

Assael



RightSizer
Regenerative build system



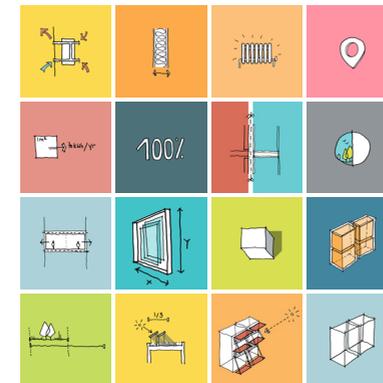
Executive summary

RightSizer is our collaborative response to the climate crisis. This MMC system, designed for 2030 and deliverable now, creates high-performance, regenerative, adaptive and demountable buildings using a concrete structure, timber infill and remanufactured materials, made locally, and achieves ultra low embodied carbon of $300\text{kgCO}_2\text{e/m}^2$.

This initiative started as an idea that won Meridian Water's Placemaking with Purpose competition in 2020. Our concept was for a system that could deliver longevity underpinned by flexibility and good health, for people and for buildings. Under Meridian Water's patronage, we were commissioned to develop the idea into deliverable solutions that tackle the climate emergency head-on, whilst broadening the functionality of the solution to become a universal system.

This report addresses the problem with the 'business-as-usual' approach to construction, the ambitious triple bottom line sustainability challenge set by Meridian Water, and our solutions, which include designing for disassembly and flexibility, support / infill thinking, local making, remanufacturing, and an idea called 'public life'.

We measure our design strategies using environmental, social and economic metrics and set out a rulebook for designing for 2030, which can be delivered by our industry now.



Addressing the climate emergency requires an 'all of society' response where siloed approaches are set aside for truly collaborative and integrated working.

Design is key to transitioning our society away from a wasteful linear model and instead towards a regenerative and circular economy where value is measured not just in money, but also in terms of impacts on people and the planet.

The issue - Business-as-usual

What's wrong with the business-as-usual approach in construction?

Buildings cause almost 40% of global greenhouse gas emissions, and the principal reason for this is a general wastefulness in the way we create and make buildings, a wastefulness in how we use heating energy, and in the way we are beholden to a take, make, waste linear economy that is predicated on an endless supply of resources.

There are lots of good builders and some notable innovators, but generally there is a lot of inefficiency and fragmentation with massive amounts of waste, and this is reinforced by a linear short-term thinking that is entrenched in the system.

Misaligned interests along the construction supply chain creates adversarial tension, and an information deficit where the customer is not aware of all the facts.

In many ways, construction is a laggard; it is one of the last significant sectors of the economy to be wholly disrupted by digitalisation and new organisational structures and processes.

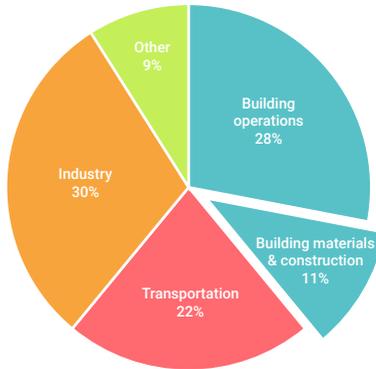
Global labour productivity growth in construction has averaged only 1 percent a year over the past two decades, compared with growth of 2.8 percent for the total world economy and 3.6 percent in manufacturing.

The purpose of this RightSizer initiative is to reimagine the construction ecosystem and the extractive economic model that underpins it.



Buildings cause almost 40% of greenhouse gas emissions; wastefulness is endemic and perpetuated by a linear economic model.

Global CO2 emissions by sector



Source: UK Environment Global Status Report 2017; EIA International Energy Outlook 2017

Meridian Water Triple Bottom Line



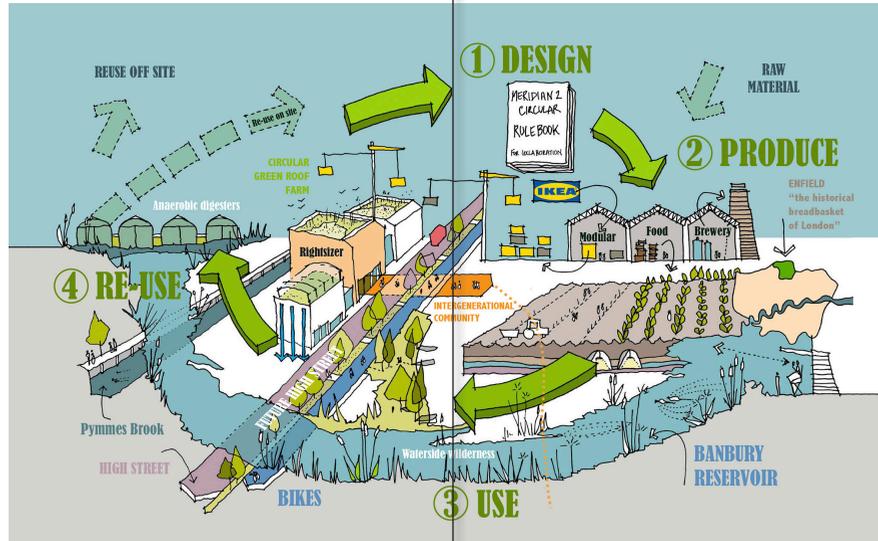
Source: Meridian Water's Environmental Sustainability Strategy (ESS)

The challenge

Our client, Meridian Water, is creating one of London's largest regeneration opportunities. Located between Edmonton, Tottenham and Walthamstow, it is a unique site on the cusp of inner London and neighbouring the Lee Valley Regional Park, in a landscape rich in wildlife as well as industry. Building on carefully-crafted placemaking pillars and best practice design principles, Meridian Water will be at the forefront of sustainable development worldwide and emerge as a distinctive, inclusive place, designed to nurture economic, environmental and social sustainability.

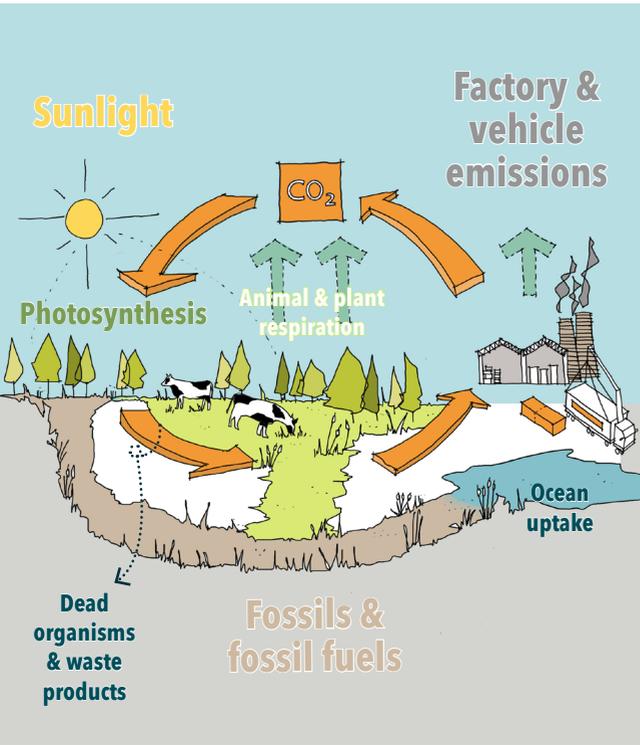
In 2020, Meridian Water launched their 'Placemaking with Purpose' competition, calling on innovative approaches to triple bottom line sustainability and placemaking for Phase 2 of the development. The 'RightSizer' team, led by Assael Architecture, was fortunate to win from a long list of over one hundred teams. Our winning vision was for a continuing care community comprising adaptive and flexible buildings assembled from a kit of construction parts, designed for disassembly and made locally from low-carbon materials. The commission awarded by Meridian Water asked us to expand the functionality of the build system beyond residential to a universal series of use cases and to draw a parallel with the longevity and successful reinvention of Victorian warehouses.

Our initial studies for the commission comprised a thorough examination of the spatial parameters for the various use cases and a cross comparison and overlaying of layouts to determine the optimum floor-to-floor height, column grids and knockout elements to allow reconfiguration to accommodate multiple uses.



Inspiration - Nature systems

Humanity has been on a fossil fuel binge that has destroyed huge amounts of biodiversity and heated the planet to dangerous levels. We have behaved as though we are apart from nature, not an intrinsic part of it.



The elegant interconnectedness and regenerative qualities of nature are the product of millions of years of evolution. We urgently need to reorganise our civilisation to align with these principles if we are to have a viable future on this planet; humans have a capacity to redeem themselves through corrective and collective action.

Design - meaning making decisions about how we want to live - is the key to creating a regenerative future. By moving away from an approach predicated upon novelty, obsolescence and waste, we need to make longevity, adaption and reuse the intrinsic drivers of all design.

Materials are being cycled continuously in nature in various processes, such as the nutrient and carbon cycles. We can replicate aspects of this circularity in our designs.

We can imbue materials and manufactured goods with information for reuse, giving them greater utility and therefore value. We can massively increase our capacity to capture the power emitted by the sun; 173,000 terawatts of solar energy continuously hit the planet, 10,000 times the world's total energy use. We can design systems that have a capacity for change over time instead of a closed, single use approach. We can drastically reduce the energy demand of our products and buildings, and scale up our capacity for energy storage.

“ There is no waste in nature. When a leaf falls from a tree, it feeds the forest. For billions of years, natural systems have regenerated themselves. Waste is a human invention. The Ellen MacArthur Foundation

Inspiration - Human systems

There are human-designed systems and products that replicate aspects of nature's circularity. We draw inspiration from these approaches for our RightSizer system; some are old, some are new, all are made for longevity, adaption and reuse.

'Half a House', Mexico - Alejandro Aravena of Elemental
 'Incremental buildings' designed for future expansion by residents.
 By building 40 sq m of accommodation with capacity to expand to 80 sq m, the price of home ownership is reduced. Expansion designs and construction are often resident-led.

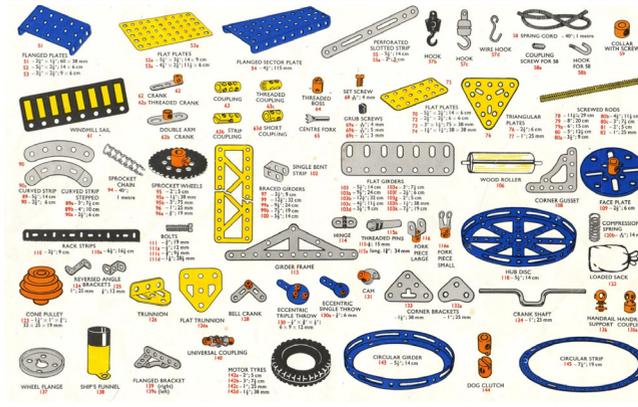


Miami car park - Herzog & de Meuron
 Multi-storey exposed reinforced concrete structure sized for car parking and various other uses, including culture and events. Enclosed retail, residential and F&B space at ground floor, some at mid-level and roof. A fine example of a super robust support layer accommodating a softer, frequently changing infill layer.



Falcon 9 rocket - SpaceX
 A space transportation system designed for reuse to dramatically reduce the cost of spaceflight. To date, the state-led model has been predicated on a disposable single-use model, which has kept the cost prohibitively expensive and affordable only by a few national space programmes.

Meccano parts, 1960s
 Model construction set comprising reusable, perforated metal or plastic strips, plates, axles and wheels that can be bolted together in various configurations, using a minimal number of standard connectors to join the different components. Interoperability, standardisation, flexibility and reusability provide inspiration for the RightSizer system approach.



FUTURECRAFT.LOOP - Adidas
 Trainers made from a single material – virgin thermoplastic polyurethane – that significantly simplifies the recycling process, making the shoes 100% recyclable. Only 9% of all plastic ever made has been recycled and this is due to lack of recycling infrastructure, incentives and complexity of products.



Solution - Design for disassembly

In this 'Take, Make, Waste' linear economy, we designers and consumers have been conditioned to believe products and buildings have an inherent obsolescence and so can be discarded and replaced ad infinitum without regard to planetary inputs or outputs.

But this narrowing of outlook is just a recent trend; in pre-industrial societies, we built to last - products and buildings would adapt and transcend lifetimes, and materials were scarcer and more valuable, and therefore reused with greater frequency. If we don't design for reuse, we discard and throw away, and the market feeds our bottomless appetite for new shiny things. This is the system we live in.

Alternatively, if we designed everything for reuse, we can create a more resilient and regenerative world, we can eliminate waste and imbue materials with greater value. This shift starts to challenge traditional economic models underpinned by the notion of 'ownership', opening up the possibility of products being offered as services and new marketplaces facilitating remaking and reuse.

Extending Design for Manufacture and Assembly (DfMA) to also accommodate disassembly (DfMAD) allows us to piggyback on a growing and necessary construction trend to move more production from inefficient construction sites to factories, driving better faster outcomes. Design for Manufacture, Assembly and Disassembly (DfMAD) allows us to escape from a linear wasteful model and

build a circular economy. Broad circularity is powered by common values and agreed technical standards:

1. Component sizes

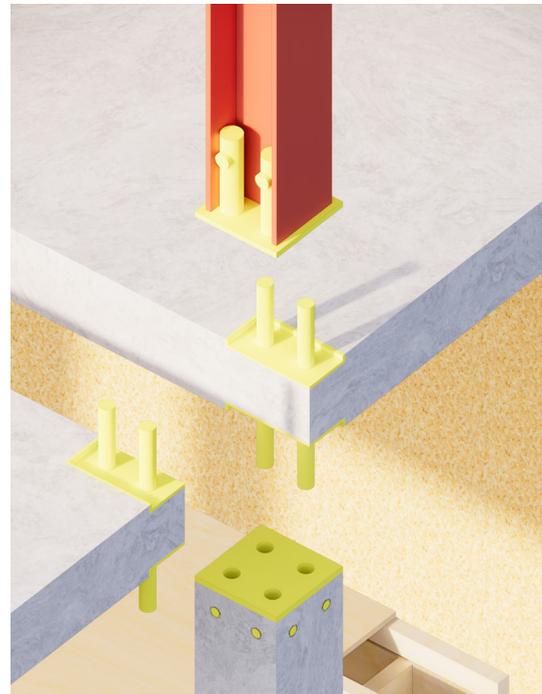
150/300/600/1200mm modules

2. Interoperable connecting details

Multi-scenario, multi-material

3. Component digital passport

BIM plus materials, assembly / disassembly data



“

If we designed everything for reuse, we can start to eliminate waste and create a more resilient and regenerative world, imbuing materials with greater utility and value.

Solution - Design for flexibility

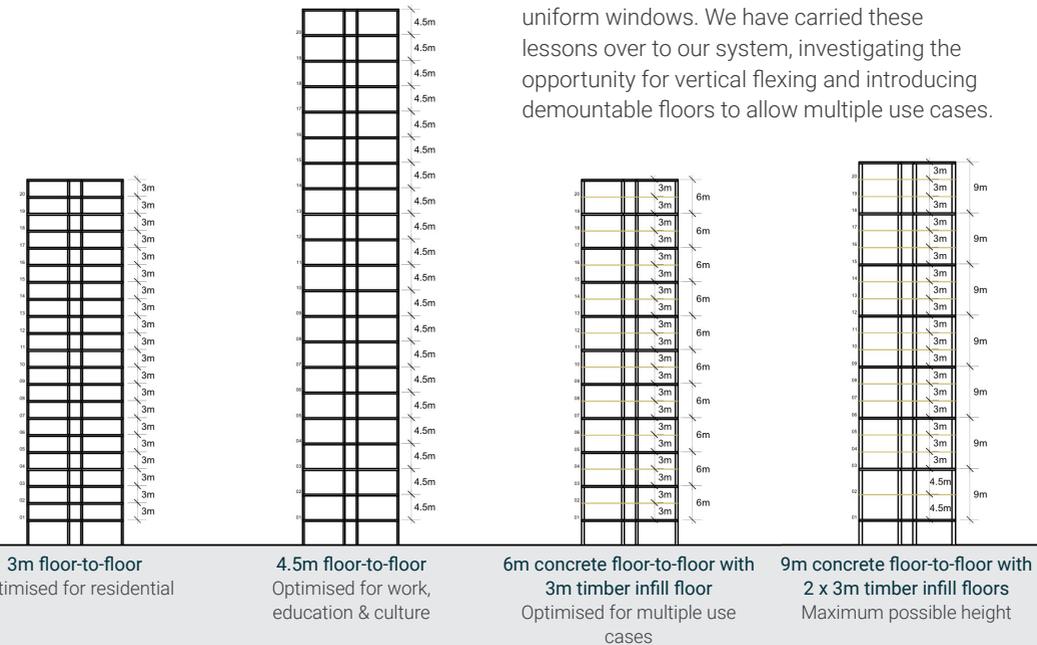


“

The most valuable buildings in the future won't be the shiniest; they'll be the most flexible and adaptive.

Central to our vision is adaptive buildings. In a world of increasing scarcity, a capacity for adaptation is a significant value enhancer.

We can look to our history for clues to the way forward. Consider the longevity and successful reinvention of notable warehouses still with us from the Victorian or Georgian eras. These buildings have typically accommodated various uses over the centuries and are synonymous with robust, modest and resolute architecture, characterised by durable, clay-based materials, tall ceilings, large spans and regularly spaced uniform windows. We have carried these lessons over to our system, investigating the opportunity for vertical flexing and introducing demountable floors to allow multiple use cases.



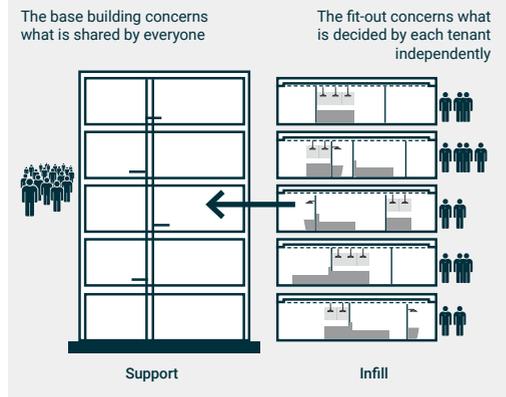
Solution - Support / infill

Our RightSizer system is inspired by John Habraken's Open Building movement from the 1960s, which espouses the idea and discipline of support / infill layers. Habraken was preoccupied with remedying the generic nature of 20th century mass housing and drew inspiration from the individualism of Amsterdam townhouses tightly packed into identical plots and adhering to certain constructional and elevational rules.

Habraken said "To inhabit is to design". He created a system that allowed for much greater end user configurability and personalisation than general housing. It was envisaged that Open Building could extend the useful life of a building by enabling adaptation; Open Buildings are the opposite of a closed system.



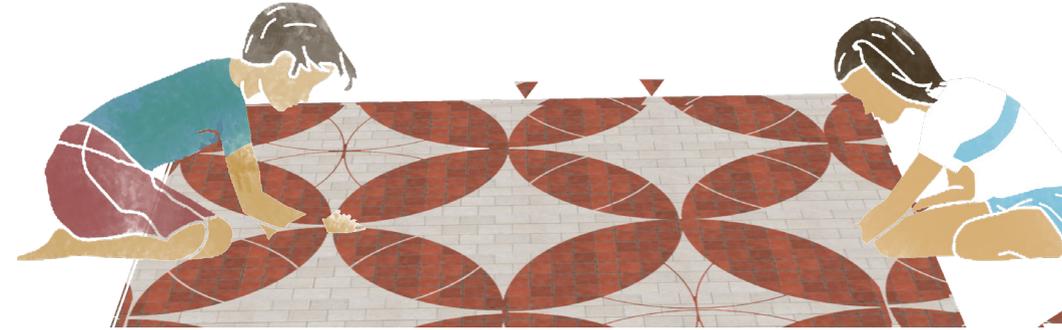
“
To inhabit is to design



Diagrams based on John Habraken's 'Open Building'



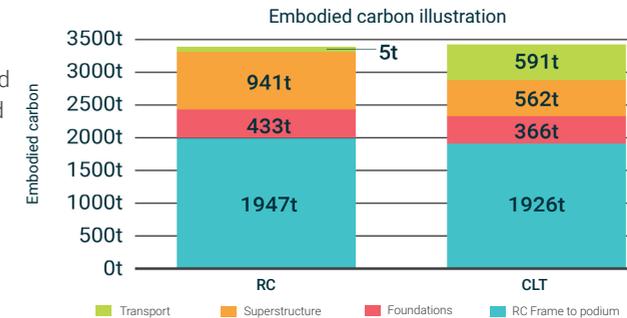
Solution - Local making



Central to our vision is to minimise embodied carbon by making building components locally where we can, and by using materials such as timber and new technologies, including low carbon cement and cement liberated from existing concrete.

For our competition submission, we presented a comparison between a reinforced concrete building with concrete made in London, and a CLT building with CLT transported from Finland. This illustration suggests the embodied carbon of the concrete building was on par with, or slightly less than, the CLT building when transportation carbon is factored in*.

We have an opportunity with the RightSizer system to drive skills and create new local maker jobs whilst drastically reducing transportation carbon. Our aspiration is for the 'infill' layer to be made locally by Building Bloqs, a large makerspace located on the Meridian Water site who we have consulted with. Building Bloqs has substantial equipment for woodworking, engineering, metalwork, CNC cutting, painting and fabric work.



“
Central to our vision is to minimise embodied carbon by making building components locally where we can.

*For a particular residential building using 50% GGBS concrete mix. Measured using BS-EN-15978 Modules A1-A3 only (excluding timber sequestration) and ICE dataset. Locally sourced concrete production (within 5km) and internationally sourced timber in line with Table 7 RICS Whole Life Carbon for the Built Environment 2017 guidance.

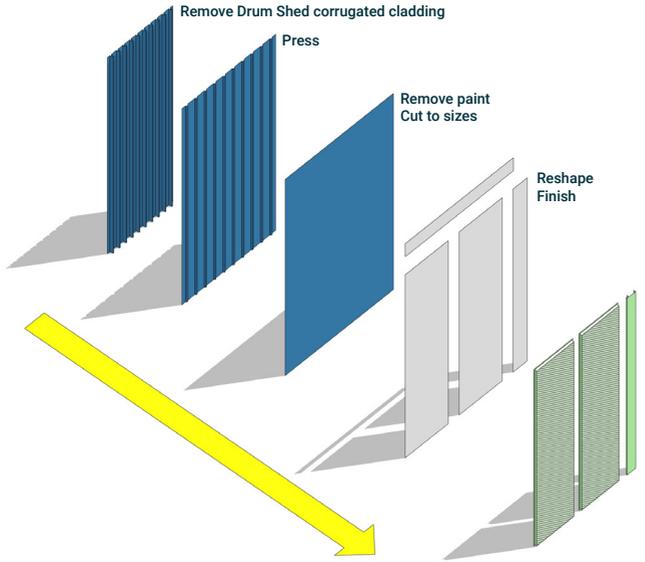


Source: Building Bloqs

Solution - Remanufacture

One of our solutions for getting embodied carbon as low as possible is to reclaim materials and components from existing 'donor' buildings that would otherwise go straight to landfill. These materials are removed and remanufactured for use on our new regenerative buildings. At Meridian Water, we have been looking at the opportunity to reclaim the corrugated cladding and steel structure from large industrial sheds currently on-site and reuse these on our pilot project designed for 2030.

“
Materials are removed and remanufactured from donor buildings to use on new regenerative structures, significantly reducing embodied carbon.
 ”



Solution - Public life

The RightSizer public life strategy is a community interface approach, which ripples out to amplify the inherent social, environmental and economic outcomes of the RightSizer system. In doing so, the RightSizer system is charged to impact both its ground floor spaces and programmes to be more responsive to the community, and to the public realm and sense of place. It addresses the inclusion of the existing community in the super diverse high street contexts of Enfield. The strategy answers the questions of how the public investment in the Meridian Water regeneration can create immediate access to entrepreneurial opportunity, authorship and sense of ownership. It does this ostensibly through the intuitive architectural devices of inclusive ground floor use, façade and threshold production from circular materials with low embodied carbon.

Municipal motif - Circular materials

The idea of municipal patterns is over 2,000 years old and was used by both the Romans and ancient city states to confirm the presence of a local government and also to emphasise a collective identity, pride and polis. Many contemporary cities and districts around the world have a municipal pattern that emphasises their identity today, one of the best known being in the district of Ipanema in Rio De Janeiro, where it has become a symbol of local pride, reference and recognition.

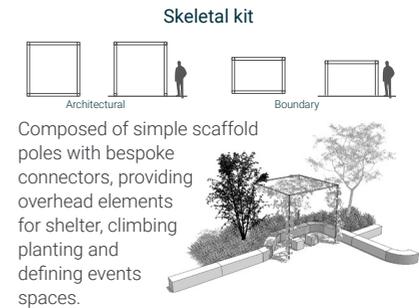
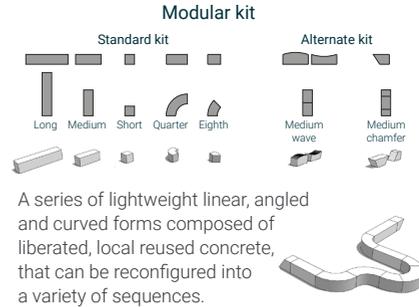
“
Inclusive ground floor use, façade and threshold production from circular materials.
 ”



Solution - Landscaping

The ground floor landscape design is modular and flexible. A multifaceted toolkit of parts can be demounted, mobilised and reconstructed in a variety of sequences on a day-to-day basis, creating a hybrid surface of multi-use spaces that fluctuate in permanence, depending on the user's requirement. The transient nature of this toolkit aims to influence social and ecological interaction, establish a community through user programming, provide flexibility for a variety of events and leisure activities, and encourage exploration.

The sustainable performance of the architecture has been reflected within the blue/green infrastructure at the ground surface to establish an ecological matrix of flora and fauna that is paired with the conditions of the semi-enclosed microclimate. Although fixed to optimise growth, the vegetation on site can also be lifted and reinstalled in the event that the architecture is reconfigured, allowing the entire development to be reconstructed, whilst retaining its biodiverse and sustainable attributes.



Building & measuring 2030

We have applied our design solutions to a test site at Meridian Water with the objective of understanding the carbon, cost and social implications of moving from a Business-As-Usual approach, raising our ambition with a 2020 specification through to an innovative and realisable 2030 design. The matrix below sets out the headline figures for our test building comprising 189 residential homes across a series of interconnected linear buildings of an average height of 12 storeys. As with all pilot projects, there is an increase in cost as this DfMAD approach is not yet ubiquitous. However, we contend the cost differential would decrease and even become cheaper with widespread industry adoption, as has happened in all industries where new innovations and technological solutions are progressively developed into mass-produced and configurable products, as has been experienced in the construction industry (photovoltaics, air source heat pumps etc) and other industries (cars, computers etc).

	Scenario 1 Business as Usual Procured TODAY	Scenario 2 2020 Specification Procured TODAY	Scenario 3 2030 Specification Procured TODAY	Scenario 4 2030 Specification Procured in 2030
Headline specification	Superstructure: Cast In-situ RC Façades: Hand set brick + SFS framing	Superstructure: Low carbon precast concrete with alternating timber cassette floors Façades: Precast concrete + SFS framing	Superstructure: Low carbon precast concrete with alternating timber cassette floors Façades: Remanufactured metal rainscreen + SFS framing	Superstructure: Liberated cement precast concrete with alternating timber cassette floors Façades: Remanufactured Metal rainscreen + SFS framing
Embodied carbon*	Approx 900 KgCO ₂ e/m ²	452 KgCO ₂ e/m ²	369 KgCO ₂ e/m ²	265-323 KgCO ₂ e/m ²
Construction rate*	£283/ft ² (baseline)	+£47/ft ²	+£45/ft ²	+£52/ft ²
Gross value added**	£143m (baseline)	+£23 million	+£23 million	+£25 - 26 million
Avoided social cost of embodied carbon**	Baseline	+£2.2million	+£2.7million	+£2.7 - 3 million

Notes: *Figures provided by AECOM. **Figures provided by Hatch: GVA based on direct construction jobs; avoided social cost of carbon based on BEIS 2021 and compared to baseline. Get in touch for further information, contacts at end of report.



2030 tactics

These are our tactics for delivering 2030 buildings today. The targets are inspired by Meridian Water's Environmental Sustainability Strategy and the solutions are the result of our conversations and collaborative efforts.

- Target 300 kgCO₂e/m² Embodied Carbon
- Recycled or low carbon cement concrete superstructure
- Timber infill
- Remanufactured façades from donor buildings
- 100% designed for disassembly above ground slab
- Eliminate basements
- Space heating demand = Passivhaus
- 100% dual aspect for C3 residential dwellings
- External gallery access and amenity
- 30% minimum roof area for PVs
- 60% regenerative materials
- Optimise building form factor < 2
- High levels of insulation
- Very airtight building fabric with MVHR
- Triple glazed windows as standard
- 50% biodiversity net gain
- Deliverable Now

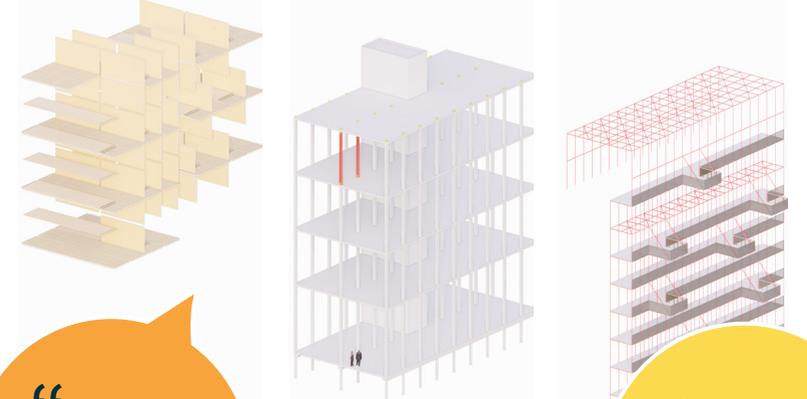


Consultation

Halfway through the project, we felt it would be beneficial to test our assumptions and design concepts with a range of leaders from the UK construction industry. The consultees included:

- | | |
|-------------------------------------|-----------------------------|
| Cast Consultancy | Vistry Partnerships |
| MHCLG Standardisation Working Group | Kier Construction |
| GLA Housing Team | Construction Innovation Hub |
| +Home – Winner of RIBA Home of 2030 | ReLondon (Formerly LWARB) |
| UK Green Building Council | Bell Phillips |

Feedback sessions were valuable, generating lively discussion and more questions than answers. Insights and learnings were fed into the next design stage to strengthen the proposal and make it more deliverable.



“ We can do this but why would we do it this way? ”



“ The RightSizer hardware needs an enabling software to operate ”



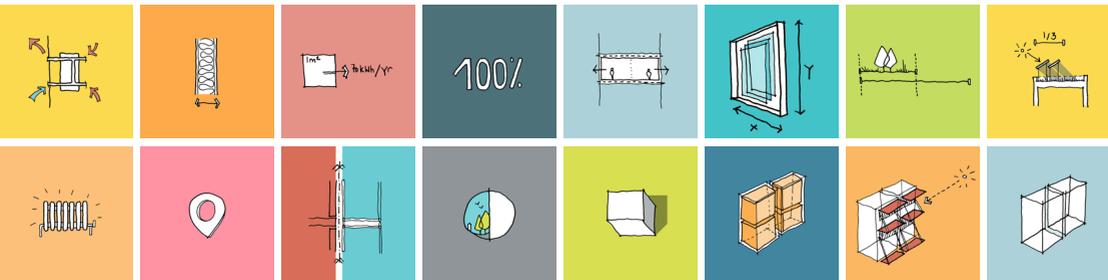
“ Who is the customer? ”



“ This goes beyond MMC ”



“ This system needs innovation in procurement ”



What next?

This project is a direct response to climate change, the existential challenge of our time, and sets out a deliverable strategy to decarbonise construction. The COP26 Climate Change conference heralded some interesting announcements, including the GFANZ initiative, which will mandate decarbonisation commitments for the majority of global investors; this will have a significant impact on real estate investment. However, the pledges are not enough and we need to halve our 2010 emissions by 2030 to keep the 1.5°C target of the Paris Agreement within reach.

This project focuses on the design of the hardware for a new construction ecosystem; for it to happen on an industry-wide basis, we must revisit and rethink the enabling software and operating system - the why and how people procure buildings. There are no non-radical choices left; we need to step up our ambition and effort to transform our economies and societies in this consequential decade.

We have secured funding from ReLondon through their CIRCuIT programme to broaden the collaboration, test this strategy and bring it closer to reality. We are also engaging with others to secure funding through to a built prototype at a land plot provided by Meridian Water.

Collaborators

Assael

Assael Architecture
Architects & design team leader
assael.co.uk
roryohagan@assael.co.uk
020 7736 7744

AECOM

AECOM
Multi-disciplinary
aecom.com
david.cheshire@aecom.com
adam.parkes@aecom.com

EXTERIOR ARCHITECTURE

Exterior Architecture
Landscape architects
exteriorarchitecture.com
leighton.pace@exteriorarchitecture.com
020 7978 2101

A.Do.P.

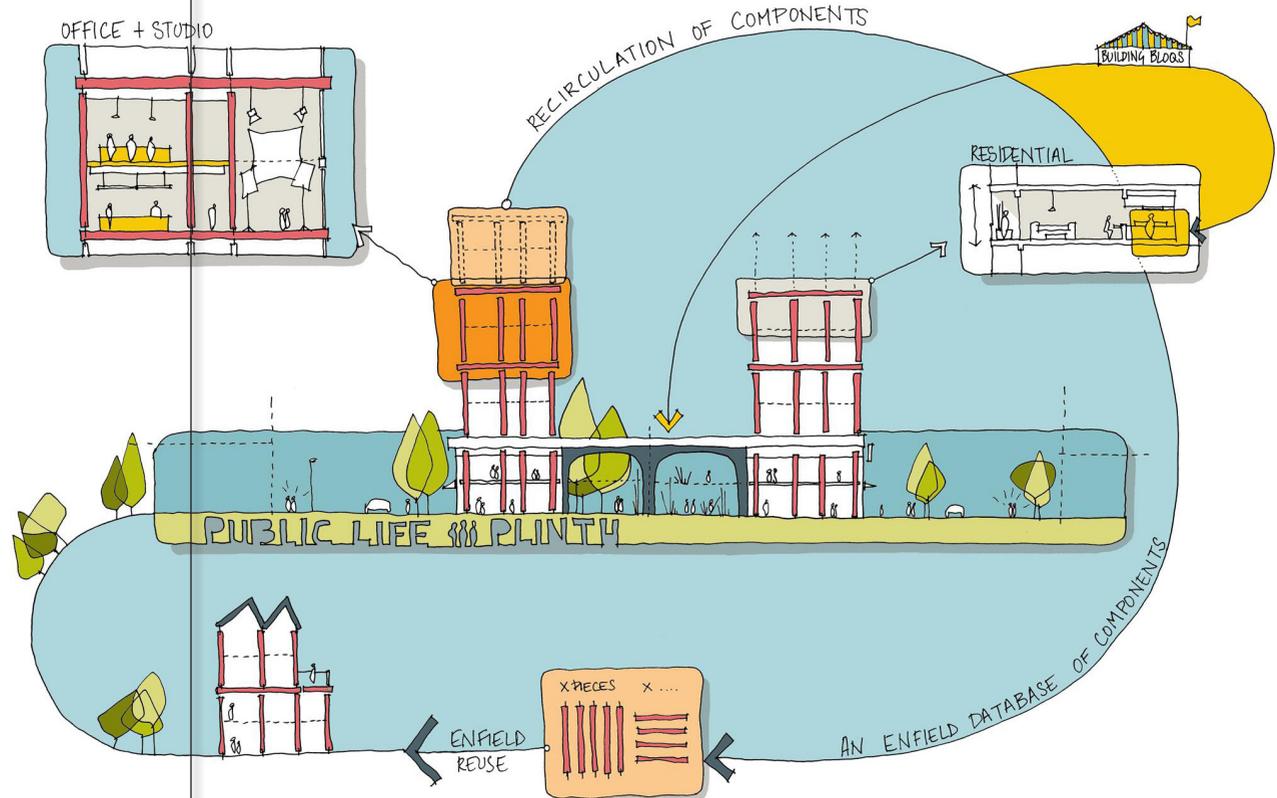
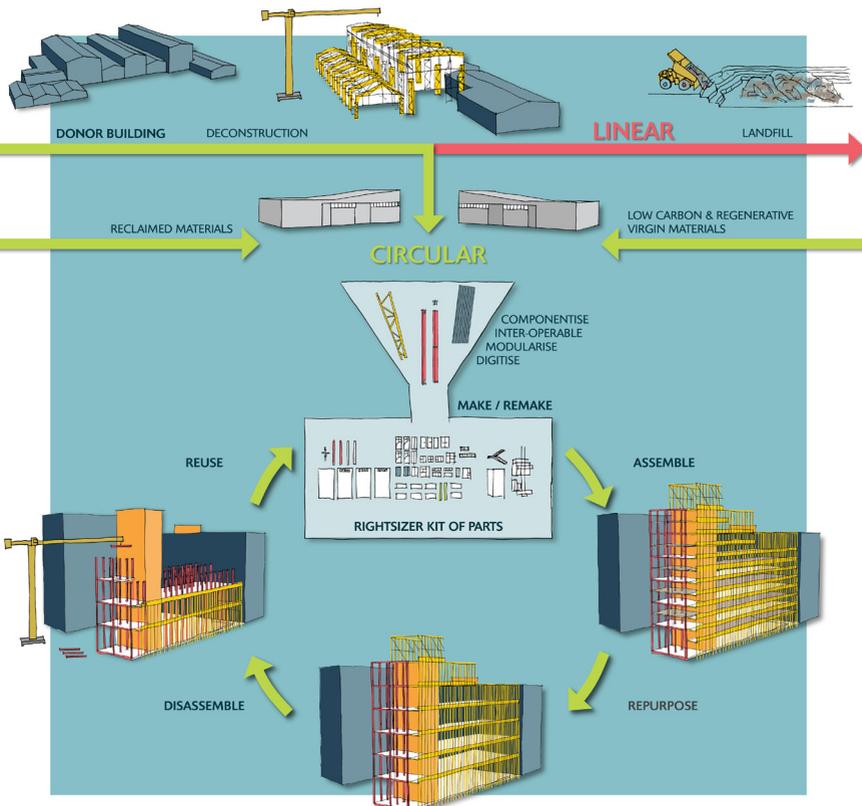
ArchitectureDoingPlace
Public life architect
architecturedoingplace.com
info@architecturedoingplace.com
07958 415 961

HATCH

Hatch Urban Solutions
Economic & social development
hatch.com
kelly.watson@hatch.com
0161 513 1477

with input at competition stage from:

THE CITY GREEN



Assael

in collaboration with



**meridian
water**



AECOM

EXTERIOR
ARCHITECTURE

A.Do.P.

HATCH



Assael Architecture

assael.co.uk

020 7736 7744