FRAME

THE NEXT SPACE

Can design solve the housing crisis?

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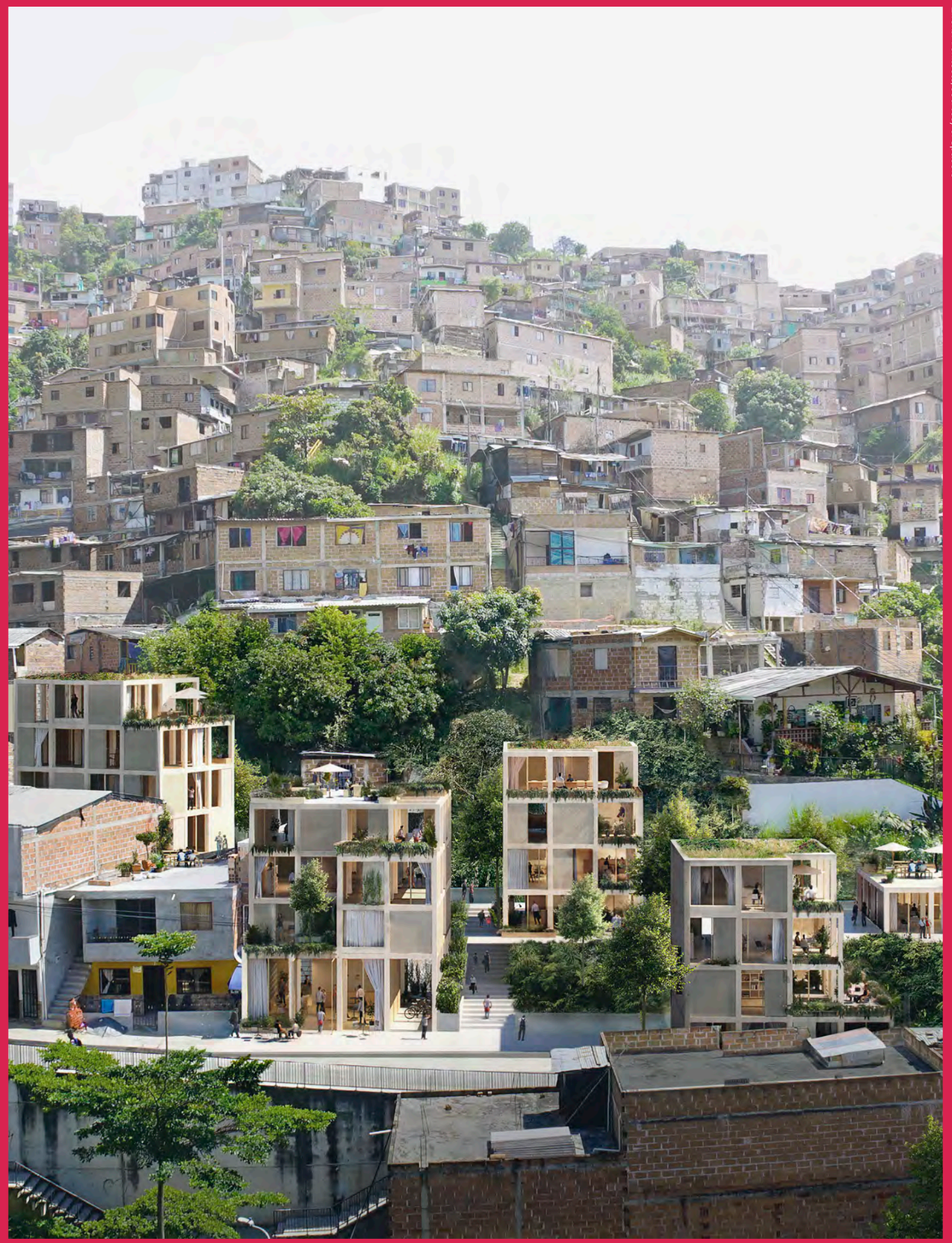


Effekt Architects, courtesy of SpaceIO

Frame lab

LIVING The shortage of adequate and affordable housing has become a global issue that needs to be tackled on many levels. There’s no one-size-fits-all solution, but what about solutions that adapt their size to fit all? Which new technologies could help us build faster than we ever have before? And what types of materials could help us pave the way?

How design can help to combat the housing crisis

Words Tracey Ingram

The United Nations Human Settlements Programme, also known as UN-Habitat, estimates that 3 billion people will need access to adequate housing by 2030. Satisfying that demand would mean building 96,000 new homes every day. Even if such a daunting task is possible, *how* should we be building these new homes? Not the way we typically have been, appears to be the consensus. 'Looking from the outside in, it seems the common approach to creating more affordable housing today is a "let's race to the bottom" approach,' says Simon Caspersen of research and design lab Space10, 'whereby we seek to offer lower pricing by building with cheap, pollutive materials, and cram as many people as possible into small, low-quality homes in big buildings on unattractive land, far away from where the promise of the city lies.'

The term 'social housing', in particular, carries a stigma. 'What generally comes to mind are the failed housing projects constructed in the post-Second World War era, planned low-income communities that had become more blighted than the ones they were meant to replace and improve,' says LOHA founder and design principle Lorcan O'Herlihy. 'From an aesthetic point of view, much of the supportive/affordable housing in the US still immediately conjures up the expectation of cheapness – both in design and construction – and blight that social housing did, a throwaway for people whose lives are considered less virtuous because they have fewer means.'

The problem is just as complex as the network of players involved in its remedy, and we're not saying the design industry has all the answers. As UNStudio's Ben van Berkel says, the issue 'encompasses many scales and requires dedicated action from multiple stakeholders. We really do believe that these stakeholders need to work together to find integrated solutions.' But, he adds: 'As one of the actors in this network, we also believe it's the responsiblity of architects and designers to devise specific and progressive design solutions to tackle the issue.'

Because we're not just dealing with a housing crisis, but also a climate crisis. At the same time, there's a shift towards pooling resources and creating communities. We want – and need – our homes to be more flexible than they've ever been. So, what *can* design do? We examine the materials, methods and master plans looking to answer that question.

Materials

There’s no getting around it: building new homes requires materials. But, taking our planet and its resources into account, do we need to reconsider the materials to which we reflexively reach?

One of what can only be a number of places in the impossible position of needing to rapidly build to remedy the housing shortage while simultaneously lower carbon emissions, Boston intends to construct 300,000 housing units (in addition to a significant chunk of commercial real estate) and reduce its carbon footprint by 80 per cent by 2050 – an unachievable goal, say those behind Tallhouse, if the status quo of carbon-emitting structures is preserved. Designed to shed some enlightenment on such conundrums, Tallhouse is an adaptable catalogue of structural solutions based on mass timber – the result of a collaboration between architecture, engineering and construction technology company Generate and a number of industry leaders. ‘Mass timber is less carbon intensive, is renewable, and brings new value to the protection of our regional working forests,’ says Nicole St. Clair Knobloch, principal of Olifant Market Development, which partnered on the project. ‘This package represents the first time a carbon analysis has been done on real design solutions, costed for a specific metropolitan area – that’s what will help it scale to be a low-carbon building solution.’

Low-embodied-carbon timber is also employed at Flat House, a project by Practice Architecture, which seeks to demonstrate that combining a low-tech approach and biobased materials with off-site construction can create scalable, low-impact architecture that also looks good. For Flat House, though, timber is combined with another low-carbon material: hemp. Located at Margent Farm in England – a rural R&D facility that develops bioplastics with hemp and flax – the three-bedroom home is a prototype to assess the feasibility of building larger houses with hemp-based materials. ‘The housing shortage is mainly an issue of land value rather than material supply,’ says Paloma Gormley, founding partner of Practice Architecture. ‘However, hemp, alongside other natural materials, is going to be integral to us meeting the housing need sustainably. Natural materials are inherently low in embodied carbon and biobased materials can actually sequester carbon. These materials are readily available in the UK and can be produced at very competitive prices. The main transition required is a cultural one, and this will be supported by regulation.’»

Courtesy of Julien De Smedt

Livo suggests using the abundance of plastic waste as a material for housing – particularly in fast-growing cities such as Nairobi. There, the result could respond to a climate that accommodates outside life but requires sun shading and ventilation.

Oskar Proctor

‘Natural materials are going to be integral to us meeting the housing need sustainably’

At the opposite end of the spectrum, Livo highlights the potential of a completely unnatural material. ‘What if we use one of our most pressing problems – the world’s plastic pollution – to solve another one, the shortage of quality affordable housing?’ That question led entrepreneur and Young Global Leader Silje Vallested and architect Julien De Smedt to develop a building system based on recycled plastic and locally sourced sustainable materials. ‘Just as cities are formed by buildings of wood, concrete, clay and steel, they could very well contain a building constructed from plastic waste, as long as it’s done in a safe and sustainable way,’ says De Smedt. ‘If you consider the amount of plastic waste worldwide, this could become an entirely new material resource to tap into.’ Calculations suggest a 60-m² Livo house could utilize 8 tonnes of recycled plastic and other waste. That means that more than 1 billion houses could be built with the exorbitant amount of plastic currently going unrecycled. »

Incorporating low-embodied-carbon timber and hemp, Flat House by Practice Architecture seeks to demonstrate that combining a low-tech approach and biobased materials with off-site construction can create scalable, low-impact architecture that also looks good.

Methods

Technology is rapidly opening the door for how we build, allowing us to construct homes at unprecedented rates. On the flipside, we're returning to hands-on processes that empower end users.

Until recently, 3D printing's viability as a large-scale production process seemed more fanciful than factual. But things are starting to change. In April, for example, a Dutch couple in Eindhoven became Europe's first tenants of a 3D-printed house. 'In addition to affordable homes, the market increasingly demands innovative housing concepts,' said Yasin Torunoglu, alderman for housing and spatial development for the municipality of Eindhoven in a statement. 'With the 3D-printed home, we're now setting the tone for the future: the rapid realization of affordable homes with control over the shape of your own house.'

But what exactly is 'rapid'? To use the Eindhoven house as an example: It has 94 m^2 of living space and, according to one of the parties involved in the construction, the actual time needed to print the house – if they would have printed all the elements in one go – was 120 hours. That's five days, the same duration it took for a 56-m^2 printed home to emerge in Chennai, India. The Vulcan series of industrial-scale 3D printers – a collaboration between construction technology company Icon and housing non-profit New Story – can construct the wall system of an entire house in just 24 hours of printing time. (These are the machines responsible for creating what's being dubbed the world's first 3D-printed neighbourhood, in Southern Mexico.) Compare these periods with results from the 2019 Survey of Construction from the US Census Bureau, which put the average completion time of a single-family home at around seven months. Not only that, but according to an article published on the World Economic Forum's website, the Chennai home – the first of its kind in India – is estimated to be 30 per cent cheaper to make than traditional houses and to have generated less waste during the building process.

Most current examples are printed using concrete, a material that's come under fire for causing up to 8 per cent of the world's CO_2 emissions. That figure is often put into perspective by comparing concrete to a country – it would be the world's highest emitter after the US and China. A project in Massa Lombarda, an Italian municipality around 40 km east of Bologna, is out to prove that 3D printing can be fast *and* sustainable. Known as TECLA – a portmanteau of 'technology' and 'clay' – the collaboration between Mario Cucinella Architects (MCA) and the »

Whereas most 3D-printed buildings are made with concrete, TECLA is the first housing model 3D-printed entirely from local raw earth. The project is not just about overcoming the housing shortage, but about doing so sustainably.

Iago Corazza

With a living area of approximately 60 m², TECLA includes a kitchen, living room and sleeping area. In line with the project's circular credentials, the furnishings are partly printed in local earth and integrated into the structure, and partly recyclable or reusable.

Developed as a low-cost system for housing in rural parts of India, CRA's design for Livingboard is based on a prefabricated core upon which end users build their own dwellings.

CRA-Carlo Ratti Associati

‘Housing should be conceived of as an ongoing project wherein the residents are co-creators’

World’s Advanced Saving Project (WASP) is printed entirely from local raw earth. Building the 60-m² project necessitated 200 hours of printing, 60 m³ of natural materials and two workers. ‘The whole concept is not solely about overcoming the housing shortage,’ says MCA’s Irene Giglio, architect and project manager for TECLA. ‘It’s mainly to help achieve this sustainably. TECLA is a nearly zero-emission project: its casing and the use of an entirely local material make it a pioneering example of low-carbon housing.’

The project started out as research by students at the School of Sustainability, a training centre founded by Mario Cucinella, and could serve as a template for future 3D-printed raw-earth buildings. ‘The model has been studied in four different climates,’ says Giglio, ‘from mild, cold regions, like where we made the first prototype, to extremely cold conditions, and from hot and humid to hot and dry environments. The composition of the earth mixture responds to local climatic conditions and can also change, since various local waste materials are added to the soil.’

But there is a reason many turn to concrete instead: it’s easier. ‘Printing with soil is not as simple as it seems,’ says Giglio. ‘The use of local earth requires specific tests and optimizations, because its composition and properties radically change from spot to spot. It was also difficult to understand how to pump the material and layer it. A company that might decide to embark on such a project should have a solid research and development team and a wide network of experts to deal with all the different aspects of the process – and a lot of motivation, of course.’

This doesn’t mean a future where all new residences are spat out by roving robots. In fact, there’s a countermove in the works, with some turning to self-building as a solution. ‘If a system is readily available that requires no previous building experience and needs specialist labour for only a small part of the project, then it makes sense to integrate the process into the wider community,’ says Ben Baker, production manager of U-Build, a modular timber construction system. ‘Buildings do not need to be complicated. There are recipes for bread that may require more components than building a home. There’s a huge assumption that architects, engineers, town planners and so on need to be around to get this stuff done.’

With self-building comes self-empowerment. Once the core ingredients of U-Build’s system have been produced with specialist machinery, the actual fabrication happens at the hands of the user – no heavy machinery, complex tools or advanced »

skill sets required. Aside from certain services like electrical wiring and plumbing, around 80 per cent of the work can be accomplished by laypeople. Again, speed is a factor. ‘The beauty of the system is that it’s quick to assemble,’ says Baker. ‘Once all the parts are on site, then a building can potentially be watertight within a matter of weeks.’

Carlo Ratti, founding partner of Carlo Ratti Associati and director of the Senseable City Lab at the Massachusetts Institute of Technology (MIT) also believes in giving a home’s inhabitants agency. ‘The maker movement has shown how empowering it is to put new fabrication tools in the hands of people,’ he says. ‘An important challenge for the next years will be to apply the same principle to construction – transferring the DIY attitude of Fab Labs to housing.’ This is the vision behind CRA’s design for Livingboard, a project developed with Indian non-profit WeRise to create a low-cost system for housing in rural communities. The design – which provides access to such basic services as electricity and water treatment – is based on a prefabricated core. Made with low-cost materials that can be flat-packed, Livingboard could potentially reach remote locations via helicopter or drone, giving it a level of accessibility that’s becoming increasingly important in the context of such issues as climate change and displacement.

‘After the core is delivered to site, homeowners can either work on their own or collaborate with construction partners to build the housing unit following vernacular principles and using locally sourced materials,’ says Ratti. He describes an example in the Indian village of Udagirinallappanahalli, where residents employ compressed earth blocks to form the structure, bamboo and wood for the frames, and Sadarahalli granite slabs for the flat roof – the latter is also used by locals for drying seeds. ‘This case demonstrates the collaborative nature of the project, as people with different skill sets join forces in the design-construction process. Especially important in this collaboration are the local residents, who are both the stakeholders and resources of local wisdom. Soliciting their input means that the ultimate design would be better suited to their conditions, and that they will feel a sense of ownership towards the house.’

At its heart, Livingboard wants to quash the idea that housing is a static unit that’s packaged and handed over to the people. ‘Rather,’ says Ratti, ‘it should be conceived of as an ongoing project wherein the residents are co-creators. In this way, the design is constantly evolving, allowing users to choose the features that work most effectively for them.’ »

Jim Stephenson

Advocating self-building, U-Build is a modular timber construction system. Once the core ingredients have been produced with specialist machinery, the actual fabrication happens at the hands of the user – no heavy machinery, complex tools or advanced skill sets required.

Master plans

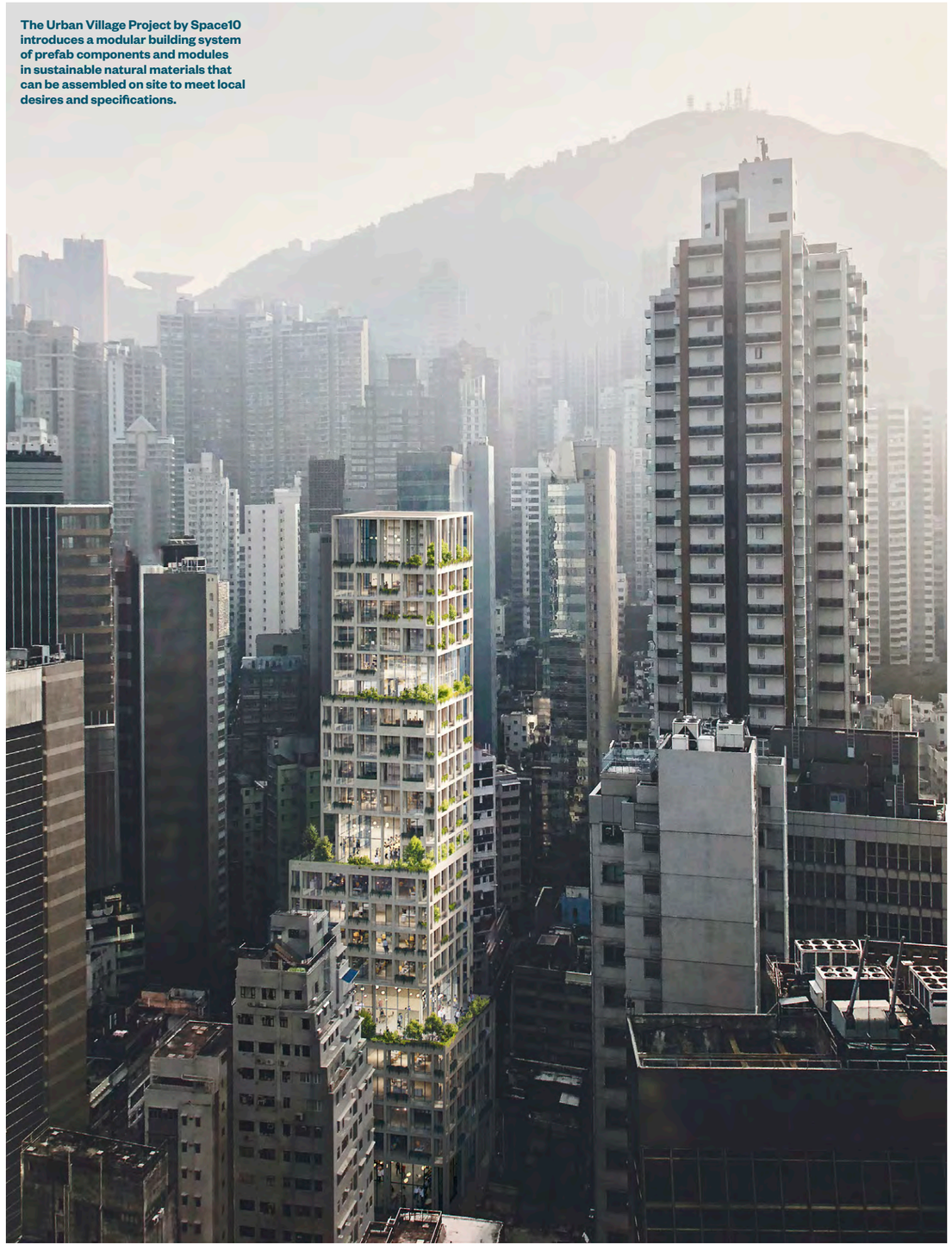
Any substantial contribution to combatting the housing shortage is unlikely to be with a string of one-off solutions. How can we create schemes that are scalable? Flexible in terms of location? Adaptable for the future? And that are more than mere shelter?

‘Today each new building is a “uniqua” – we start from scratch every time we build new,’ says Simon Caspersen of Space10. ‘Design is fragmented and local – we begin with local specifications and have to coordinate complex timelines with a multitude of subcontractors, the logistics are complex, and each building project takes years and is incredibly costly. It’s such an inefficient industry.’ Instead, the research and design lab suggests rethinking the way we plan, design, build, finance and share our neighbourhoods altogether, not only to allow for better, more affordable homes to enter the market, but to also drastically reduce the environmental impact of the industry. The group has explored these ideas in The Urban Village Project, which may be only a vision, but one Caspersen says is becoming increasingly realizable. The proposal introduces a modular building system of prefab components and modules in sustainable natural materials – ‘basically like a Lego set,’ says Caspersen – that can be assembled on site to meet local desires and specifications. This kind of method of production and assembly, he argues, would be significantly more efficient, faster and less expensive than how we build today. It also means materials and components could be easily repaired or replaced over a building’s lifespan, keeping maintenance costs low.

Space10 isn’t naive enough to believe design and architecture alone can solve social problems. That said, Caspersen feels that the ‘role of the designer has never been more important. However, we need to design on a systemic level instead of on a product level, and take a holistic, multidisciplinary and value-driven approach to everything we do.’ To illustrate, the group’s considerations in The Urban Village Project master plan include access to ownership – residents could buy into their community through a shares-based model – as well as the pooling of resources to be more sustainable and reduce living costs.

The Urban Village Project is just one of many ideas capitalizing on the benefits of modularity. Currently under construction and due to be completed later this year, LOHA’s affordable housing complex Isla Intersections in Los Angeles comprises 16 staggered units, each a composition of three 6 x 2.4-m modular recycled steel containers. ‘In order to make a dent in this massive crisis, we must provide housing faster, more cost-effectively, and more creatively,’ says founder and design »

The Urban Village Project by Space10 introduces a modular building system of prefab components and modules in sustainable natural materials that can be assembled on site to meet local desires and specifications.



Effekt Architects, courtesy of Space10

Bauwerk / Bloomimages

Currently under construction in Munich, UNStudio's Van B relies on an adaptable partition and a 'plug in' furniture system that allow residents to quickly and easily transform the same floor space from an office to a living room or bedroom.

'The efficiency of modularity is the way to go'

principle Lorcan O'Herlihy. 'The efficiency of modularity is the way to go.' The modular units used in Isla Intersections are fabricated in China, shipped to Los Angeles and then taken to a nearby distribution centre to be outfitted and welded. Finally, they're brought to site where they're assembled within days. The process allows concurrent work on and off site, condensing construction time from two years to one.

Located near one of the world's busiest motorway interchanges, Isla Intersections also shows how design can be strategically employed to exploit awkward, seemingly unbuildable sites – an important factor given the scarcity of available land in urban areas, where the UN predicts that 68 per cent of the world's population will reside by 2050. 'This project has a triangular site, so we designed with staggered boxes to accommodate the footprint,' says O'Herlihy. 'The idea, however, can be applied to any lot size.' This was one of LOHA's goals in general: creating a replicable model that can be applied to a variety of sites throughout the city and county. Elements such as landscaping could be site-specific. Here, for example, greenery was chosen for its ability to purify the air and counteract the concrete surroundings.

New York City-based Gluck+, too, is 'turning sites that might otherwise be considered risky into opportunities', says principal Stacie Wong. 'As neighbourhoods surge and slump, the result is often abandoned buildings and empty lots. Is there a cost-effective way to fill those gaping holes in the city fabric and leverage that solution for affordable housing?' To explore this question, Gluck+ has partnered with a developer to conceptualize how to develop housing for moderate-income renters on small, difficult urban infill sites – without having to reinvent the wheel each time – which has led to experimentations in off-site modular construction. 'It accelerates the schedule and shortens financing periods,' says Wong.

According to UNStudio founder and principal architect Ben van Berkel, we shouldn't just develop well-considered homes in new parts of the city, but also reassess the typology of the house itself. If residences become smaller, as many should, 'we need to find ways to make them more flexible and adaptable – at different times of the day, for different activities, and for different family configurations', he says. True to these words, UNStudio devised as many ways as possible to reconfigure an apartment and came up with Van B. Currently under construction in Munich, it relies on an adaptable partition and a 'plug in' furniture system to make a 40-m² apartment feel 150 per cent bigger. »

Residents can chose their own individual configuration of plug-ins based on a catalogue of nine elements, allowing them to quickly and easily transform the same floor space from an office to a living room or bedroom. It's not about *saving* space, per se, but making it possible to expand a space through use. 'The Van B plug-ins are just a start,' says Van Berkel. 'They were designed and developed specifically to suit this development and its future residents, but the system itself can be developed further, adapted and scaled for a broader variety of homes. The plug-ins could also be easily adjusted to suit different budgets – through the range of options, the materials used, etcetera. The concept and system can remain the same and provide the same spatial advantages; it would just require making a few tweaks to lower the production costs.'

Munich, New York and Los Angeles are all cities with significant existing infrastructure, but what about places not yet equipped to deal with new demand? Urban-Rural Systems (URS) suggests a path forward with the Expandable House. It's designed to adapt to many different locations, specifically those on the fringes of Asian cities and towns where the impact of rapid urbanization is most directly felt. These are places where land is still relatively affordable and where new industries and associated jobs spring up, describes project lead Stephen Cairns. 'Rural migrants are often the first to arrive in the city, and the infrastructure – for transit, water, energy and waste – is often inadequate to support them.'

A key principle in URS's scheme is what the designers call the 'sandwich section', which lends the Expandable House its name. The building's raisable roof, floor and foundations are the 'bread', which can support up to three additional floors, the 'filling'. Crucial here is that developers or state housing agencies could provide that bread, while the residents add in the fillings as and when circumstances require and/or their budget allows. Some of these fillings could even generate income – residents could use the ground floor as a commercial space, for instance. What began as design and experimentation in Singapore's Future Cities Laboratory is now a prototype in the village of Kampung Batu Besar in Batam, Indonesia. Cairns refers to it as a '"seed" that's capable of generating many different kinds of dwellings rather than a singular, one-off design'. The team is currently working with developers in Indonesia to secure a suitable site for larger-scaled implementation.●

Carli Teteris

Designed to adapt to many different locations, specifically those on the fringes of Asian cities and towns where the impact of rapid urbanization is most directly felt, URS's Expandable House has a raisable roof that allows it to grow in size from one to three storeys.