FINE-GRAINED PARALLELISM FOR POST-PANDEMIC CITIES: 12 DESIGN STRATEGIES FOR RESILIENT URBAN PLANNING

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Abstract

The COVID-19 pandemic has changed the way we live in the city. Social distancing will remain as a provisional code of conduct for unforeseeable outbreaks of pandemic diseases in the future. Social distancing is predicated upon reduced density of people in any given space and time. Since urban sprawl has been proved to be unsustainable, spreading out the urban density to suburbs cannot be the right direction to achieve this. Fine-grained parallelism is proposed as a single theoretical framework for an alternative post-pandemic urbanism. It is a way of maintaining simultaneous movement and co-presence, two essential properties of urban living, without the risk of crowding, by reconceptualising the existing spatial setting in a finer resolution. Existing urban spaces that have been underused, ill-used or unused can be reconfigured to achieve fine-grained urbanism for the resilient post-pandemic city.

Keyword: Post-pandemic city, Fine-grained parallelism, Density distribution, Decentralisation, Spatial flexibility

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INTRODUCTION

Decentralisation became an important agenda during the COVID-19 pandemic. During a crisis, decentralisation delivers another strength, i.e. resilience (Gevers 2020). Decentralising a mega centre into smaller local centres enables re-distribution of people and traffic. A self-sustained and walkable community saves unnecessary trips to the urban centre which helps to control the spread of viruses. There was a clear tendency during the pandemic that people were attracted to local neighbourhoods and shopping closer to home for smaller amounts, more often (The Economist 2020a, 2020b; Crawford 2020). People now pay more attention to their homes and towns than ever before and find new meaningful activities embedded in them. This is an important turning point in our contemporary urban life that will remain for a long time.

Decentralisation can be put into effect by devolving the domination of a major city into many local cities and towns outside of it in the wider region. However, we know the environmental and economic value of a compact city, so it is not a viable solution to stretch out the city to the suburbs (Stevenson et al 2016). Urban sprawl as a remedy to overcrowded cities has been an experiment in the last century, but it caused more traffic, inefficient land use and environmental harm (Osman et al 2017; Saxena and Chidambara 2016). Moreover, recent articles on COVID-19 found that crowdedness and economic status have more direct impact on the spread of the virus than population density itself (Lim et al 2021; Carozzi et al 2020; Hamidi et al 2020; Almagro et al 2020; Center for Active Design 2020). What then could be a sustainable solution to decentralisation of the modern city in a time when we expect more pandemics to come?

This paper proposes a concept of fine-grained parallelism that can provide a possible approach to decentralisation within the given boundary of the city. It is a way of seeing urban spaces in a finer resolution to make the best use of them rather than expanding the existing territory of the urban area. Finer re-configuration of a given space, finding under-used niche spaces, and increased links between them will offer spatial potentials and behavioural options for users. By using it as a single theoretical framework, we can enhance the performance of our cities at all levels of built environment to maximise adaptability and resilience to pandemics, climate change, and social transformation.

Cities are densely interweaved by built structures and flow systems, making social distancing a hard-to-achieve goal. Restrictions were enforced during the pandemic to prevent gatherings in public spaces but this could only be implemented by sacrificing the quality of everyday life. Fine-grained parallelism is a way of preventing the concentration of urban activities with minimum impact on human life, while maintaining the overall density of the urban population. It is not to advocate density at any cost. High density, if done right, makes the city more liveable and sustainable while overcrowding is something that should be

avoided (Jacobs 1961). Density would still work post-COVID-19 with well-planned urbanism (Miller 2020, Badger 2020). Thus, fine-grained parallelism aims to provide more nodes, routes, and occupiable spaces for a wider distribution of movements and events in the city.

Post-COVID-19 design strategies have been discussed and suggested widely in related industries and academic fields in recent years. However, there has been no meaningful attempt to integrate them to provide a consistent approach to a wide variety of urban planning agendas. This paper provides a single theoretical framework of fine-grained parallelism that is applicable to multi-level design interventions. Through the critical review and analysis of literature and case studies, we propose twelve design strategies that are applicable to the micro and macro urban scales for the resilient post-pandemic city.

FINE-GRAINED PARALLELISM
Fine-grained parallelism has been defined in computer science as a way of configuring a computer with many small-capacity processors, enabling a programme to be broken down into a number of smaller tasks. Whereas a computer with several large processors can be efficient in executing a heavy work, a large number of small processors makes the whole amount of work to be evenly distributed to them; hence 'fine-grained parallelism facilitates load balancing' (Barney 2021).

| (a) | (b) | (c) |

Figure 1: Examples of Fine-grained parallelism in spatial planning
Source: Author's own photos from Newcastle upon Tyne, UK

The same logic can be applied to architecture and urban planning, especially during the time when a crowd needs to be dispersed to reduce density. It has been tested in many cities across the world during the COVID-19 pandemic that buildings and road networks are reconfigured to allow finer distribution of vehicular and human movements. Corridors were marked with arrows for smooth flow of users (figure 1a); building entrances were assigned a single direction of movement for entering or exiting (figure 1b); and street lanes were subdivided to separate different modes of traffic (figure 1c). These examples show how cities

can respond to the density distribution problem by simply changing the way we use the existing built environment.

Based on the hierarchy of built environment, fine-grained parallelism can be implemented at four distinct levels: the floor level, the building level, the block level, and the urban level. Thus, the urban system is defined in this paper as a spatial continuum that interconnects indoor and outdoor spaces. Inclusion of the indoor space, in particular the domestic space, is essential in the discourse of post-pandemic city planning since it has been proven to be one of the major locations for virus infection (The Health Foundation 2020). Table 1 outlines strategies in each level to achieve fine-grained parallelism. Three essential strategies were selected for each level, totalling twelve strategies. They are all different in terms of their scope and scale but they all aim to achieve a maximum degree of density distribution of people by providing more diverse routes and occupiable spaces. Diversified routes will provide navigational options for movement efficiency, and more occupiable spaces will provide habitational options for spatial flexibility. By increasing the capacity of movement and space use, fine-grained parallelism enhances urban resilience.

Table 1: 12 Design Strategies for Fine-grained parallelism

Levels	Strategies for Fine-grained Parallelism	min. degree of intervention
Floor level	· Ring connection of rooms	remodelling
	· Options of open and closed plans	remodelling
	· Supplementary spaces on the periphery zone	remodelling
Building level	· Pocket spaces in communal corridors	rebuilding
	· Comfortable and inviting staircases	remodelling
	· More building entrances and lobbies	remodelling
Block level	· Smaller perimeter blocks and courtyards	rebuilding
	· More shops and civic facilities along the street	remodelling
	· More dynamic and walkable routes	redefining
Urban level	· Subdivision of roads for various movements	redefining
	· Well-connected pedestrian network	redefining
	· Reinvigorating niche spaces & unused roads	redefining

Source: author

In implementing these strategies, there are three different degrees of intervention: redefining, remodelling, and rebuilding. The column on the right in table 1 indicates the minimum level of intervention needed to implement each

strategy. Redefining is the least energy consuming approach by which an existing building or urban structure is re-configured without demolition or construction. Thus, subdividing lanes for movement and repurposing the existing entrance in figure 1 fall into this lowest level of intervention. Remodelling normally involves partial demolition and partial construction, requiring a medium level of energy consumption. Finally, rebuilding is the most energy consuming approach that requires a whole-scale demolition and construction. These three levels of intervention provide indices on how much impact each strategy will make on the environment. It looks evident from table 1 that the degrees of intervention at the urban level are all redefining while other levels have mostly remodelling or rebuilding. With minimum changes, the urban-level spatial setting can quickly respond to environmental crises such as pandemics, while those in other levels tend to take a longer time and more resources to deal with them. In the following sections, a selection of successful cases will be analysed to show how fine-grained parallelism has been incorporated in their design approach.

EMPERICAL ANALYSIS OF 12 STRATEGIES
FLOOR LEVEL
The first strategy for fine-grained parallelism at the floor level is *ring connections of rooms*. When two rooms are connected to each other without mediation of a corridor, they create a room-to-room enfilade. When more rooms are linked in this manner to make a loop, the interior space embeds a ring structure where any room on it necessarily has two complementary access points from neighbouring rooms. A ring provides a higher level of flexibility in room use since rooms on it can be either independent or interdependent in its function. In other words, it gives an option whether a room's function be confined within it or spills out to neighbouring spaces (Seo 2013). This is particularly beneficial for domestic space because home activities can be easily re-distributed in a flexible way to support changing demands in time. Being reached via two separate routes, the room on a ring can control privacy and communication as well as functional interchangeability (Leupen 2005, Bijdendijk 2005).

Figure 2: Fine-grained circulation and activity distribution by addition of winter gardens in the front facade of Bordeaux social housing in France
Source: www.archdaily.com; Photos by Philippe Ruault and axonometric modified by the author

Figure 2 shows a social housing scheme in Bordeaux, France remodelled in 2016 by adding an extension at the front side of the elevation for winter gardens. Before the remodelling, the typical unit plan has rooms accessed via a central corridor as in figure 2(b). The plan did not provide any flexibility in terms of activity distribution and movement choices with all rooms disconnected from each other by the corridor. By adding a winter garden that stretches across the three front-side rooms, rings emerged as in figure 2(c), providing flexibility in circulation. The project also achieved two other strategic goals of fine-grained parallelism. With the existing front windows converted to full length glazed sliding doors, the winter garden can be either integrated with or separated from the front rooms. By implementing the second strategy of *options of open and closed spaces*, it benefits users to gain control over their spatial configuration (see Burkus 2016).

The addition of winter gardens also achieves the third strategy of *supplementary spaces on the periphery zone*. It provides an extra zone on the outer perimeter that can be utilised for the function of sanitisation, open-air relaxing, home-office working and gardening, all of which became crucial element over the course of the pandemic. Post-pandemic homes are expected to have new types of spaces such as a vestibule with sinks and storages, an internal third place to relax, green spaces, outdoor spaces, and home offices (Duncan 2020; Feintzeig 2020; Blackall 2020; Crawford 2020); and they are all likely to be allocated on the perimeter zone. In this regard, an 'elaborated boundary' can be an emerging design trend post-COVID-19 to fend off a hostile outdoor

environment while providing an extra space to accommodate the lockdown mode of domestic life.

BUILDING LEVEL
All three strategies at the building level aim to provide more occupiable spaces within the navigational system for better dispersion of building users. The first strategy of *pocket spaces in communal corridors* is to reduce the movement friction on a long corridor which typically has no niche space (Levitt and McCafferty 2019, p.51; Mayor of London 2020a, p.53).

The photo in figure 3(a) shows a communal corridor in a residential building that is detached from the building mass in a way to provide a small entry zone to each flat. The main purpose of this is to offer each flat a transitional space as well as visual and acoustic privacy but it has a potential utility as a temporary niche space to step aside when a multiple number of people are moving. Figure 3 (b) shows an entrance hall where a comfortable, bright, and attractive staircase is well positioned for easy access. *Comfortable and inviting staircases* will encourage users taking it more often and reduce the chances of using crowded elevators (City of New York 2010, p.78). Figure 3(c) represents the concept of the third strategy at the building level: *more building entrances and lobbies*. A multiple number of entrances will lead to different clusters of flats in a building, distributing people's movement (The National Affordable Homes Agency 2007, 2.1.5; Mayor of London 2020b, p.14). To maximise this effect, a single entrance hall can have two entrance doors from each side of the building and a shop on the ground level can have their own entrance as in the photo.

(a)   (b)   (c)

Figure 3: (a) Communal corridor with entry zones to units; (b) a hall with an inviting staircase; (c) a residential building with many entrances and halls
Source: (a)(b) The Housing Design Handbook, p.53 & p.280; (c) Neckabrogen development: Gestaltungshandbuch, p.47

BLOCK LEVEL

A block is a basic unit of urban grid system normally defined by streets around it. It may be occupied by a single estate developed at the same time, or by many separate buildings developed in different times. Smaller blocks (ideally 80 to 100m on each side) as in figure 4(a) will help distribute the traffic of cars and pedestrians by increasing the total length of road network and the number of intersections (Llewelyn-Davies 2007, p.58; The Department of Transport 2007, 7.3.13; Jacobs 1961, p.196; Sim 2019, p.25; Speck 2018, p.89). Thus, the first strategy of *smaller perimeter blocks and courtyards* enables spreading of the traffic density. This also helps implement the second strategy, i.e. *more shops and civic facilities along the street*, that makes a self-sustained neighbourhood within a walking distance as in figure 4(b) (Birkbeck and Kruczkowski 2016, 2a). To further vitalise the street environment, it is necessary to generate transparent and human-scaled shop fronts with an attractive frontage zone with plants, benches, tables, and awnings which is often called 'active facades', 'sticky edges' or 'soft edges' (Speck 2018; Gehl 2011; Llewelyn-Davis 2007, p.85). The third strategy at the block level is *more dynamic and walkable routes*. In contrast to the wider urban fabric where pedestrians are naturally given multiple options to move from one place to another, urban blocks tend to have a limited number of routes within their boundary. Various types of fast and slow passages will support different trip purposes, potentially distributing movements.

(a)   (b)   (c)

Figure 4: (a) Smaller perimeter blocks in Heilbronn Germany; (b) Residential project in Vienna, Austria with shops on the ground floor; (c) Kings Crescent social housing regeneration, London, UK
Source: (a) https://woehr.de/en/project/heilbronn-neckarbogen.html; (b) http://karakusevic-carson.com; (c) ©Daniel Hawelka: www.tovatt.com/projects/buildings/d10-3/; modified by the author

Figure 4(c) illustrates the masterplan of Kings Crescent social housing regeneration in London where grey perimeter buildings are existing houses refurbished and white buildings inside are new builds. The success of this project lies in its shaping and allocation of new builds in a way to form six small clusters. Each cluster enclosing a human-scaled courtyard, it cultivates small-bubble

interactions between residents. This configuration also inscribes a finer degree of internal pedestrian network as indicated by red arrows. The project is an excellent example of fine-grained parallelism. The regeneration clearly increased the density, but it split the existing scheme into smaller clusters and provides a wider variety of route choices for residents.

(a)   (b)

Figure 5: (a) Livingroom of the Sonnwendviertel, Vienna, Austria; (b) Via Verde affordable housing in New York
Source: (a) © Photo by Bruno Klomfar; https://www.vlst.at/en/prj/sonnwendviertel/#51; (b) © Photo by David Sundberg; https://grimshaw.global/projects/via-verde-the-green-way/

The third strategy of providing more walkable routes does not have to be implemented on the ground level. It could happen above the ground or on the roof top. The social housing project Livingroom of the Sonnwendviertel in Vienna, Austria in figure 5(a) adopted bridge connections between buildings and the affordable housing project Via Verde in New York in figure 5(b) linked several buildings of different height to provide a spiralling roof garden walkway starting from a ground level courtyard. Offering many alternative routes for various trips within a block minimises the concentration of moving bodies at any moment.

URBAN LEVEL
Fine-grained parallelism at the urban level also shares the same strategic goal of achieving diversification of movements and space use that helps spread density. The first strategy is *subdivision of roads for various movements*. Separation of different modes of traffic on the road has long been recommended for safety and efficiency (Department of Transport 2007, 4.2.4; Secured by Design 2019, 8.8). During the pandemic, it became more crucial to refine the urban flow system to decrease the level of friction. Many cities around the world redesigned their streets to establish multi-modal street lanes for uninterrupted and separate flows. Figure 6(a) shows Grey street in Newcastle upon Tyne in the UK which used to be a four lane vehicular road with two narrow footpaths along the building frontage. During the COVID-19 pandemic, only a single lane was marked for cars while the remaining lanes were allocated to accommodate bikes, pedestrians,

parking, and outdoor tables for cafes and restaurants. Thus, the same street that used to have only two categories of traffic, i.e. vehicles and pedestrians, now has been redefined to accommodate five.
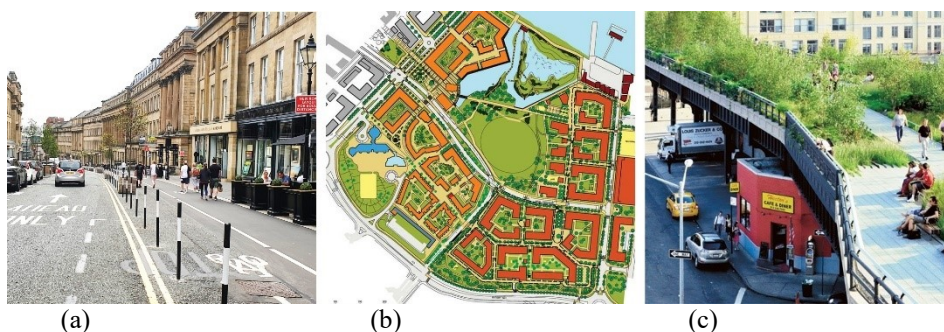

| (a) | (b) | (c) |

Figure 6: (a) Grey street, Newcastle, UK; (b) Greenwich millennium village masterplan, London, UK; (c) The High Line park, New York.
Source: (a) author (b) www.tovatt.com/projects/buildings/gmw-phase-1-village-square/; (c) © Center for Active Design

The second strategy at the urban level is a *well-connected pedestrian network* as shown in the masterplan of Greenwich millennium village in figure 6(b). This also has long been emphasised for a liveable neighbourhood but it became even more crucial for the post-pandemic city planning. Without multiple walkways that are interweaved and stretched long enough, the pedestrian flow would have to eventually converge onto the limited number of major roads, causing concentration of movement. This is why cul-de-sac or dead-end streets are not recommended in many contemporary cities (Urban Design London 2017, p.35; Department of Transport 2007, 4.2.5).

The third strategy of fine-grained parallelism at the urban level is *reinvigorating niche spaces and redundant passages*. There are various types of niche spaces in the city that are often residual and abandoned. Villagomez classified urban niche spaces into eight types: spaces between, spaces around, rooftops, wedges, redundant infrastructure, oversized infrastructure, void spaces, and spaces below (Villagomez 2010). What can be also included in this typology is redundant passages that have lost their usefulness. Old cities typically have organically grown roads trapped and fossilised within the urban grid, yet still possessing a narrative value of local history (Seo 2019). Through the lens of fine-grained parallelism, niche spaces and redundant passages provide a huge potential to accommodate various activities. Turning them into pocket parks, gardens, public facilities, attractive walkways, and habitable spaces will reinvigorate our cities. As this conversion will generate small and large destinations as well as enhancing the quality of urban environment, it will lower the load of existing destinations by offering additional spots for strolling,

lingering, and dwelling. Thus, they help redistribute density and reduce potential trip distances. Figure 6(c) shows a disused elevated railway in Manhattan that has been remodelled as a linear park. By creating a popular route out of the abandoned railway, the pedestrian flow can be effectively spread out to mitigate the concentration in other routes in the city.

CONCLUSION

When the centre fails in a centralised system, the damage is critical, but the decentralised system with many small centres can still operate even when many of them fail. The purpose of fine-grained parallelism in urban planning is for load balancing, i.e. evenly distributing the density in main routes and destinations to multiple locations. Hence it is a way of implementing decentralisation by reconceptualising the existing urban fabric. Twelve strategies for fine-grained parallelism have been discussed in relation to real-world cases. They all aim to achieve density distribution of people through diverse routes and occupiable spaces. Diverse routes provide navigational options for movement efficiency while occupiable spaces provide habitational options for spatial flexibility – hence urban resilience. With varying design approaches, these twelve strategies operate at four different levels of built environment, ranging from building floor plans to urban networks, which when put together make a spatial continuum of the urban system. Three degrees of interventions, i.e. redefining, remodelling, and rebuilding, were also introduced in table 1 to gauge the minimum amount of energy consumption each strategy would require in its implementation. This revealed that urban-level interventions can be implemented more quickly and easily owing to their less energy-consuming strategies of redefining the current system. This also means that it will be more time and energy-consuming at the block level, the building level, and the floor level since they require remodelling and rebuilding as a minimum intervention. Therefore, municipalities and stakeholders need to make changes in their urban policy framework to set new criteria for long-term planning goals by incorporating the dimension of post-COVID-19 resilience.

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REFERENCES

Almagro, M. & Orane-Hutchinson, A. (2020). JUE insight: The determinants of the differential exposure to COVID-19 in New York city and their evolution over time. *Journal of Urban Economics*, (October), 103293.

Badger, (2020). A manifesto for planning after the coronavirus: Towards planning of care, *Planning Theory*, Vol.19(3), 329-345.

Birkbeck, D. & Kruczkowski, S. (2016). *Building for Life 12*, Edition 5, Building for Life Partnership.

Bijdendijk, F. (2005). Solids, in *Time Based Architecture*, 010 Publishers, Rotterdam.

Blackall, M. (2020). Lockdown UK: 'There are now two classes, people with gardens and the rest of us', *The Guardian*, Thu 23 Apr 2020.

Burkus, D. (2016). *Under New Management: How Leading Organisations are Upending Business as Usual*, Macmillan, London.

Carozzi, F, Provenzano, S. & Roth, S. (2020). *Urban density and Covid-19*. London: London School of Economics and Political Science.

Center for Active Design (2020). *Building Health for All in the Face of COVID-19*, FITWEL.

City of New York (2010). Active Design Guidelines: Promoting Physical Activity and Health in Design, Mayor Michael R. Bloomberg.

Crawford, I. (2020). The Domestic New Deal, in *The e-paper about the future of shared spaces*, Issue 04, Aug 2020, Vitra.

Department of Transport (2007). *Manual for the Streets*, Thomas Telford Publishing, London.

Duncan, A. (2020). Top 10 Design Trends of the Next Decade, *The Wall Street Journal*, 10 Sep 2020.

Feintzeig, R. (2020). It's OK to Miss the Office During the Coronavirus Lockdown, *The Wall Street Journal*, 18 May 2020.

Gehl, J. (2011). *Life Between Buildings: Using Public Space*, Island Press.

Gevers, M. (2020). *Three design lessons for the post pandemic city*, 8/8/2020, Arup.

Hamidi, S, Sabouri, S. & Ewing, R. (2020). Does density aggravate the Covid-19 pandemic? Early findings and lessons for planners. *Journal of the American Planning Association*, 86(4), 495-509.

Jacobs, J. (1961). *The Death & Life of Great American Cities*, Random House, New York.

Leupen, B. (2005). Towards Time-Based Architecture, in *Time Based Architecture*, 010 Publishers, Rotterdam.

Levitt, D. & McCafferty, J. (2019) *Housing Design Handbook*, Second Edition, Routledge, London.

Llewelyn-Davies (2007). *The Urban Design Compendium*, 2nd Edition, English Partnerships and Housing Corporation.

Mayor of London (2020a). *Optimising Site Capacity: A Design-led Approach*, Module A – Pre-Consultation Draft, Supplementary Planning Guidance.

Mayor of London (2020b). *Housing Design: Quality and Standards*, Module C – Pre-Consultation Draft, Supplementary Planning Guidance.

Miller, G. (2020). Density can work post-COVID-19, with good urban planning, in *OPTIONS*, June 8 2020

Osman, S, Abdulla, J. & Nawawi, A. H. (2017). The Financial Costs of Urban Sprawl: Case Study of Penang State, *Planning Malaysia*, 15(2), p.13-24.

Saxena, N. & Chidambara (2016). Implications for Sprawled and Compact Development on Mobility Patterns: A Case-study of Bhopal, India, *Planning Malaysia*, Special Issue IV, p.353-368.

Secured by Design (2019). *Secured by Design: Homes*, Version 2, March 2019, Official Police Security Initiative.

Seo, K. W. (2013). Interpretable Housing for Freedom of the Body. *Journal of Building Construction and Planning Research*, 2013, 1, 75-81.

Seo, K. W. (2019). Oxcart Route in the City: Tracking the Urbanisation Process of an Agricultural Village in Korea, *Sustainability*, 2019, 11, 2153.

Sim, D. (2019). *Soft City: Building Density for Everyday Life*, Island Press.

Speck, J. (2018). *Walkable City Rules: 101 Steps to Making Better Places*, Island Press.

Stevenson, M, Thompson, J, Herick de Sa, T, Ewing, R, Mohan, D, McClure, R, Roberts, I, Tiwari, G, Giles-Corti, B, Sallis, J, Sun, X, Wallace, M. & Woodcock, J. (2016). Land-use, transportation and population health: estimating the health benefits of compact cities. *Lancet*, Dec 10; 288(10062): 2925-2935.

The Economist (2020a). *The end of commuterland*, September 12th 2020.

The Economist (2020b). *Convenience stores may benefit from Covid-19 – if they adapt*, October 17th, 2020.

The Health Foundation (2020). *Better housing is crucial for our health and the COVID-19 recovery* <www.health.org.uk/publications/long-reads/better-housing-is-crucial-for-our-health-and-the-covid-19-recovery> accessed 15 Feb 2022.

The National Affordable Homes Agency (2007). *721 Housing Quality Indicators Form*, Version 4 (For NAHP 08-11), Updated April 2008, Housing Corporation, UK.

Urban Design London (2017). *The Design Companion: For Planning and Placemaking*, RIBA Publishing, London.

Villagomez, E. (2010). Claiming residual spaces in the heterogeneous city, in *Insurgent Public Space*, ed. Hou, J. Routledge, London.