongside design review to evaluate proposals (image: Hyndburn Borough Council).

- Establishing a level playing field for developers when tendering for projects by enabling an efficient tendering process based on clear quality benchmarks
- By setting quality aspirations that not all designers and developers are able to meet, therefore weeding out underperforming parties early in the process
- Providing a means to assess potential parcel design / development teams and their proposals.

Codes also have a potential role to play in the long-term management of developments, as long as an appropriate system is set in place to tie the content of codes into these ongoing processes. Such an ongoing role for codes has rarely been attempted in the UK, although coding teams were mindful of its potential. They noted a number of ways it could be achieved: through planning powers (e.g. removing permitted development rights); by establishing local management companies with a remit to 'police' the code; placing restrictions on inhabitants at the point of sale (e.g. restrictive covenants); or through establishing post-completion design guidance based on the code. More than one interviewee felt, however, that "codes can only code for the development and not what might happen in the future".

4.5.3. Reviewing codes

Pilots were clear that changing external circumstances and the experience of using design codes and determining what works and what doesn't, should lead to periodic review processes. This will be particularly important for authority-wide codes or those covering large sites or areas where development will spread over many years. The pilots were

aware of the challenges and had factored it into their thinking in three ways:

- The usual process: Most pilot teams expected their code to evolve over time, and that revision would need to happen in a similar way to any other planning policy document, namely through full formal policy development processes, including public consultation. Given the time-consuming and resource intensive nature of such processes, this implied that reviewing codes might not happen at all.
- A dedicated process: Several pilot teams had determined that their code would set out an anticipated review process. For very large schemes built-out over many years it was thought that codes would need to be reviewed every two to five years or in relation to achieving defined delivery thresholds, for example the delivery of a defined number of housing units or phases of development (Fig. 31)
- A staged process: A final group saw coding as a staged process of the type already discussed (see Fig. 23), with the initial coding setting out high level principles to be developed and refined in subsequent design codes that focus on a finer grain of detail for whole sites or phases of development. In one of the 2021/22 pilots, a commitment was made to review the proposed county-wide guide (the 'A code') within a year of its completion to review how it was working. A decision would then be made about progressing with a set of more detailed 'B codes', focusing on key sites or development locations in the county.

Only one team considered post-adoption formal review mechanisms impractical, arguing that the speed of market change and the challenges

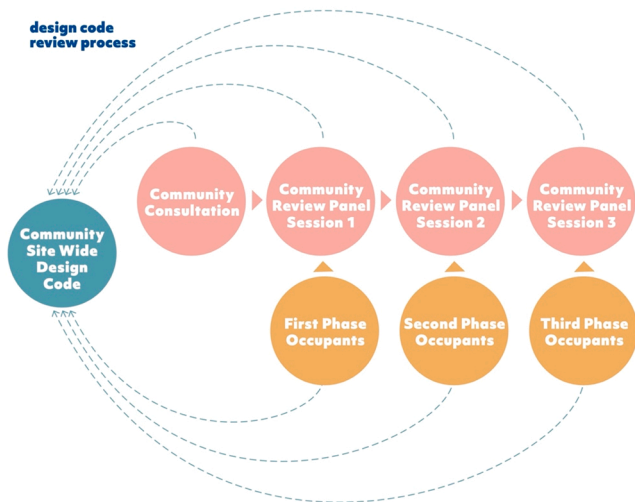


Fig. 31. The review process built into the Weyside Urban Village Design Code links key phases of development with a review of the code's content (image: Guildford Borough Council).

of getting amendments adopted made it easier to start again if codes needed revision. Other teams envisaged drawing on different sources of evidence to inform these processes ranging from monitoring development management decisions (against the code) to periodically and “Informally turning up to view things”. As one interviewee commented, this “shows developers and their contractors that you are an interested authority”, engaged in understanding what is working and what isn't and proactive about making amendments when necessary. What was clear was that for large sites and authority-wide codes, completion and adoption of the first draft of a code was not the end of the road.

4.5.4. Early impacts

While the 2021/22 pilot programme was short and codes were largely unfinished and untested on its completion, pilot teams, community representatives and development stakeholders who had been involved in the design code production largely proclaimed satisfaction with the tools and / or processes that had been put in place and with their potential to deliver a more certain, streamlined and quality focused development process. Unanimously they declared that they would choose to use design coding again – resources allowing.

The earlier, and longer, design code testing programme had allowed more definitive findings around the actual impacts of coding. Overwhelmingly, where codes had been used through to fruition on site, they received a strong endorsement from those who had been involved. Typically, this entailed coded schemes helping to set new quality benchmarks in the locations where they were being used and acting as flagship developments for the developers who were involved. The first pilots showed, and the second pilots were expected to show that design codes can help to guarantee that a defined level of quality will be delivered across the different phases of a development, safeguarding the investments of developers and purchasers alike and delivering public design aspirations. Codes also provide certainty for developers applying for planning consents – if their schemes are code compliant – and when used across large sites, they assist developers to cost units (and thereby developments) with more certainty by introducing a degree of standardisation. For non-compliant schemes the opposite was true.

Most importantly they acted as delivery tools for the physical site-specific design visions to which they related – whether traditional (Fig. 32) or contemporary (see Fig. 26) in appearance. In doing so they helped to deliver consistent quality thresholds across large-scale developments that involve different developer and design teams over time. Codes were also having a beneficial effect in helping to deliver a more coherent public realm; resisting inappropriate development (notably



Fig. 32. Cambourne in Cambridgeshire utilised a combination of a masterplan and detailed site-specific design guides to shape this new settlement in a largely traditional style (image: Matthew Carmona).

overcoming undesirable roads-dominated highways solutions by questioning standards-based approaches to the design of the public realm); generally raising the importance and profile of design; and encouraging the appointment of better quality designers than would otherwise be the case. It was notable, however, that the Advanced code schemes examined in 2004/06 showed that it remained possible to deliver designs of varying quality using the same design code, emphasising the critical importance of other factors as well, including the quality of the designer, the determination and resources of those charged with implementing the code, and the aspirations and ability of the developer.

A major goal of the 2004/06 pilot programme was to determine the impact of codes on the speed of the development process. The programme revealed that the speed of code production depends on the range of stakeholders involved and their working relationships, and on the extent of existing design work (namely whether a masterplan was already in place). Given the right circumstances, incentives and information, draft codes could be prepared in as little as two or three months, but their refinement, agreement, and adoption took much longer – sometimes up to two years. The 2021/22 pilots largely confirmed this with eight of the fifteen teams producing first drafts of their codes during the six-month pilot programme.

One authority claimed: “If you have a design code, you might not need a huge amount of design input because the idea is that the design code saves time and provides clarity in that it is front-loading the level and quality of design”. The Advanced code schemes examined in the 2004/06 pilot programme showed, however, that the choice of using design codes had little bearing on the length of the regulatory (consents) process. Ultimately large-scale developments such as those for which codes are typically prepared are complex, and their progress is dependent on a wide range of factors beyond the influence of the code. For England choosing to produce authority-wide codes, this is likely to more time consuming and more costly to prepare than site-specific codes. Those pilots attempting to create such codes during the second pilots remained at the beginning of the process six months after the pilots had begun.

For site-specific codes a wide range of bottlenecks occur at critical junctures, many tied to the failure to develop a convincing partnership amongst relevant stakeholders when preparing codes, or a strong vision on which to base coding upon. Such factors quickly undermined commitment to the delivery of codes. Most important seems to be the need to involve high quality parcel designers to creatively interpret codes and produce designs which accord with them without the need for significant time-consuming negotiations. Ultimately compliant schemes are likely to receive permissions without delay, while non-compliant schemes will be further held up – providing (theoretically) a ready

incentive to deliver better quality design.

The 2004/06 pilots suggested that over time the process of applying for and obtaining detailed planning consents becomes more efficient when assessments are made against a code. At the time it was also expected that the increased familiarity of local authority teams with coding would progressively streamline their preparation. This, however, does not seem to have happened. Thus few of the 2021/22 coding teams had direct experience of code production and coding processes had not noticeably streamlined over the 17 years between the two pilot programmes.

5. The effectiveness of codes in England

5.1. Conclusions from the pilots

In this penultimate part to the paper, the exploration of English practice continues with an examination of the spread and effectiveness of coding practices. First, overarching conclusions are drawn out from the pilot programmes, and second, other related survey evidence is briefly examined. Before that, both monitoring and evaluation programmes concluded with a set of findings, nineteen in 2006 and twenty-one in 2022. Table 7 compares these which comprehensively cover the four stages of coding discussed in the previous part of this paper. They summarise both the considerable overlaps but also the divergence between the two pilot programmes.

The 2004/06 pilots sought to test the impact of design coding on a range of possible outcomes: on the speed and certainty of the development process, the quality of resulting schemes, the coordination of stakeholder activities and aspirations, inclusion of the community in the design process, and relating to the economic costs and benefits of coding. From the evidence reviewed in the fourth part of this paper it can be concluded that as a particularly robust form of design guidance, design codes can play a major role in delivering better quality development, and this should be the major rationale for supporting them (Fig. 33).

They also have a significant role to play in delivering a more certain design and development process, and – if properly managed – can provide the focus around which teams of professional stakeholders can integrate their activities, delivering a more coordinated and consensus driven process. For this to occur they require a significant up-front investment in time and resources from all parties, although development interests engaged in the first round of pilots suggested that this was more than returned in the enhanced economic value that better design and a stronger sense of place can deliver. The finding has been supported by a wealth of studies on both sides of the Atlantic (Asabere et al., 1989; Eppli & Tu, 1999; FPDSavills Research, 2003; Certero & Duncan, 2004; Song & Knaap, 2004; Dittmar et al., 2007; Diao & Ferreira, 2010; CBRE, 2016; Nase et al., 2016).

Teams involved in the second pilot round concluded that while coding was generally more time consuming than they had anticipated and could not easily be repeated, given resource constraints effecting English local government, but was nevertheless a worthwhile upfront investment in creating a smoother and more streamlined delivery process and in delivering better designed development. Landowners and developers who were engaged in the 2021/22 pilot process seemed largely positive about the codes being generated, perceiving them as giving certainty about what was required (establishing a level playing field amongst developers) and unlocking critical regulatory permissions. The proviso was that they should lead to schemes capable of being viably delivered through the market.

Codes are still largely viewed as ‘delivery tools’ put in place to ensure design quality aspirations are complied with. They are not seen as stand-alone tools, but instead as part of a long-term journey in which the application of design principles is more consistent. This related to what were seen as the more objective dimensions of design quality concerning issues such as the layout and form of new housing, while offering greater flexibility around aesthetic concerns. Overwhelmingly, in the most

Table 7

Published pilot programme findings compared (findings from Carmona & Dann 2006a; Carmona, Clarke, Quinn, & Giordano, 2022).

2004–6 pilot programme, 19 findings (From Carmona & Dann 2006a, order revised)	2021–22 pilot programme, 21 findings (Adapted from Carmona, Clarke, Quinn, & Giordano, 2022, order revised)
Inputs into coding	
1. Motivations for using coding largely focus on quality, in particular the ability to coordinate outputs across large sites	1. Aspirations focused on reinforcing design quality expectations across the scales
2. Codes are delivery (not vision-making) tools, but can help to develop and refine the vision	2. Codes can be vision defining as well as vision delivery tools
3. Coding processes can vary, but should typically build upon and interpret a spatial vision for the site	
4. Coding is resource intensive, but overall, the balance sheet is positive	3. Coding takes significant time, skills, resources, and leadership
5. Key skills are missing, and are needed across the development team	4. Bringing the highways authority onboard early is critical
6. Partnership working is required but also clear leadership	
7. Codes sit as the most detailed level in a hierarchy of policy and guidance to which they need to have regard, and in which their status should be made clear	5. Clear local planning policy hooks can give codes status and ensure their delivery
The process of coding	
	6. Some places are more challenging to code, and all places are complex
	7. Defining area types (as recommended in the <i>National Model Design Code</i>) may not be necessary, but characterisation always is
8. Codes can help to guide the design/development procurement process, setting explicit quality benchmarks from the start	8. Understanding development viability is key to coding and should be reflected within it
9. Engagement should be technical, but a failure to engage key stakeholders from the start can fatally undermine coding processes	9. Engagement is a journey, not a one-off exercise
	10. There is a need to moving beyond passive engagement, perhaps by mixing technological and traditional methods and not forgetting the value of professional expertise
	11. Staged coding offers potential, coding the fundamentals first (prior to development interest or for large areas or sites) and detailed coding later (for smaller sites or stages of development)
Outputs from coding	
	12. Character areas / area types can be complex and potentially overlap
10. Codes are deliberately prescriptive and tend to be inflexible in the short-term, but are not fixed entities and should be capable of evolving throughout their life	13. In the way coding is articulated, there is a need to balance certainty with flexibility and creativity
11. Codes concentrate on urban design criteria, but architectural coding is popular	14. Codes should prioritise character not style
	15. Codes can code for ‘process’ as well as ‘product’
12. Codes need to be robust working documents that carefully distinguish mandatory from advisory components, and should be user-friendly	16. Different (professional and lay) audiences for coding are often compatible in their need for digestible, readable, precisely worded, and attractive design codes
	17. There is a need to use consistent language, clear graphic protocols and to slim codes down to make them more useable, for example by bringing ‘must haves’ requirements together in a framework or regulatory plan
13. A wide range of means can be used to give codes greater status	18. Formal adoption of codes can give them added weight
Anticipated impacts of coding	

(continued on next page)

Table 7 (continued)

14. Integrated assessment processes can help to deliver a robust delivery tool	19. Codes can help to turn development management into a more active and proactive process of place shaping
15. Creative means to monitor codes and consistency in requiring compliance are required	
16. Codes can be management as well as delivery tools	20. It is desirable to build-in formal review protocols into the production of codes, perhaps every two to five years
17. Aiding the delivery of design quality is the major benefit of coding, although other factors are also critical	21. Coding processes have been meeting aspirations, so far
18. Coding per se has little bearing on speed, but the pursuit of quality does	
19. Coding can help to deliver a more certain design and development process	



Fig. 33. High quality placemaking at Greenwich Millennium Village, tested in the first round of pilots. The design code in this case provided the wireframe to structure successive phases of the development over 25 years (image: Matthew Carmona).

recent round of pilots, teams declared that they would choose to use design coding again to achieve their design aspirations, while remaining pragmatic about what they could achieve: “the code aims at creating something which is appropriate, which has local identity, character that is distinctly from here ... elements of the code are supporting that aspiration but in themselves cannot guarantee it”.

As design codes are just one possibility amongst a range of detailed design guidance options, it is important to understand where they should and should not be used. The initial pilots suggested that they would not normally be of value for small sites where only one developer and design team is involved. Conversely, the sorts of site-specific codes that have predominated in England seem most valuable when sites possess one or more of the following characteristics:

- Large sites (or multiple smaller related sites) that will be built out over a long period of time
- Sites in multiple ownership
- Sites that are likely to be developed by different developers and/or design teams.

As suggested in 4.5.4, evidence of the benefits of such codes on other factors was less clear. Codes on their own do not deliver faster planning or development processes, and have no significant role to play in building consensus within communities. Regarding speed, this seems to be no different to other forms of detailed design guidance which can also

deliver the benefits described, but, like coded schemes, are influenced by a complex range of factors that determine the length of the development process, few of which relate to the choice of the guidance tool itself. Codes make no discernible difference to the length of the formal stages of the planning process, although the process of applying for and obtaining subsequent more detailed consents for what in English planning are known as ‘reserved matters’ can, over time, become more streamlined and predictable when based on the clearly defined parameters contained in a design code.

With regard to the issue of community buy-in, as primarily technical documents, few codes seem to play a significant role in helping to engage the community in the design process, but then neither do other forms of very detailed design guidance that are used to supplement a masterplan vision. The 2004/06 pilots suggested that typically the masterplan or urban design framework provides the correct vehicle for community engagement because the spatial vision for the site is easier for lay audiences to engage with than the more abstract design components and parameters found in a code. The later pilots aimed to test this further, reflecting the national drive towards the community voice and “design preferences” fully informing anticipated future codes (DLUHC, 2023 para 127). However, despite significant attempts to engage communities by some of the 2021/22 pilot teams (see 4.3.2), the overall inclusivity of code production processes remained limited, as one officer admitted: “We struggled to get meaningful engagement and therefore to understand what would be popular locally ... most people don’t engage”.

It can be concluded that large complex sites should benefit from detailed design guidance of some description, which should be produced as a means to help deliver design quality, certainty of process, stakeholder coordination, and (potentially) enhanced value. Codes seem particularly suited to such a role but, in turn, need to be supported by a range of other equally important factors: by the right design skills within the teams creating and using the codes; by developers who are committed to quality (if more than a safety-net is to be secured, see 4.2.1); a willingness among regulatory authorities to work together to achieve the same high design goals (notably, in England, both planning and highways authorities); and by a consensus between key stakeholders concerning the vision for the site and the strategy for its implementation. Other evidence, discussed next, suggests that the production of site-specific codes is often a strong predictor of the presence of these complementary factors.

5.2. The diffusion and effectiveness of codes

Alongside the pilot programmes, several studies have pointed to the effectiveness of design codes in England. First, and unscientifically, there is a strong association between projects often viewed as national exemplars (for example those used to illustrate the *National Design Guide*, the *National Model Design Code*, and other documents) and the use of design codes (Fig. 34). This, and the national drive to prioritise code production, first in the mid 2000’s and now in the early 2020 s, has driven a gradual but increasingly rapid mainstreaming of codes as tools of urban design governance. The result can be traced in four national surveys published over a twenty year period that collectively add to the evidence of an increasingly widespread acceptance of design coding as an effective tool of urban design governance, even when not actively promoted by Government.

The first survey pre-dates the pilot programmes. Undertaken in the late 1990 s, the national survey of residential design guidance discussed in 2.2.2 found that recognisable design codes amounted to less than 1% of the residential guides at that time (Carmona’s, 2001: 286). The study utilised a national postal survey and telephone follow-up to achieve a response rate of 93% from across the country’s then 404 local and county planning authorities. As such it established a reliable baseline from which to track how practices have developed subsequently. Projecting forward to 2004, the first pilot programme was also the first



Fig. 34. Commonly referenced exemplar schemes, each shaped by design coding, have helped to drive a national interest in design codes as a tool or urban design governance. These include: a) Derwenthorpe, York b) Chobham Manor, London c) Graven Hill, Bicester d) Nansleden, Newquay (image: Matthew Carmona).

significant attempt to promote the use of codes in the UK. Consequently, it can be safely assumed that the use of these tools would have remained at this very low rate until at least the mid 2000 s. Instead, as discussed in 2.2, other forms of guidance, notably residential design guides and development briefs, were far more frequently used.

The first pilot programme was followed six years later by a national survey of practice to determine the spread of design code practices across the country. Utilising an email sent to local authority Chief Planning Officers in England and an online questionnaire to collect data, the overall diffusion of design coding was revealed to be approaching half of England's local authority areas (45%) (Carmona & Giordano, 2012). In the survey 'diffusion' was liberally defined as the proportion of local authorities in which design codes had been used and / or who recommend their use in policy. A relatively low response rate of 16% was supplemented by searching online through the published and emerging local plans of all local planning authorities in England, and by a separate online analysis of the websites of the 117 urban design consultancies who, at the time, were members of the Urban Design Group. Using these three means a clear, but imperfect, picture of significant diffusion was revealed.

Despite the methodological challenges, the 2012 survey clearly showed a year-by-year growth in the use of design codes in England following the first pilot programme (Fig. 35). It also revealed that much of this diffusion was being driven by private developers, landowners or consultants who were submitting often unsolicited design codes as part of formal planning applications for development. It was estimated that

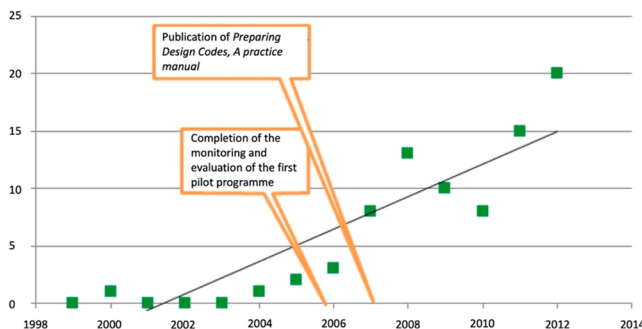


Fig. 35. Diffusion of design codes in England as measured in 2012, showing the publication of the original pilot programme monitoring and evaluation report and the subsequent national Practice Guide, neither of which were widely promoted (image: Matthew Carmona).

more than 120 design codes had been prepared between 2006 and 2012, compared to a smattering of codes before that.

In 2021, with the second pilot programme about to get underway, the same research team included a question about the production of design codes as part of a wider study looking at the national *Design Deficit* in urban design skills in local planning authorities around England (Carmona and Giordano, 2021). Again, based on a national survey of England's local planning authorities (by then 322), the researchers used a formal Freedom of Information enquiry to elicit a much higher response rate of 72% to their online survey tool. Findings suggested that the use of design codes had continued to rise, with three quarters of local planning authorities having some experience of their use by the early 2020 s (Fig. 36). Continuing trends identified almost a decade before, most local authorities who used codes were either requiring or encouraging developers to produce these tools, with only 14% produced by an in-house design team.

Authorities were also asked how their practices would change if, as expected by the passing of the 2022 Levelling-up and Regeneration Bill into law (see 3.2.4), the production of design codes became mandatory. In that scenario: a third of authorities planned to produce design codes in-house, 7% aimed to commission consultants to do the work and a third didn't know how they would produce (or fund the production of) codes. The uncertainty was reinforced because, up to that point, codes had been viewed as site-specific or area-wide tools and, beyond the generic forms of design guidance that had been in use since the 1970 s, almost no authorities had attempted to code at the authority-wide scale.

Reinforcing qualitative conclusions from the pilot programmes regarding the effectiveness of design codes as tools of urban design governance (see 5.1), a final piece of analysis showed quantitatively that site-specific design codes had been effective at driving better design quality within large-scale housing developments across England. A physical audit of 142 large scale housing projects covering every region of England was undertaken by a network of trained auditors who evaluated design outcomes (what was built on the ground) against seventeen widely recognised urban design considerations (Carmona et al, 2020).

The headline results showed that the large majority of new housing developments in England exhibited 'mediocre' or 'poor' quality design, with three quarters of the audited projects falling into these combined categories (Fig. 37). However, correlating the project-by-project scores against the design governance tools that had been used to guide their design and development, a very clear pattern emerged. While all design governance tools helped to deliver better design outcomes, suggesting that it is better to use even the most generic guidance than nothing, the impact on design quality varied considerably between tools.

Most effective – by some margin – were site-specific design codes followed by design review. Schemes that benefitted from the use of design codes were almost five times more likely to appear in the 'good' or 'very good' design categories than in the 'poor' or 'very poor' ones. Schemes that benefitted from the advice of a design review panel were approaching four times more likely to feature in these categories. Schemes relying on generic local design guides were only fractionally more likely to record enhanced design outcomes.

While neither site-specific codes nor design review offered a panacea for good design, the trends were confirmed in the regional scores. Regionally, the top scoring region, as measured by the quality of its housing-led developments, was Greater London. London was also the heaviest user of design review and a heavy user of design codes. By contrast, the East Midlands scored least well in the national audit and was a very low user of both design review and design codes.

While discussion of design review is beyond the scope of this paper (see Carmona, 2019b), reflecting on why these two tools are significantly more effective at delivering design quality in new residential areas than others, a simple observation can be made. Their use typically involves directly engaging with sites (either constructing design parameters for sites or critiquing propositions for sites) and this contrasts with common industry practices in the UK where "a plansmith simply

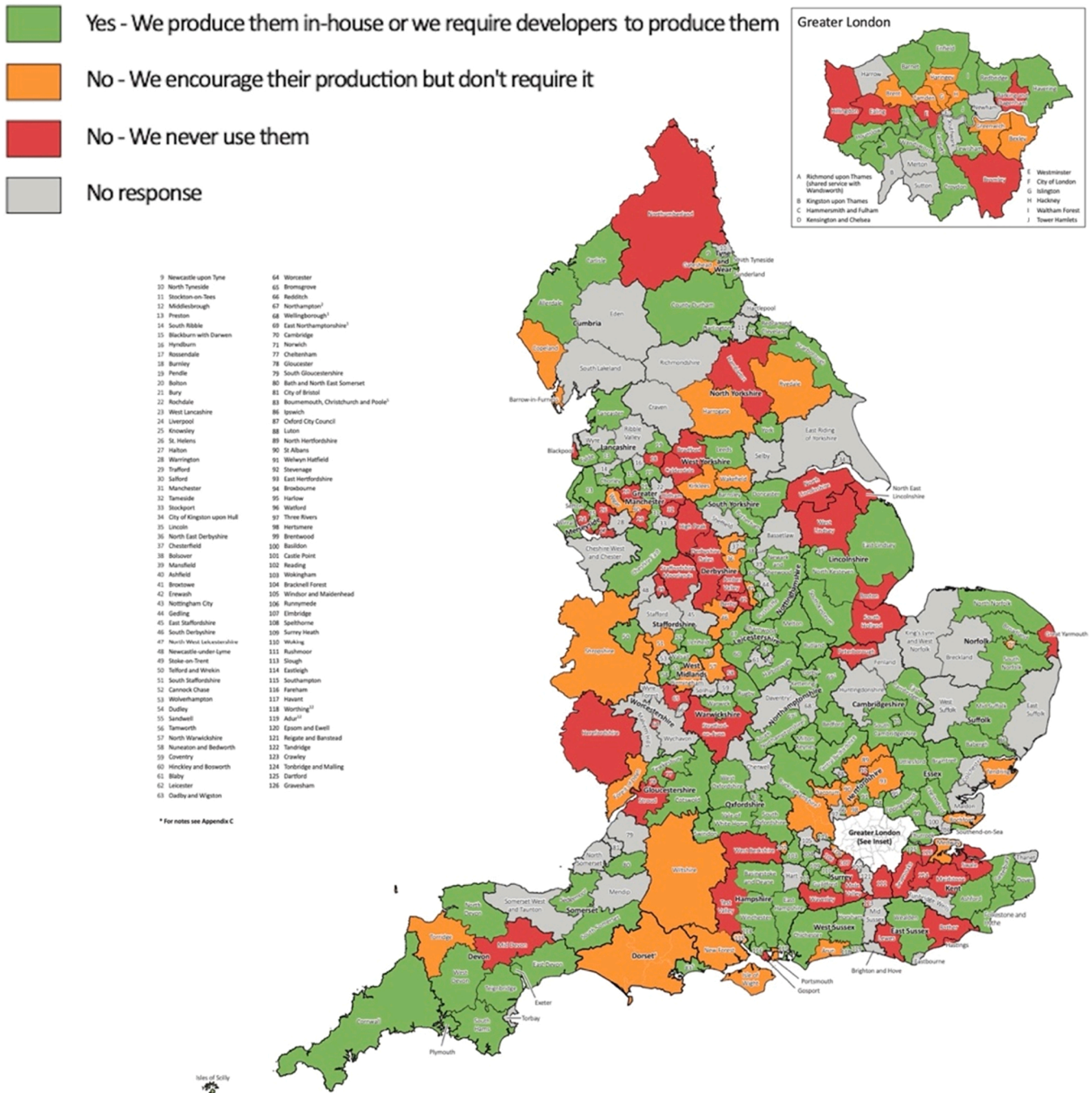


Fig. 36. The use of design codes across England in 2021. The map shows large areas of the country where design codes are unused or rarely used (image: Carmona and Giordano, 2021).

applies generic housing products and generic codes to a site ... often prepared without visiting the site or conducting any analysis” (Carmona, 2022) – the latter a common complaint among the pilot teams. As (up to now) the use of design codes in England have focused on specific sites and specific projects, rather than on offering generic guidance across larger areas, this necessitates a skilled design team to create and to respond to them (as the pilot projects showed). This marks perhaps the key and fundamental benefit of their use.

6. Conclusions

6.1. Twenty principles for coding

In this final part of the paper, conclusions are drawn out that link the earlier conceptual, historical, and comparative discussions in Parts 2 and 3 of the paper to the empirical evidence and practice-based focus of Parts 4 and 5. In Part 1, the paper asked how can codes be used as a positive wireframe for a more place-focused urbanism? In this final part of the paper the question is answered. Design codes, it turns out, have the potential to deliver place value in a world where, left to its own devices, the market will often deliver less than optimum design outcomes.

This paper began by comparing coding in the built environment with



Fig. 37. Low-scoring housing developments scored especially badly in terms of ‘character’ and ‘sense of place’, with architecture that did not respond to the context in which it was located. The worst reported aspects of design included developments dominated by access roads and the poor integration of storage, rubbish bins, and car parking, leading to unattractive and unfriendly environments. All these elements are heavily controlled by generic standards-based codes applied with little thought to holistic place quality (image: Matthew Carmona).

that used in the field of information technology. While computer software can ultimately be boiled down to a series of 0s and 1s (to binary code) and the fabric of the built environment to solids and voids, coding in both fields is hugely complex in order to accommodate the numerous languages, delivery tools and, of course, objectives – what coding is attempting to achieve. The need is to have a clear vision of what is intended and to write the code in such a way that it will be delivered without fail. Just as a computer must follow its coding – it can’t (yet) decide to simply disregard it if it doesn’t like the direction of travel – so also should a good urban design code lead inevitably and irreducibly to the outcomes defined by and in the code. It should be easier to follow the logic path defined by the code than to ignore it. In the built environment, ideally this should deliver a more desirable set of outcomes than would have been secured without the code, although, as was shown in 1.1, 2.2 and Fig. 37, crude coding can also materially reduce the quality of designed outcomes, delivering the default, unsustainable sprawl (Mehaffy, 2011: 493).

As revealed by the pilot programmes in England and before that by Alexander, Schmidt, Hanson, Alexander, & Mehaffy, (2008), the impact of codes does not simply relate to the design components chosen for coding. It is also dependant on parameters that define how they should be used, where and when in order to give meaning to the codes and the place being created (see 3.2.2). In turn this depends on how the processes of code generation, adoption, and use are managed in order that codes are clear and unequivocal to all. Collectively, as the analysis has shown:

- Codes are particularly effective tools of urban design governance
- They have the potential to deliver a greater focus on place – on a more place-focused urbanism – by establishing the wireframe within which design qualities are shaped, components are positioned and places are supported to grow
- In doing so codes help to safeguard the public interest in urban design, albeit as value laden products with varying focus, impact, and interests that they serve.

Drawing on the analysis it is possible to suggest one final set of overarching principles for the production of design codes, drawing primarily on experiences in England across two decades of analysis and two pilot programmes, while also folding in allied experiences from the

USA. This is because significant overlaps are apparent between the findings brought together in Table 7 and the practices summarised in Table 1 which reflect the experiences of using form-based codes in North America. While the UK experience focuses more on process and the American guidance on normative design expectations, overlaps can be seen in seven key areas:

- Codes as tools to support a clear spatial vision for sites or areas
- Codes that focus on critical urbanistic components and parameters, the wireframe rather than the architecture
- Precise design parameters established spatially to define the public realm
- Critical design components expressed as non-negotiable parameters and other components articulated more flexibly
- A strong focus on unambiguous graphic communication, understandable by all
- Coordination between codes and other critical policy and guidance
- Codes designed to be monitored, reviewed and updated regularly.

Twenty principles are defined under five headings:

Coding aspirations

1. Coding should define a clear vision for a place-focused urbanism by advancing design aspirations to shape distinctive, high quality built environments that maximise place value, enabling sustainable, inclusive and fulfilling lifestyles to be led
2. Codes can be vision defining (pre-masterplan) as well as vision delivery (post-masterplan) tools, but are of greatest value supporting a clear spatial vision for large sites or areas

Inputs into coding

3. Coding front-loads design time, defining and locking-in critical design aspirations earlier in the development process
4. This requires leadership, proper resourcing (up-front) and the harnessing of an appropriately skilled and ambitious coding team, as a by-product, helping to exclude incapable development partners
5. Effective design codes require that all regulatory and development stakeholders (public and private) work together to agree the content of design codes
6. Codes need to be carefully coordinated with other critical strategic and place-level planning and regulatory frameworks, bringing place-based specificity and meaning to design aspirations

The process of coding

7. A coding process should always begin by understanding the physical and ecological context to which the code will apply through a process of characterisation that responds to the multi-layered and varying complexity of places
8. Codes should reflect the social and development context and what is or is not viable in any given locality while stretching design ambitions in locations characterised by poor quality urban design
9. Input from stakeholder and community engagement processes needs carefully thinking through, engaging different interests at the right times by encouraging community input on the broad vision and design aspirations for development, and involving development stakeholders on technical detail and deliverability
10. Coding may usefully be viewed as a staged process that utilises different levels of coding in combination – fundamental design aspirations coded first, for large areas or sites and detailed and technical coding later for smaller sites or the different phases of a larger development

Outputs, the wireframe

11. Codes should focus on the critical urbanistic components and parameters that define the wireframe of the place, 'shaping' its physical and functional character and endowing it with meaning
12. Codes gain their value through their status as relatively prescriptive and inflexible tools of urban design governance, 'positioning' critical components in relation to each other while maintaining scope for architectural interpretation and creativity
13. Codes can code for good design process as well as desired outcomes – 'supporting' the growth of something that is coherent and greater than the sum of its parts
14. Codes need to be digestible (not thicker than needs be), precise and readable (written in a consistent language) and attractive (graphically led utilising clear graphic protocols)
15. Critical design components should be expressed through non-negotiable 'must' have parameters while other components can be articulated more flexibly as 'shoulds' (expected unless a clear justification for a variance is shown) and 'coulds' (suggested good practice)
16. Codes can usefully bring 'must' have prescriptions together in a framework or regulatory plan that also defines spatially where and how different coding combinations apply and how they relate

Impacts, delivering codes

17. Formally adopting codes for the purpose of design regulation can give them the status and weight required to ensure consistent compliance and effective implementation
18. Codes should provide the means to deliver a fully integrated assessment process, turning public sector design regulation and associated decision-making into a robust and certain, responsive and proactive process of place shaping
19. Including means to monitor the delivery of design quality over time, alongside periodic review protocols, will be critical components of any delivery strategy
20. Codes possess the potential to be long-term place management as well as short-term development management and delivery tools.

6.2. Looking to the future

In England, design codes are being used to deliver a more design focused planning system in the belief that better designed development will be more acceptable to local communities who will thereby be more accepting of new development in their areas (Airey et al., 2018). Design codes are seen as adding greater certainty and reducing the discretion inherent in British planning systems. If implemented across the country, they will complete, or at least come closer to completing, a historic journey from rigid planning rules to discretion and then back again (see 2.2). At the time of writing, it is yet to be seen if this will be delivered.

In countries with a zoning tradition (see 2.1), various forms of coding are being introduced with two purposes. Either to be more responsive to the specificities and nuances of sites – beyond what is possible in a broad-brush zoning system – or to offer greater flexibility to changing market circumstances by coding separately and sequentially for different phases of development – beyond what is possible in a blueprint masterplan.

Codes have been linked, therefore, both to reducing flexibility and to increasing it. The recent policy and legislative changes discussed in 3.2.4, mark a major point of departure in England where codes are to take on a new and more central role than they ever have in the past. The *National Model Design Code* distinguishes between design guides (more generic and flexible) and design codes (more specific and prescriptive). It is also possible to distinguish between harmful codes (in place-making terms), particularly those that focus on singular issues such as roads or parking at the expense of the larger place, and those that will deliver more locally responsive place-focused design outcomes. Also, between effective and ineffective tools for delivery.

Generic municipality-wide coding (of different types) is nothing new. On the one hand there are the ubiquitous 'amenity' and highways standards that are effective at delivering on their objectives (sprawling highways dominated developments) but poor at delivering place quality. On the other there are the equally ubiquitous generic policies and / or guidance that can be so open to interpretation and so detailed that, despite their focus on place quality, they are just as easily ignored as used. In the UK, as elsewhere, the impacts of these sub-standard codes are plain to see in the poor and mediocre housing schemes that dominate across the country (see Fig. 37).

So how will the new design codes in England and elsewhere be different from these? Drawing on the research reported in this paper, the aspiration should arguably be to combine: i) the prescriptive (non-negotiable) qualities of the highways standards (in England) or zoning ordinances (elsewhere) with, ii) the statutory position in the planning process of the formally adopted development plan (relating design firmly to broader spatial objectives and decision-making) and, iii) the holistic place-focused urbanism found in the sorts of local design guides that have been produced in the UK since the 1970 s. And to strike this illusive balance codes should focus foremost and with clarity and precision on those 'must have' qualities of the desired new places, which should be expressed in an unequivocal manner as statements of expectation rather than negotiation (Fig. 38). When this was the focus, the pilot programmes discussed in Part 4 of the paper revealed that codes can be prepared surprisingly rapidly. Most, however, were for specific sites rather than more generic coding for whole authorities, or were seen as part of a staged approach to coding in which fundamental principles are articulated at a more strategic scale to be combined at a later date with more specific coding for areas or sites (see Fig. 23).

With the drive in England towards the production of authority-wide codes, there seems to be an alignment with practices in the USA where many form-based codes have been produced as alternatives to, or replacements for, city-wide zoning ordinances. The evidence discussed in this paper suggests, however, that the real prize remains the production of site-specific design codes (floating-zone codes in the USA) that represent a continuation of the practices that have guided the best development projects in the UK since the 2000 s (see Fig. 34) and which are closer in type to the site based regulatory plans found in continental Europe. Such codes deliver a greater degree of place-specificity that is only possible at a smaller scale involving a design team directly focusing on the site and its potential rather than applying standard types to a remote and abstract site (see 5.2).

The coding pilots nevertheless demonstrated that there are many paths to successful coding, and that codes are not a single tool or process. These diverse ends are inevitable because there are many beginnings, with municipalities all at different stages in the development of their design governance infrastructure. At the same time, the research reported in this paper has brought together both conceptual ideas and practical evidence that might suggest a possible route forwards in the future (Fig. 39).

More important than the exact form design codes took during the English pilot programmes was the journey coding teams embarked on to get there, and the raised commitment to design quality which that represented. Design codes have gained a new status in the English planning system and their use looks set to grow, as also seems to be the case internationally. Like any tool of urban design governance (or any form of coding – IT to urban), there will be good codes and bad ones and just having a code in place will be no guarantee that anticipated quality thresholds will be secured.

As Raymond Unwin (1909: 9) noted "In desiring powers for town planning our town communities are seeking to be able to express their needs, their life, and their aspirations in the outward form of their towns, seeking, as it were, freedom to become the artists of their own cities, portraying on a gigantic canvas the expression of their life". In this sense codes clearly put public authorities on the front foot, lending them the power to shape a desired outward expression in a proactive and

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