

LONDON CALLING

OFF-SITE BUILDING STRATEGIES FOR HOUSING DEMAND: THE UK CASE

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ABSTRACT

Today, a strong re-proposal of building prefabrication is at the basis of the new housing policies that can be detected in main evolved industrial contexts. Off-Site is the word through which the theme of prefabrication seems to recur under new auspices. Among the Countries of the European continent more involved in this new challenge, Great Britain offers several insights, considering its consolidated culture in the field of urban development and its historically dynamic real estate market. Great Britain and its capital, in particular, represent an ideal point of view to understand the potentialities and the criticalities of this new building culture, in the UK explicitly supported by specific housing policies. Starting from the author consolidated interest for technological innovation applied to housing issues and coherently with the historical attention that the same author has over the years perpetrated for the British social, economic and productive context (considered as an advanced context), the paper critically illustrates an innovative housing program underway in the City of London (based on the application of Off-Site production principles), questioning about new prefab housing potentiality.

KEYWORDS

off-site, made-factory, housing, production, innovation

The idea that in the main European Countries since the 1960s, building prefabrication would solve the problems connected with the housing emergency caused by the II world war first, and the industrial development later, has been a ‘dream’ that has rarely been reflected in reality. Often presented as an innovative way to create a new generation of high-quality housing and to solve quickly a large housing demand, the prefabricated systems generally failed their task. Actually, they allowed building, in the space of some decades, with relatively contained costs and high profits, a huge low-performance housing stock, generally unfit to satisfy inhabitants’ needs and their aspirations. Some Countries in particular, such as the UK and French, were the ‘driver’ of what we can now consider a ‘betrayed revolution’, in relation to some enthusiastic position spread in those years in many European political environments. In the UK, the Country on which this paper is mainly focused, Richard Crossman, Labour Minister for Housing and Local Government between 1964 and 1966, declaring his idea to ‘forge’ a new Britain in the ‘white heat of technology’, stated that «the new factory-built housing can be just as good as production-line cars [...]. The only thing is to make sure they are done by good architects and well landscaped, that will get over any danger of monotony; the main

thing is you standardize the production» (NLA Research Report, 2018, p. 5). Today we know that, in most cases, the result of this idea was a large stock of prefab housing made by gigantic, monotonous buildings and shoddy architectural figures, really far from local living cultures. The twentieth-century productive culture, based on the standardization of industrial components, produced, even in the best examples of innovative and ‘illuminated’ design, a large number of neighborhoods which became, after few years, a social, urban and technological emergency.¹

Nevertheless, the ‘idea’ to combine the promise of an industrialized building with the dream of a popular mass-market for architecture «has exercised a magnetism over architectural culture» that continues still today (Smith and Quale, 2017, p. 77). This is also demonstrated by the recent Robin Hood Gardens controversy (Fig. 1), the querelle about the famous (cult object for many architects) residential complex designed in London by Alison and Peter Smithson in the late 1960s which, despite the tenacious opposition of a significant part of Anglo-Saxon (and not only) architectural culture, will soon be demolished². In any case, in Europe the word ‘prefabricated’ has never recovered its bad reputation in public opinion. The failures of the 1960s building policies have been a huge setback that, still now, makes many people associate the prefab housing to an idea of bad quality and speculation.



A new technological scenario – In the last decade the technological scenario has changed. Referring to building production in advanced industrial contexts like Sweden, Netherlands, the UK and, outside the European continent, the USA and Japan (i.e. high-industrialized countries with a consolidated culture in building prefabrication), we can notice how the ‘dream’ of a high-quality prefab housing is now not far from becoming a reality. Unlike the 60s, when concrete was almost the only material available and the Henry Ford production system was the main reference model, today a greater variety of materials, structure, cladding and, above all, tools and production methodologies are available (Figg. 2, 3). This explains the birth of a new concept of prefabrication applied to Architecture, supported by digital technologies and capable of supplying high-quality products: efficient, sustainable, flexible, i.e. adequate to the current standards and, in the field of housing, to the users’ expectations. If the first wave of building industrialization was dominated by a logic based on the repetition of a small number of different elements produced through mass production, the second wave of industrialization is coming, characterized by advanced IT technology and high-tech manufacturing processes.

This development is often named New Industrialization and both as a concept and as a production process, it derives from an advanced concept of industrial production,



Fig. 1 - Previous page. Robin Hood Gardens, London (Alison and Peter Smithson, 1972).

Fig. 2 - Factory production line.

Fig. 3 - Transport operation of a façade component, all factory-assembled.



supported by new computer technology and new business models. In particular, the widespread of Building Information Model (BIM) and the software connected to this approach matches perfectly with this new industrial production mindset. Indeed, working in BIM environment, it is possible to provide a complete, shared digital model of a project, down to the detail of every component. This not only enables much more comprehensive collaboration between different design and production operators but allows more efficient monitoring of information and workflows, according to the typical industrial process of production. As a consequence of the Digital Revolution, this New Industrialization is not only concerned with efficient production but also with establishing new organizational patterns and structures of collaboration between the many different actors engaged in construction. These changes are primarily based on technological, organizational and collaborative dimensions, not on architectural visions. Nevertheless, they do have a decisive impact on the way architecture is conceived.

Off-Site construction: prefab housing is back – To better understand this new ‘wave’ of prefab housing it is necessary to explore the multitude of terms today used to describe it. The terms vary between Countries as well as across industry, academic and policy domains, but generally the word Off-Site (followed by building or construction) can be considered the current translation of the original term Prefabricated. In particular, in the USA, the spectrum of applications where buildings, structures or parts are manufactured and assembled remote from the building site prior to installation in their final position is described as Off-Site Construction Techniques (OSCT). Differently, in the UK the expressions Off-Site Manufacturing (OSM) or Off-Site Construction (OSC) are used to refer to «the process of planning, designing, fabricating, transporting and assembling building elements for rapid site assembly to a greater degree of finish than in traditional piecemeal on-site construction» (Blismas and Wakefield, 2009, p. 72).

As seen, this change of name to describe prefabrication derives not only (but also) from a question of brand (in relation to the reluctance, in particular in European context, to use the term Prefabricated because of negative connotations resulting from postwar failures); it depends also on the new philosophy of intending buildings and, then, Architecture, as a manufacturing activity; a mindset due evidently to a new technological background. If ‘quantity’ was the driver of the first prefab construction, ‘quality’ seems to be the new password of Off-Site Construction, meaning for ‘quality’ not only the intrinsic quality of the final product, but also the process quality, i.e., between others, the speed of delivery, construction health and safety, energy in use, whole-life carbon footprint and reduced transport pollution. «Housing not only faster but better, to avoid to repeat the mistakes of the past», this is the new promise connected to Off-Site Construction.

Refusing the ‘one-size fits all’ approach, typical of the first age of mass prefabrication, and using the current technological ‘know-how’ based on the digitalization of design and production processes, the Off-Site approach, in many current experiences, has

demonstrated to succeed in providing a new generation of housing, characterized by a huge range of different solutions and innovations that can be adapted to different conditions and requirements. In this way, housing can be conceived as a ‘tailor-made’ industrialized product, very close to other kinds of evolved industrial products like cars (Fig. 4-6). This second chance for prefab housing derives not only from the digital upgrade of design and production processes. It is also the answer to the construction industry to a new, large, housing demand, which involves today many countries and certainly most of Europe. To this market ‘pressure’, that in some areas of our continent is becoming a real emergency, generally, the building industry has not been able to reply, also because of structural weakness. In his report, entitled *Modernise or Die*, Mark Farmer, CEO of Cast Consultancy for the UK Construction Leadership Council, in 2016 used a medical analogy to define the British construction industry crisis, common to many Countries. In particular, Farmer stigmatized the motivations of the crisis indicat-



Fig. 4, 5 - Building site as ‘assembly’ place; Prefab housing module, just before to be ‘plugged’.

Fig. 6 - 18 Floors in Wood: Student Residence in Vancouver designed by Acton Ostry Architects and Schwarzach’s Hermann Kaufmann Architekten.

ing, among others, low productivity, fragmented leadership, lack of collaboration and shortage of investment in innovation. At the same time, he indicated in *Modern Methods of Construction* and, in particular, in *Off-Site Construction*, the best cure (Farmer, 2016).

The UK in the international context – Japan and Sweden have long been established as leaders in this field. Up to 90% of single-family homes in Sweden are ‘factory-built’, while available figures from Japan showed that the Off-Site manufacturing sector has in recent decades resulted in up to 160,000 properties per year or about 14 to 20% of the annual total. Other countries such as Germany and the Netherlands, which have been identified as having highly efficient traditional or ‘craft-based’ house-building industries, also have significant levels of Off-Site production. The USA and Australia sit alongside the UK as countries where manufacturing has been employed less frequently, generally to ten per cent or less of total housebuilding (Smith and Quale, 2017). In terms of the future global picture, a 2016 study forecast that worldwide demand for prefabricated housing would increase 2.7 per cent per year to 3.4 million units in 2019, with advances in overall housebuilding – as well as greater take-up of factory-made systems and components – likely to occur in the Asia/Pacific region, Africa and Middle East, and Central and South America³. In these regions, demand will likely increase for both low-cost, multioccupancy housing units and high-quality homes for more affluent residents, especially in urban areas with high population growth. China is also taking a lead in cutting-edge construction techniques: in 2015, Chinese company Broad Sustainable Building, for example, reportedly completed a 57-storey skyscraper housing 800 apartments alongside office space in just 19 days, using modular Off-Site construction methods (with more than 2,500 individual modules) to complete three-storey daily (Steinhardt and Manley 2016).

Among the Countries today more focused on this point there is certainly the UK, a strong-industrialized Country where a rooted culture of ‘transformation’ of the urban environment matches with a traditionally dynamic real estate market. The UK and its capital, in particular, represent an ideal and original field of observation to better understand the potentialities and the criticalities of this new culture of factory-made Architecture, in the UK explicitly supported by specific policies, that would be welcome in other countries like Italy, for example, where building production and new housing market are too feeble to create new development conditions. Over the last 20 years, the economic productivity in the UK has risen by over 30% and productivity in the manufacturing sector has grown by over 60%. In contrast, productivity in the construction sector has increased by just over 10% (WPI Economics Report, 2017, p. 6).

That’s why the UK government has identified *Modern Methods of Construction* (MMC) and, in particular, *Off-Site Construction* as a key vision for meeting the UK housing needs, considering that the UK expresses today, in the main urban areas, a strong housing demand. In this regard, the recently published government White Paper (February 2017), reports how the UK needs 225,000-275,000 or even more homes to be built

per year to keep up with population growth. This indicates as to what the Off-Site market size could be⁴. The White Paper summarizes in some points the new UK housing strategy. Some of those points seem to be particularly relevant to our focus: «an expanded and more flexible affordable homes program, for housing associations and local authorities, with £7.1bn of already announced funding; smaller building firms will be given assistance to expand, including support for Off-Site construction, where parts of homes are assembled in a factory». The White Paper was followed by the Construction Sector Deal announced by the Department of Business, Energy and Industrial Strategy (BEIS) in July 2018, in which the Government promised to invest £420 million in ‘bytes and smart mortar construction’ through the use of digital design, new manufacturing technologies and Off-Site manufacturing, as well as procurement. In this delicate phase of UK policy, where the Brexit makes impossible a serious forecast on the country future economic asset, the developing of Off-Site Building is, on many sides, seen also as a new export opportunity for the post-Brexit economy that would be possible just through the modernization of the sector in the Off-Site direction.

London policy – The lack of housing to accommodate a growing population is one of the most challenging issues that London is facing. To reach the Mayor’s target of delivering more than 60,000 new homes in London each year – and indeed the UK Government’s overall target of 300,000 nationally per year – radical new approaches in housebuilding are being sought to accelerate the pace of delivery, at a time when local Authorities have been demanding targets for completion. Factory-Made and Off-Site housing are now being explored and advocated by National and Mayoral policy as one of the key potential solutions to meeting acute housing demand, not only in London but across the UK (Mayor of London Report, 2018). The objective of this new policy is not only referred to the determination to satisfy so large housing demand. In London, the recent Grenfell Tower tragedy raised urgent questions about the safety and quality design of some existing buildings so as new building.

On this regard, the Mayor’s London Housing Strategy is the reference document where the current London Administration sets out its vision for housing, declaring the aim to invest over £4.8bn of affordable housing up to 2022⁵. In this document Mayor explicitly promote the new technological opportunities linked to Off-Site construction, also informed by an influential report by the London Assembly⁶. This urged the Mayor to galvanize the sector by measures such as developing and adopting a Manufactured Housing Design Code that would generate a component standardization ‘catalogue’ approach that can then be configured in multiple combinations as part of a specific design response. The Mayor report explicitly refers to the need for supporting and promoting the modernisation of London’s construction industry through more precision manufacturing of homes, but also «working with the housing industry to promote greater standardisation of precision-manufactured homes, [...] negotiating a share of the Accelerated Construction Fund to be used flexibly in London to support the shift to more precision

manufacturing of homes, [...] making the shift to more precision manufacturing of homes a key priority for investment in London's skills system» (Mayor of London Report, 2018, p. 84).

After declaring his general strategy for London housing problem and adopting a clear position on behalf of Modern Method of Building, according to a Factory-Made and BIM approach, in April 2018 the Mayor commissioned Cast Consultancy (Real Estate & Construction Consultancy) and Bryden Wood (a multidisciplinary design group) a survey focused a digital toolkit with design principles and guidance to assist designers and clients in understanding where and how different Factory-Made e approaches can be applied. On those bases, London's built environment industries are now developing and delivering innovative and high-quality Factory-Made housing in a huge variety of contexts, forms and tenures, from individual houses on small sites to large-scale developments in major areas of opportunity (Fig. 7-10).

London experiences – Manufacturing processes are not only being applied to the construction of large-scale housing but are also disrupting the conventional market for individual detached, semi-detached and terraced homes, especially through customization and self-build. Companies are developing a 'vertically integrated' approach to design, manufacture and construction – often including the building or acquisition of factories – which therefore offers greater control over the production process from beginning to end, and makes the customization of individual homes more viable by offering different permutations around a core, repeatable manufactured element.

Many examples of innovative Off-Site individual homes in London could be done. Robinson Court⁷, for example, consists of five houses from the townhouse range of the Urbane toolkit. Each house is manufactured in a day, and installed in a day on site. These homes follow a clear concept: 'customize the visible, standardize the invisible'. A flexible yet standardized toolkit of homes, developed with their manufacturer, enables all projects – from detached homes, terraces, townhouses to apartments – to surpass national policy and building regulations. All homes are created around a series of pre-designed and easily transportable components – these consist of pre-clad SIPS panels, roof and floor panels, to kitchens and bathrooms. In this example, speed, quality and cost of building, combined with the flexible yet standardized layouts, made up of relatively small components, produces an agile business model which can operate effectively on the full range of challenging London sites from the micro to macro sites. This could be considered a paradigmatic experience in London, imported, in its principles, from Urban Splash's Town House⁸ concept based on the customer purchasing a home by space rather than the number of rooms. In the Town House the core element is a standardized shell with a stair, kitchen and bathroom pod, from which the purchaser can select sizes, living spaces and layouts, again in an enormous variety of possible arrangements to suit their needs and lifestyle. The complete home can be produced in the factory and delivered to site or the purchaser can choose to fit out the shell themselves. In other examples, at-

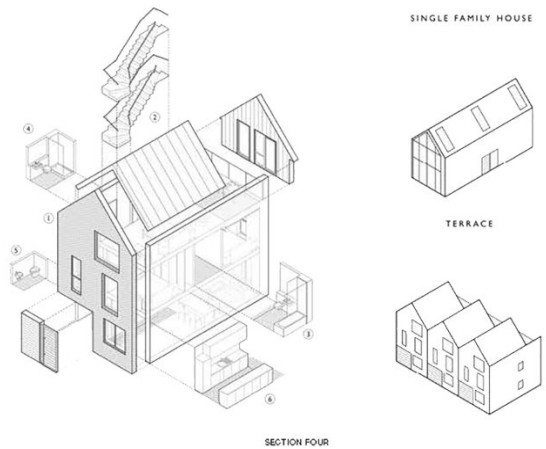


Fig. 7 - Town House in new Islington, Manchester (Shedkm Architects, 2016).

Fig. 8 - Robins Court in London (Surface to Air Architects, 2019).



tention has been focused recently on how innovative manufactured homes can be suitable for constrained and infill sites. Cube Haus⁹, is working to deliver high-quality customized CLT homes for small urban sites with simple material palettes manufactured in the UK; these will be commissioned and installed by the company or available as a self-build solution.

Being quicker to build, reducing noise, waste and pollution on-site, and offering flexibility and adaptability on site through the use of repeated elements, Off-Site housing has seen its biggest take-up to date in London for larger-scale apartment blocks, hotels and student accommodation. This has emerged alongside the rapid growth of the build-to-rent sector. Employing prefabricated modules and fit-out materials such as CLT for such developments enable design and construction to be completed, sometimes up to a year earlier than those using traditional methods, as in HTA's Apex House¹⁰, a 29-storeys the tallest modular building in Europe. Faster completion times mean that residents can move in earlier and the building's owner or operator can make a return on investment more quickly. Yet the sophistication and customization of prefabricated systems and building elements available today mean that these high-rise developments, while often containing stacked units, can respond to local context and character effectively through distinctive massing, choice of materials and facades, quite unlike the uniform towers of the modernist era; just one recent example is the green terracotta-clad Mapleton Crescent designed by Metropolitan Works for Pocket Living. Using frames, panels and modules produced Off-Site can not only result in fewer deliveries but easier and quicker installation in constrained areas, making them especially appropriate for infill sites and the drive to support housing growth through the intensification and densification of places in and around London's town centers and transport hubs. In the same way, the lighter weight, adaptable configurations and need for minimal foundations mean that prefabricated systems can be especially suitable for opportunities to build over rail and tube lines and on top of existing structures. One of the most significant recent examples is Waugh Thistleton Architect's Dalston Works¹¹, the world's largest CLT building for affordable and private rent; constructed over the proposed Crossrail 2 line, it weighs only 20 per cent of a similar structure in concrete.

Factory-Made housing can provide innovative and high-quality temporary as well as permanent solutions to urgent housing need in areas undergoing long-term regeneration and/or for brownfield sites. The Y:Cube project¹² designed by Rogers Stirk Harbour + Partners for YMCA London South West in Mitcham, completed in 2015, is a pioneering example of affordable housing comprising self-contained factory-made units with services already incorporated, that can be taken down and reconstructed in other locations, and to which additional units could be added. Y:Cube Housing is a modular system

Fig. 9, 10 - Previous page. Prefab housing 3D module assembly; Ladywell in Lewisham, London (Rogers Stirk Harbour + Partners, 2016).

using volumetric technology that enables the factory-made units to stack easily on top and/or alongside each other, making it completely adaptable to the size and space available and therefore perfect for tight urban sites, creating semi-permanent communities. It is not designed to provide long term accommodation, but to act as a transition between temporary accommodation and market housing.

Conclusions – Using Off-Site methods primarily to design and build any type of new home on any scale requires a complete rethink of established attitudes to commissioning, procurement, finance, design and construction. Off-Site building put in crisis the conventional construction industry and represent an opportunity to explore new and flexible building typologies adapted to living and working in the 21st century, and to take full advantage of innovations such as digital planning to make decision-making quicker and more agile. That is what is now experienced in some advanced Countries with a strong industrial production tradition. In this context, the City of London is an exceptional case-study, where the speed and the variety of the urban, social and technological processes is pushing innovation in building towards a new and unexplored target. London and other experiences show as, today, Off-Site Construction methods come with a wide range of potentially large productivity, economic, social and environmental benefits. Between its current key-benefit, we can mention some main questions that emerged clearly from the example previously showed and from a larger analysis of current London experiences.

Speed and Reliability of Delivery. It has been estimated that Off-Site housing can be built 30% more quickly with 25% lower costs. Normally, on-site methods are impacted significantly by the weather, site conditions and access conditions (Oliveira et alii, 2018).

Reduced Costs. Although it is a controversial point, some observers state that the increase in quality in building deriving from off-site construction methods implies a reduction in building costs (linked to the simplification of construction phases) and, above all, in the maintenance (linked to the increased level of quality of the buildings). Off-Site housing (especially for high rise social housing) could be more expensive than traditional in-situ construction. Although, some observers found that it could achieve lower overall costs by incorporating the construction time reduction because of lower material and labour cost in the place of production (Jaillon et alii 2009).

Improved and More Consistent Quality. These benefits typically arise from the fact that the factory environment facilitates the use of tighter controls and more consistent and standardized processes. Vastly improved materials and quality control within the factory can exponentially reduce variation and potential defects, as well as provide quality assurance and rigorous testing on aspects such as acoustic and fire performance, durability and structural resilience. As well as the obvious benefits of improved quality, this drastically reduces the need (and associated costs) of re-design and re-work.

Improved Safety and Workforce Satisfaction. Off-Site Construction has the potential

to significantly reduce the risk of accidents and ill health. The HSE¹³ list a range of potential advantages, including that it provides a controlled, clean and warm environment, uses production line techniques and standards, reduces the need to work at height or below ground and reduces exposure to UV rays.

Reduced Environmental Impact. The principal new force bearing on construction is the climate crisis. Improved performance and quality certainly lead to reduced energy costs and waste. Furthermore, by reducing traffic flows to and from the construction site, there are significant benefits in terms of congestion and, by implication pollution in the local area. Recent research based on case-studies has suggested that projects using Off-Site construction can deliver a reduction of between 20% and 60% in metric tons of CO₂ associated with project transport. Likewise, the energy use associated with the completed assets can also be lower. This is a result of the fact that Off-Site construction is generally associated with higher and more consistent building quality, for example, leading to improved air-tightness. Estimates suggest these savings could be as high as 25% over the asset life.

Flexibility and Customization. The variety of systems and materials in use means that there is a solution for almost every site and scale of project, and the interchangeability of many components can allow a greater diversity of form and typology. Modular constructions especially can be assembled and de-constructed for relocation and reuse. This focus has been successfully employed both from the market and from some advanced research. As an example, in the first case, the urban developer Urban Splash in Manchester (UK) gives consumers different options through selected combinations, with a focus on space instead of rooms. Rather than selling homes on the number of bedrooms, as is usually done, Urban Splash idea is to encourage the customer to work out how much space they want and then how they want to use it to suit their family circumstance, their lifestyle and their budget. This gives our customers the ability to curate their new homes to suit how they actually want to live. With regard of research experiences, at the Advanced Manufacturing Research Centre at the University of Sheffield, pick and place robots can assemble a stud wall in one operation, and with changes in automated tools, they can produce many design variants with flexible fixturing.

Offering a really flexible and adaptable product to different needs is probably the more attractive result of this new kind of prefabrication. It also can allow Off-Site Construction to better compete in the housing market. In this way, it is possible to imagine a real tailor-made housing stock but at affordable prices. This new concept can be defined of course as ‘standardization’, but with controlled and researched variations (options!) in relation to client requirements or aspirations for their housing units. As final result of this essay – that however represents the first outcome of a research path undertaken by the author in the field of innovative housing processes in Europe, with particular focus on the UK – there are two questions involving the figure of Architect that is here considered strategic and that deserve to be developed in the research prosecution.

The reported positive consequence of Off-Site method needs of a new design and building approach that not only concerns, as already said, digital technologies and design tools, but also the operators of the construction (modifying their conventional roles) and the logistics of the building site. Where traditional construction is characterized by waves of trades passing over the site in alternating sequence, in the new model the workflow foresees the contemporary development of the different construction and design phases. In this scheme, the specialized workers (electricians, plumbers, cabinet makers, wall finishers, ironworkers) and, crucially, the architects and engineers all collaborate side-by-side, sharing information on a single digital model, learning from each other in real-time. About the crisis of the traditional role of the architect in the professional market, considering buildings as an industrial advanced product, it is also possible to imagine a new and more central role of the architect in this process. If, for architects, the role of ‘shape creator’ seems to be relinquished, Off-Site Construction defines a new process where the architect should integrate his traditional expertise with new skills, particularly in terms of ability to deal with complexity and industrial dynamics, to initiate open processes and to create a characterful, strong architecture on industry’s terms. In this scheme, ‘design’ and ‘management’ should be the new pillars of architects’ expertise.

NOTES

1) In the UK, when the failure of the ‘prefab way to housing’ had already become explicit, the 1968 collapse of Ronan Point gave the definitive ‘coup de grace’ to the idea that prefabrication could have been the solution to housing problems. A 22-storey tower in east London fell down killing 4 people and injuring 17. This tragedy dealt a deep blow to public confidence in prefab house and has profoundly shaped perceptions which endure to this day.

2) The interest of architectural culture for prefabrication has its roots also in a previous and noble history which goes from the first half of XX Century pioneering experiences (Gropius, Mies, Le Corbusier, to mention just a few), to the late and heterogeneous experiences of Buckminster Fuller, Jean Prouvé, Konrad Wachsmann, Charles and Ray Eames, Paul Rudolph, Moshe Safdie, and Metabolists in Japan (always just to mention a few). Those and many others explored – sometimes in provocative form, if not always in method – the implications of prefabrication and its corollary, i.e. modularity, in the construction of housing.

3) For more details, see Global Wood Markets. Info on the website: <https://www.globalwoodmarketsinfo.com/prefabricated-global-demand/> [Accessed 18 January 2019].

4) One of the slogans of the White Paper is: «planning for the right homes in the right places». This strategic document also reports that «where communities have planned for new homes, we want to ensure those plans are implemented to the timescales expected [...]. As of July 2016, there were 684,000 homes with detailed planning permission granted on sites which had not yet been completed. Of those building has started on just 349,000 homes».

5) For more details, cfr.: London Assembly Report, (2016), *Designed, sealed, delivered: the contribution of offsite manufactured homes to solving London’s housing crisis*. [Online] Available at: https://www.london.gov.uk/sites/default/files/london_assembly_osm_report_0817.pdf [Accessed 17 January 2019].

6) This vision underpins the five priorities of the Mayor’s London Housing Strategy: building homes

for Londoners; delivering genuinely affordable homes; high-quality homes and inclusive neighborhoods; a fairer deal for private renters and leaseholders; tackling homelessness and helping rough sleepers.

7) The building is about to be completed with a cost of 150 pounds per sq ft. Address: 85 Kings Avenue, Clapham, LB Lambeth, London, SW4.

8) Town house was completed in 2016 with a cost of 1,000 pounds per sqm. It is allocated in Manchester, new Islington, M4.

9) Cube house is in London, Forest gate, LB Newham, E7. It will be completed in June 2019.

10) Apex house has been completed on August 2017 with a total cost of 46 million of pounds per 16,600 sqm. It is in Fulton Road, Wembley, LB Brent, London, HA9.

11) Dalston Works consist of 121 new affordable homes alongside 3,500 sqm of commercial spaces. It has been completed on October 2017 and is situated in Dalston Lane, LB Hackney, London E8.

12) The Y:Cube units are 26 sqm one-bed studios, for single occupancy, that arrive on site as self-contained units. Y:cube Mitcham is the first Y:Cube development, made up of 36-units and the first residents moved into their homes in September 2015.

13) The Health and Safety Executive (HSE) is Britain's national regulator for workplace health and safety. It prevents work-related death, injury and ill health. HSE is an executive non-departmental public body, sponsored by the Department for Work and Pensions.

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