

Workshop 4d

Standardising modular construction: benefits of switching to off-site manufacturing

Speaker:

John Gray, HTA Design

Richard Harral, Chartered Association of Building Engineers

Room: Norfolk room



National Housing
Maintenance Forum

NHMF
Maintenance
Conference
2019



Presentation outline

- To provide an overview of current state of the art in Modular Construction
- Discuss benefits of modular construction
- Look at the drivers behind the need for standardisation
- Explain how standardisation can support sustained and sustainable growth in use of modular systems
- Why PAS 1025 is the right vehicle to enable standardisation
- Case Studies
- Q&A

0.0

INTRODUCTION

We are...



HTA's Modular Credentials

- To date ~6,000 modular dwellings built (or in progress) - and counting...
- Only UK Architectural practice to have built work with multiple modular manufacturers
- Designers of tallest modular building in Europe (completed September 2017)
- Designers of tallest modular building in the world (currently on site)
- Authors of Modular Design Standard (in collaboration with BSI)
- Member of Construction Leadership Council (steering group)





Olympic Way
Hotel, BtR Flats, Affordable Housing



Apex House
Student Housing



Dexion House
Student Housing





Greenford Green
BtR Flats



Savoy House
Student Housing



Queen's Parade
Student Housing



George Street
BtR Flats

Richard Harral - Technical Director

Chartered Association of Building Engineers

- CABE
- Professional membership organisation for building engineering professionals - our objectives are:
- To encourage and facilitate co-operation between the construction professions
- To promote and advance the knowledge, study and practice of each and all of the arts and sciences concerned with building technology, planning, design, construction, maintenance and repair of built environment and the creation and maintenance of a high standard of professional qualification, conduct and practice.



1.0

CONTEXT

Standardising Modular



Drivers for change - Modernise or Die



SYMPTOMS

The critical symptoms of failure and poor performance have been identified in this review as:



One

The industry has evolved a 'survivalist' shape, structure and set of commercial behaviours in reaction to the environment in which it operates. That environment is fundamentally characterised by low capital reserves and high demand cyclicality.

Two

The industry and its clients usually have non-aligned interests reinforced by traditional procurement protocols and a deep-seated cultural resistance to change pervading across both parties.

Three

There is no strategic incentive or implementation framework in place to overcome the issues above and initiate largescale transformational change. The issues of variable demand, resistance to change and lack of alignment / integration with clients have become *de facto* accepted norms for the industry.

Standardising Modular



Drivers for change - Modernise or Die

Recommendation 3: Industry, clients and government should work together leveraging CLC's *Business Models* workstream activity, to improve relationships and increase levels of investment in R&D and innovation in construction by changing commissioning trends from traditional to pre-manufactured approaches. The housing sector (spanning all tenures) should be used as a scalable pilot programme for this more integrated approach.

Recommendation 4: Industry, government and clients, supported by academic expertise and leveraging CLC's current *Innovation* workstream activity, should organise to deliver a comprehensive innovation programme. This should be fully aligned to market, benefits case led and generate a new shape of demand across industry (with a priority on residential construction). It should quickly define key measures of progress and report regularly against these as a check on the possible need for more radical measures. It should, in turn, also help to shape CITB reform proposals in relation to technology and innovation grant funding initiatives.

Recommendation 8: Government should act to provide an 'initiation' stimulus to innovation in the housing sector by promoting the use of pre-manufactured solutions through policy measures. This should be prioritised either through the conditional incentivisation of institutional development and investment in the private rented sector; the promotion of more pre-manufactured social housebuilding through Registered Providers; direct commissioning of pre-manufactured housing; or a combination of any of the above. It should also consider planning breaks for pre-manufactured approaches.

Standardising Modular



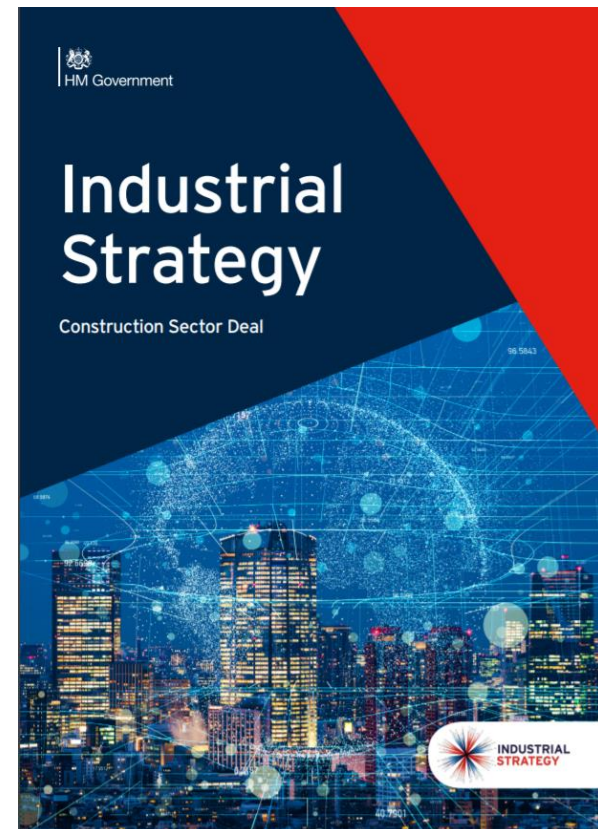
Construction sector deal

The Sector Deal builds on Construction 2025⁷, published by the government and the Construction Leadership Council (CLC) in 2013, and provides the framework for a sector that delivers:

- ▶ a 33 per cent reduction in the cost of construction and the whole life cost⁸ of assets;
- ▶ a 50 per cent reduction in the time taken from inception to completion of new build;
- ▶ a 50 per cent reduction in greenhouse gas emissions in the built environment – supporting the Industrial Strategy’s Clean Growth Grand Challenge; and
- ▶ a 50 per cent reduction in the trade gap between total exports and total imports of construction products and materials.

These goals will be met by focusing on three strategic areas:

- ▶ **Digital** techniques deployed at all phases of design will deliver better, more certain results during the construction and operation of buildings. Clients, design teams, construction teams and the supply chain working more closely together will improve safety, quality and productivity during construction, optimise performance during the life of the building and better our ability to upgrade and ultimately dismantle and recycle buildings.
- ▶ **Offsite manufacturing** technologies will help to minimise the wastage, inefficiencies and delays that affect onsite construction, and enable production to happen in parallel with site preparation – speeding up construction and reducing disruption.
- ▶ **Whole life asset performance** will shift focus from the costs of construction to the costs of a building across its life cycle, particularly its use of energy.



Standardising Modular

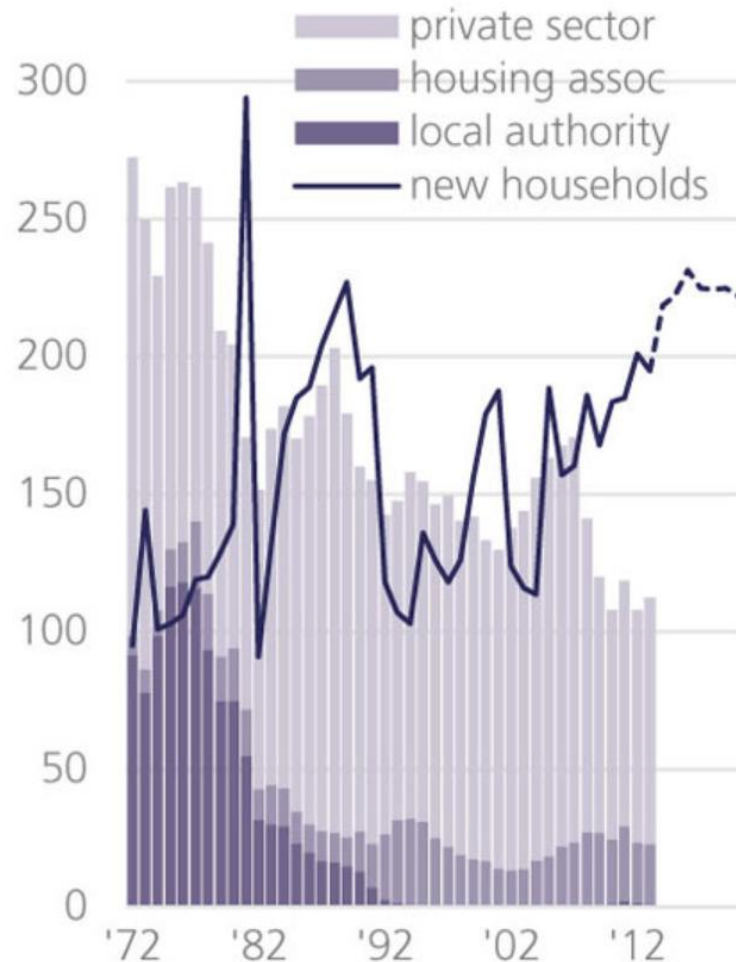


Housing supply and demand

“ Government has a stated ambition to increase housing supply to

300,000

net additions per annum on average”



Standardising Modular



Hackitt Review - Final Report

- New regulatory regime for High Risk Buildings
- New duty holding obligations for building owners
- New maintenance and management obligations
- New competency requirements
- New requirements for 'Golden Thread' of information sustaining building knowledge throughout building life cycle
- Need for improved Quality Assurance of construction work

Building a Safer Future

Independent Review of Building
Regulations and Fire Safety:
Final Report

May 2018

Dame Judith Hackitt DBE FREng

Cm 9607

2.0

WHY MODULAR?

APEX HOUSE, WEMBLEY

hta

6 MONTHS



02.02.17



21.02.17



24.03.17



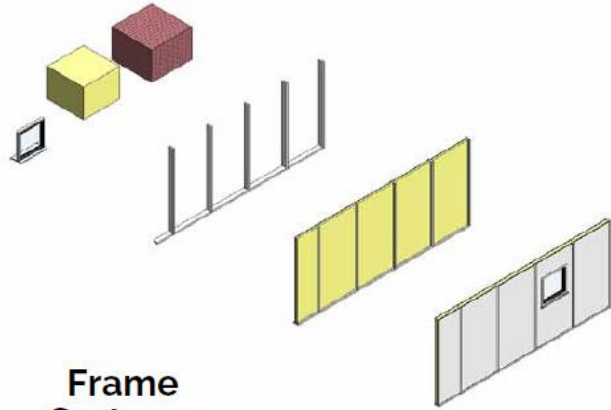
06.04.17



17.08.17

Construction

OFFSITE SYSTEMS



Frame Systems

Panel Systems



Pods



Volumetric



40%

PRE-MANUFACTURED VALUE (PMV)

75-80%

DESIGN FOR MANUFACTURE

hta

Quality



Safety



Waste reduction



BENEFITS

Commercial partnerships



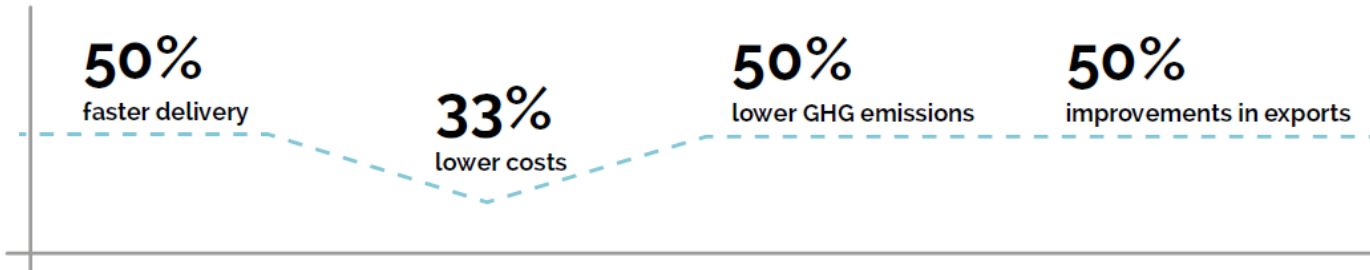
Inspiring careers

Speed, efficiency



Predictability; cost, performance

RIBA: DESIGN FOR MANUFACTURE



UK
Government
Construction
2025
Strategy

RIBA
DfMA

Design
for
Manufacture
and
Assembly

20-
60%

Reduction in
construction
programme
time

0-
40%

Reduction in
construction
costs

70%

Reduction in
onsite labour
(health and
safety)

90%

Reduction
in onsite waste
using
volumetric
construction

20%

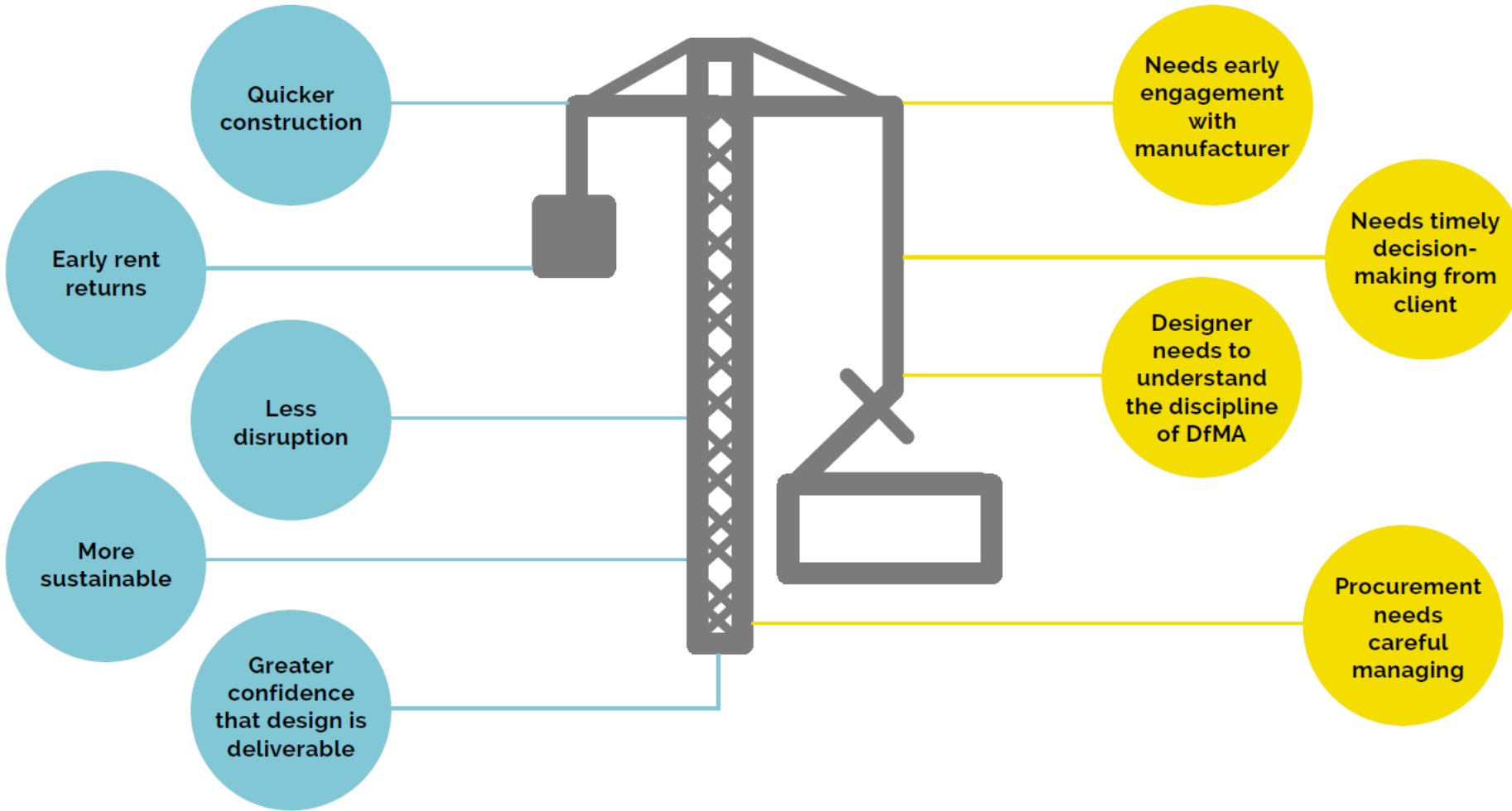
Reduction in
pollution and
congestion
(road
accidents)

ADVANTAGES AND BARRIERS



Pros

Cons



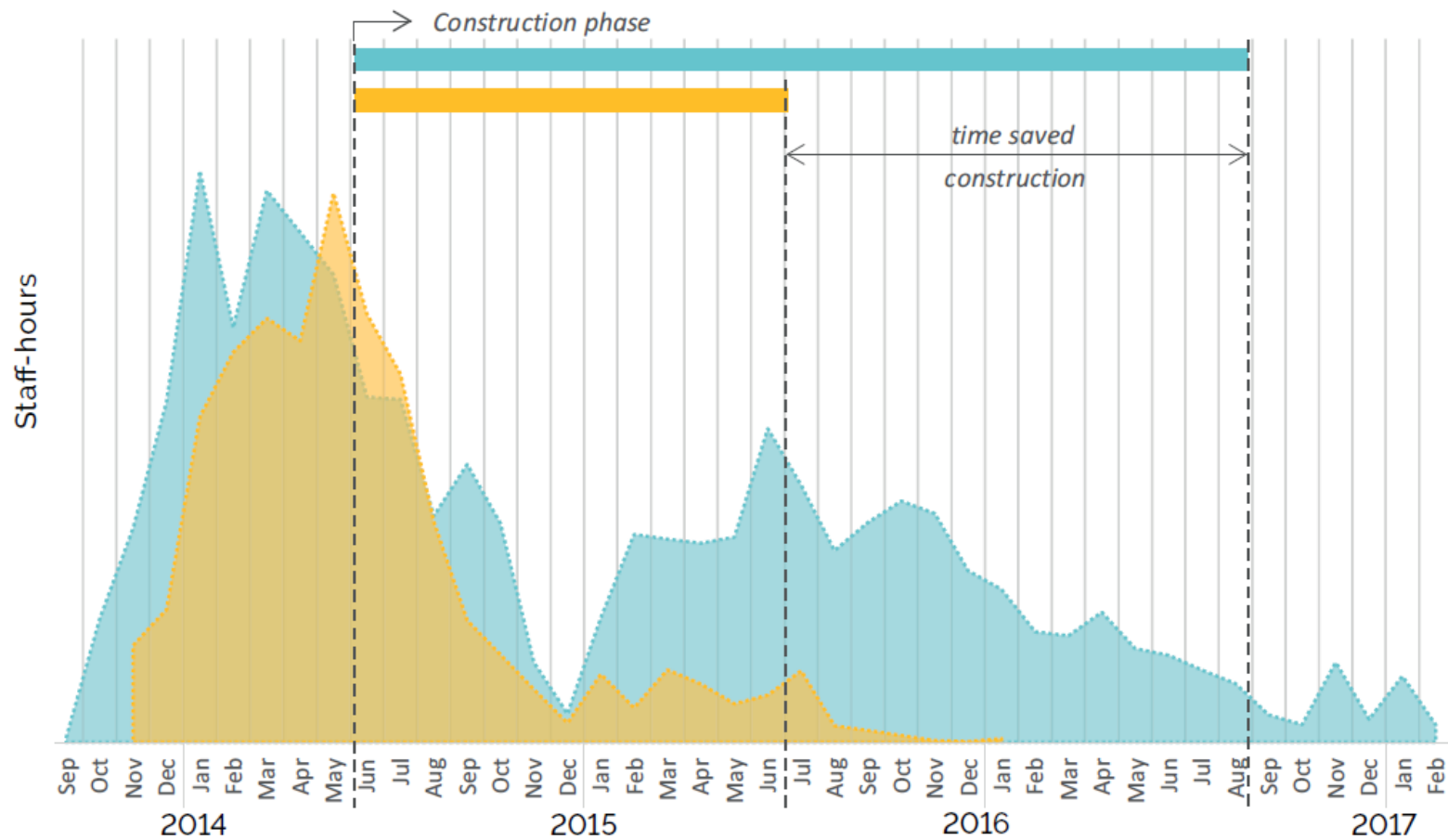
RIGHT FIRST TIME

- Traditional Project
- Felda House, Wembley

No. of hours	No. of homes	m ²	m ² / staff hours ratio
14,187	188	20,282	0.97
6,903	450	14,678	1.66



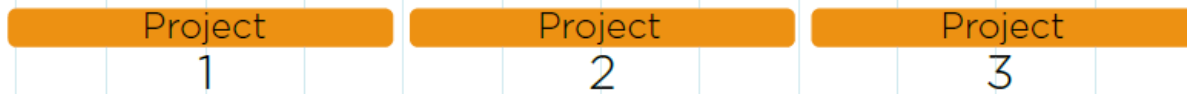
Traditional vs Offsite Design & Construction



Years

0 3 6 9 12

Traditional Procurement



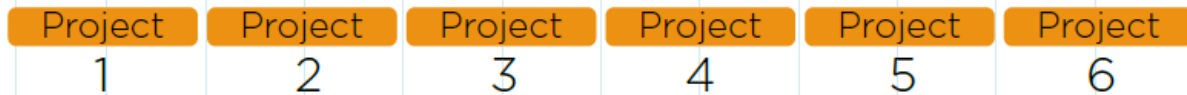
3x £30m = £90m

Better Procurement



4x £30m = £120m

Best Procurement



6x £30m = £180m

Work in Progress

Greenwich Creekside



Number of homes

249



Site size

0.48 (ha)



Residential tower

21 Storey



Typical floorplan

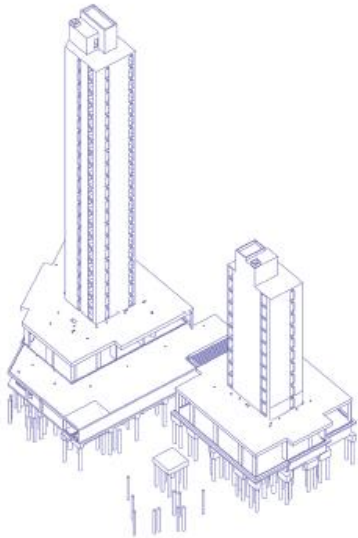


Site plan

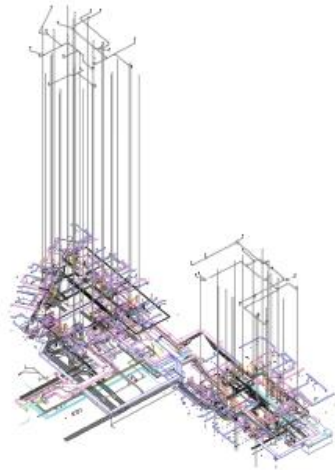
Work in Progress

Greenwich Creekside





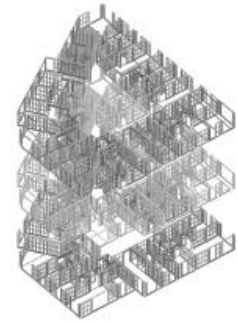
RC STRUCTURAL MODEL



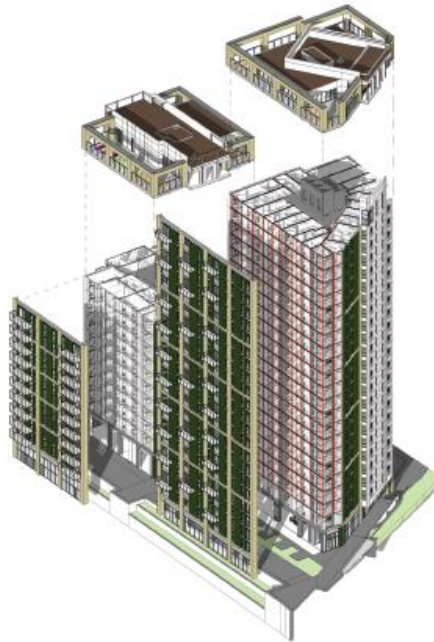
MEP MODEL



STEEL STRUCTURAL MODEL



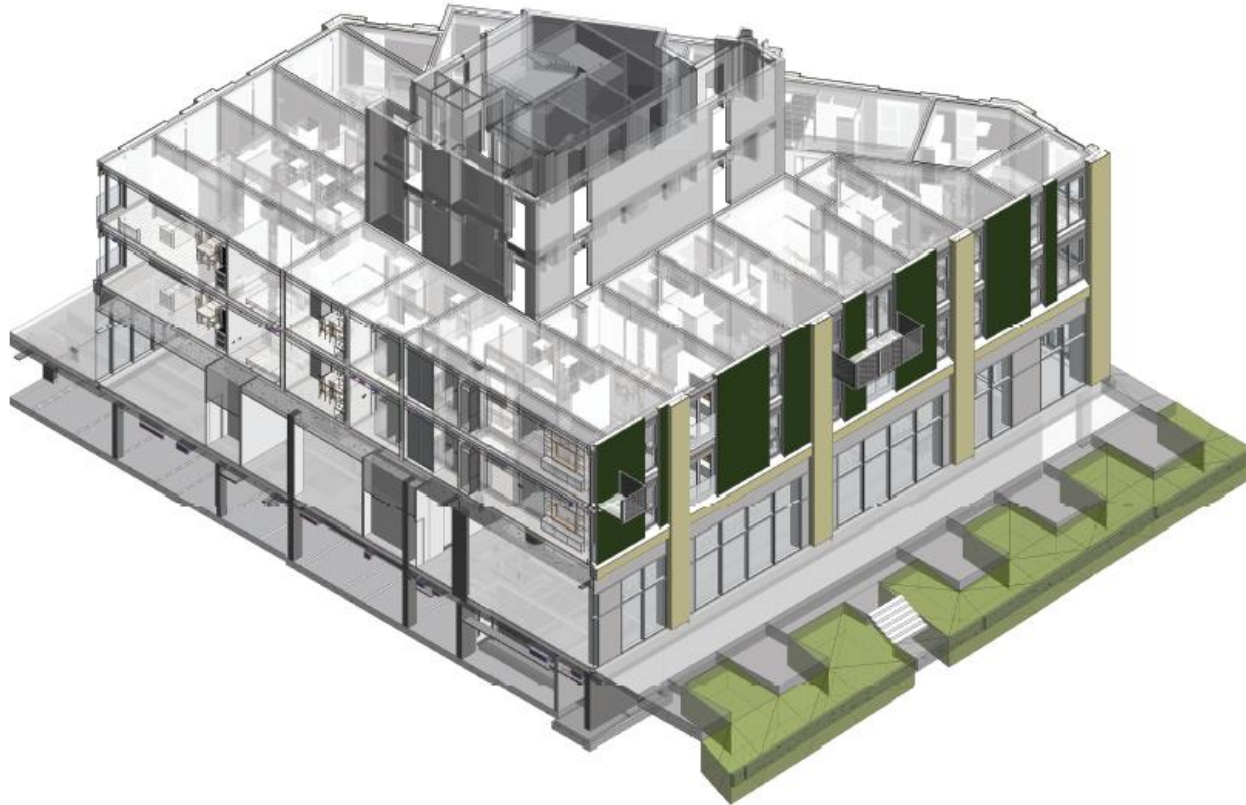
LIGHT-GUAGE STEEL INFILL MODEL



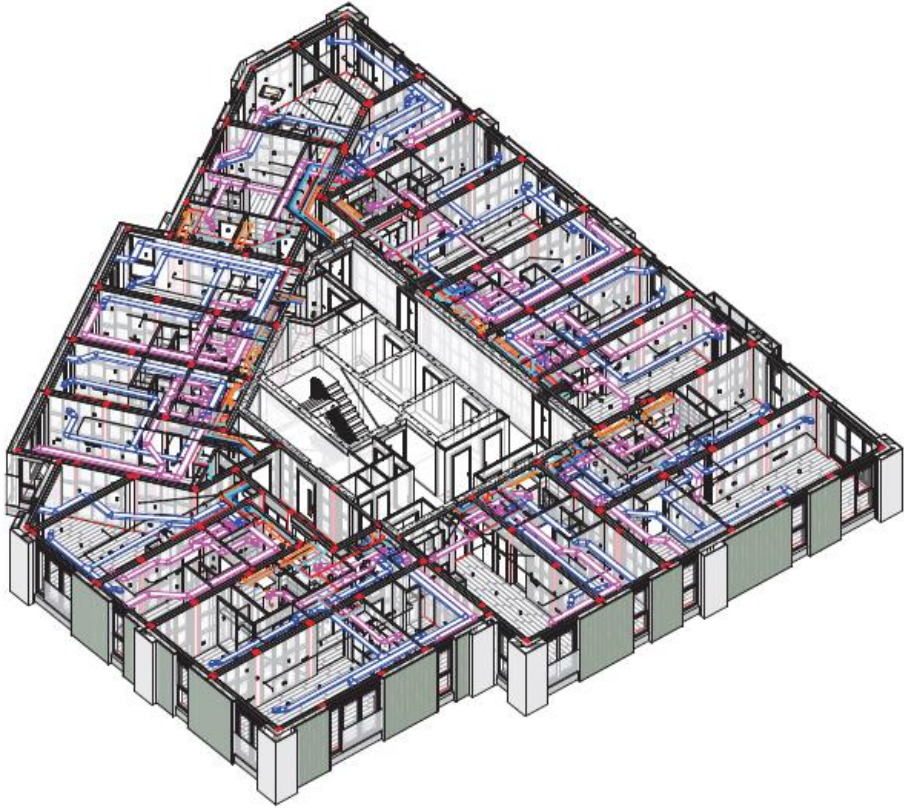
EXPLODED FEDERATED MODEL

Work in Progress

Greenwich Creekside



Work in Progress
Greenwich Creekside



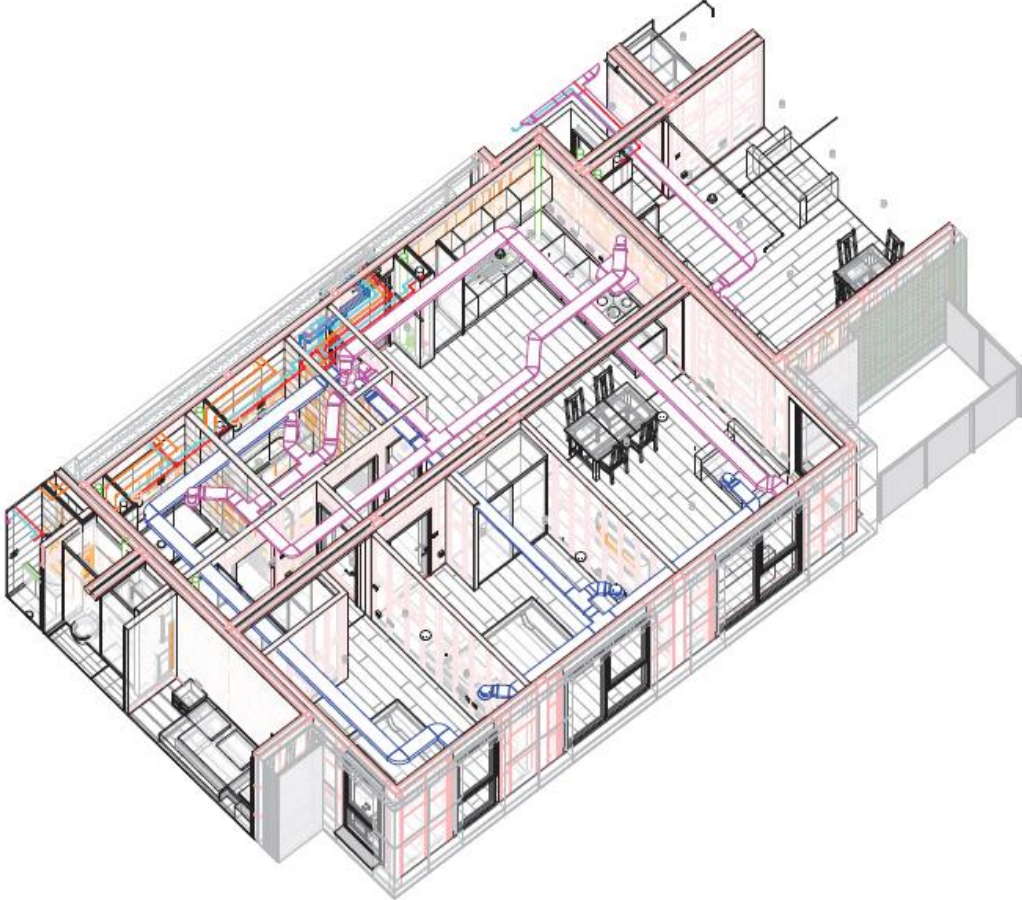
Work in Progress

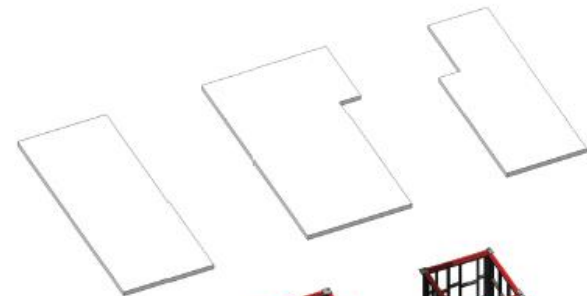
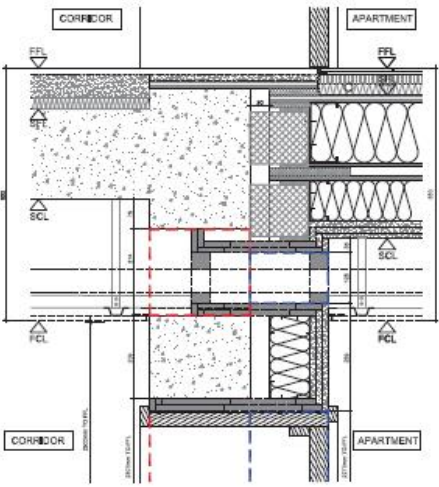
Greenwich Creekside



Work in Progress

Greenwich Creekside





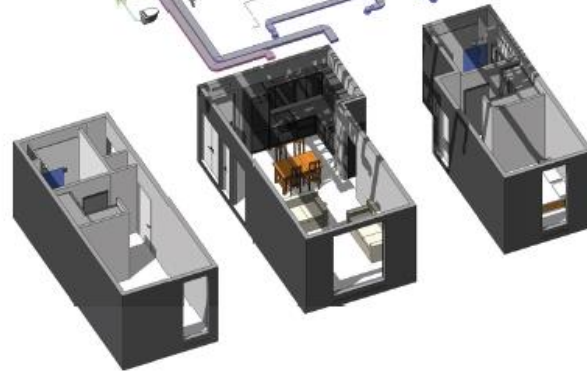
Module Ceiling Cassette



Module Steel Frame

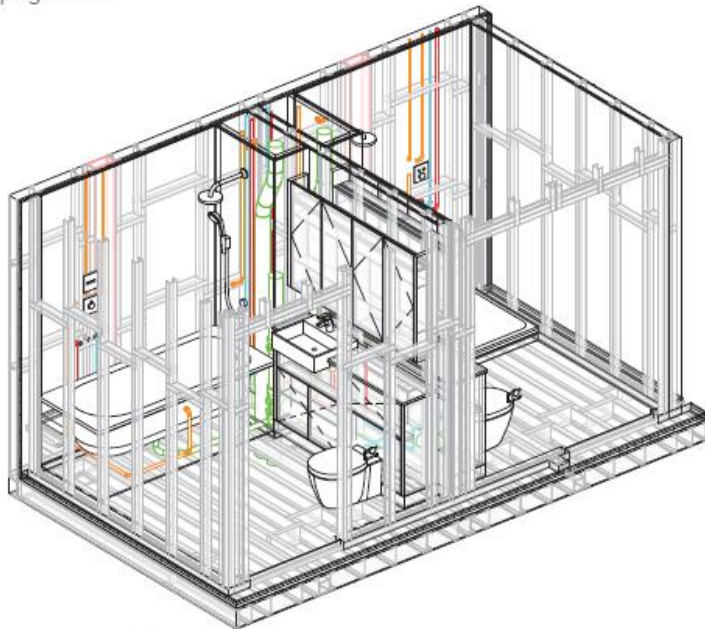


MEP



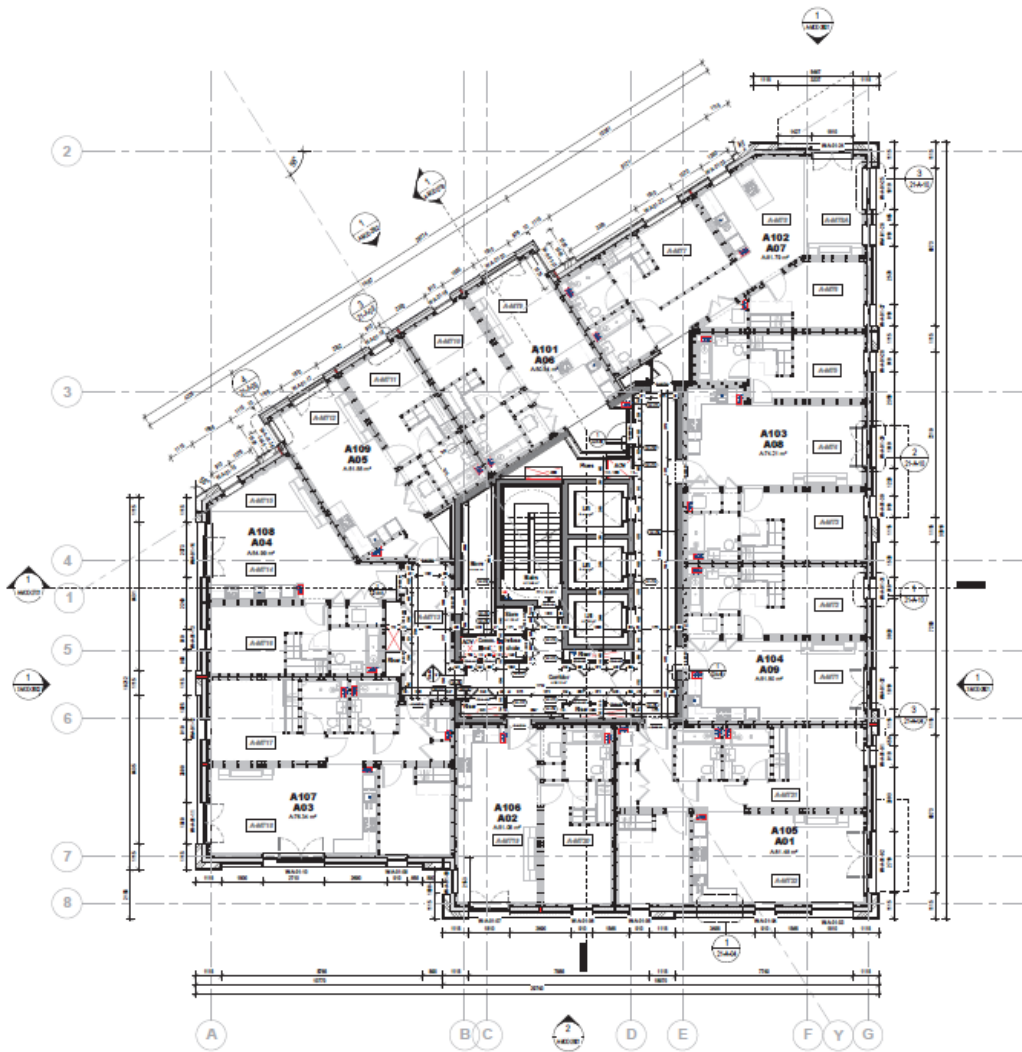
Architectural Finishes

Typical Zipping Details



Bathroom and Shower Components

Exploded Dumbbell Apartment



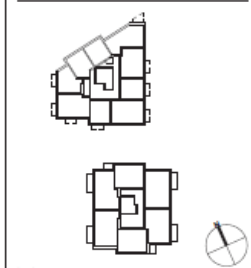
1 Level A1

Do not scale from drawings unless in agreement with HTA.
 Check all dimensions on site prior to commencing the works.
 Drawing to be used in conjunction with other relevant construction information.
 This drawing is the copyright of HTA Architecture Ltd and must not be copied or reproduced in any form without the express permission of HTA Architecture Ltd.
 Drawing to be used in conjunction with the 1000 specification.

888 for TFC, MCG, OR, 888, refer to the British Standard series HTA_A-MOD-030 and HTA_A-MOD-031 for details and dimensions drawings to be made.
 A101 & A102-030: See section and power TFC by MBE engineers.
 ADDITIONAL INFORMATION: refer to the relevant level drawings.
 MBE: 0200 300000 www.mbe.com HTA_A-MOD-030 & HTA_A-MOD-031
 MCG: 0200 300000 www.mcg.com HTA_A-MOD-030 & HTA_A-MOD-031
 OR: 0200 300000 www.or.com HTA_A-MOD-030 & HTA_A-MOD-031
 TFC: 0200 300000 www.tfc.com HTA_A-MOD-030 & HTA_A-MOD-031

- NOTES TO Q&H EXAMPLE**
- Window: Window type reference
 Window - Store - Floor - Count
 For window schedule refer to HTA_A-MOD-000 & 001
 For window component drawings refer to HTA_A-MOD-430 series
 - Door: Door type reference
 External Door - Floor - Count Internal Door - Unit Type - Count
 For door schedule refer to HTA_A-MOD-000 & 001
 For door component drawings refer to HTA_A-MOD-430 & 435 series
 - Wall: Wall type reference
 For wall type drawings refer to HTA_A-MOD-430 series
 - Floor: Floor type reference
 For floor type drawings refer to HTA_A-MOD-430 series
 - Ceiling: Ceiling type reference
 For ceiling type drawings refer to HTA_A-MOD-430 series
 - Unit: Unit type reference
 Fridge - Unit Type - Area
 For unit location drawings refer to HTA_A-MOD-430 series
 - Multiple: Multiple type reference
 Block - multiple type number
 - Detail: Detail reference
 Drawing reference / Sheet number
 - Section: Section reference
 Drawing reference / Sheet number
 Refer to drawing series HTA_A-MOD-000, HTA_A-MOD-001 & HTA_A-MOD-002
 - Section: Section reference
 Drawing reference / Sheet number
 Refer to drawing series HTA_A-MOD-070, HTA_A-MOD-071 & HTA_A-MOD-072

- SYMBOLS & LEGEND**
- Wall Floor
 - Soil vent pipe
 - Sub-soil
 - Discharged vent pipe
 - Floor Gully
 - Rainwater pipe
 - Rain water outlet
 - Automatic opening vent
 - Flush floor level
 - Movement joint
 - Proprietary fire cavity barrier
 - Over floor
 - TV Panel Zone (size & quantity TBC)



- FOR INFORMATION**
- 17.04.20: POI: NOT ISSUED: FOR INFORMATION
 - 8: 18.02.22: POI: Additional Provision
 - 9: 18.02.22: POI: Update to Floor Orientation
 - 4: 18.02.10: KOA: Stage 1 sign-off
 - 1: 18.02.08: KOA: URM plan update
 - 2: 18.02.04: KOA: Consulted for marketing comments
 - 1: Initial issue
 - revision: date: description

FOR INFORMATION

Essential Living
 Greenwich Creekside
 client / job name

GA PLAN-Level A1

HTA-A-MOD-2001A 6
 drawing number

job reference: name: date: version:
 EBL-CWG: As Indicated: KOA: @ A1








elements europe

10
09
08
07
06



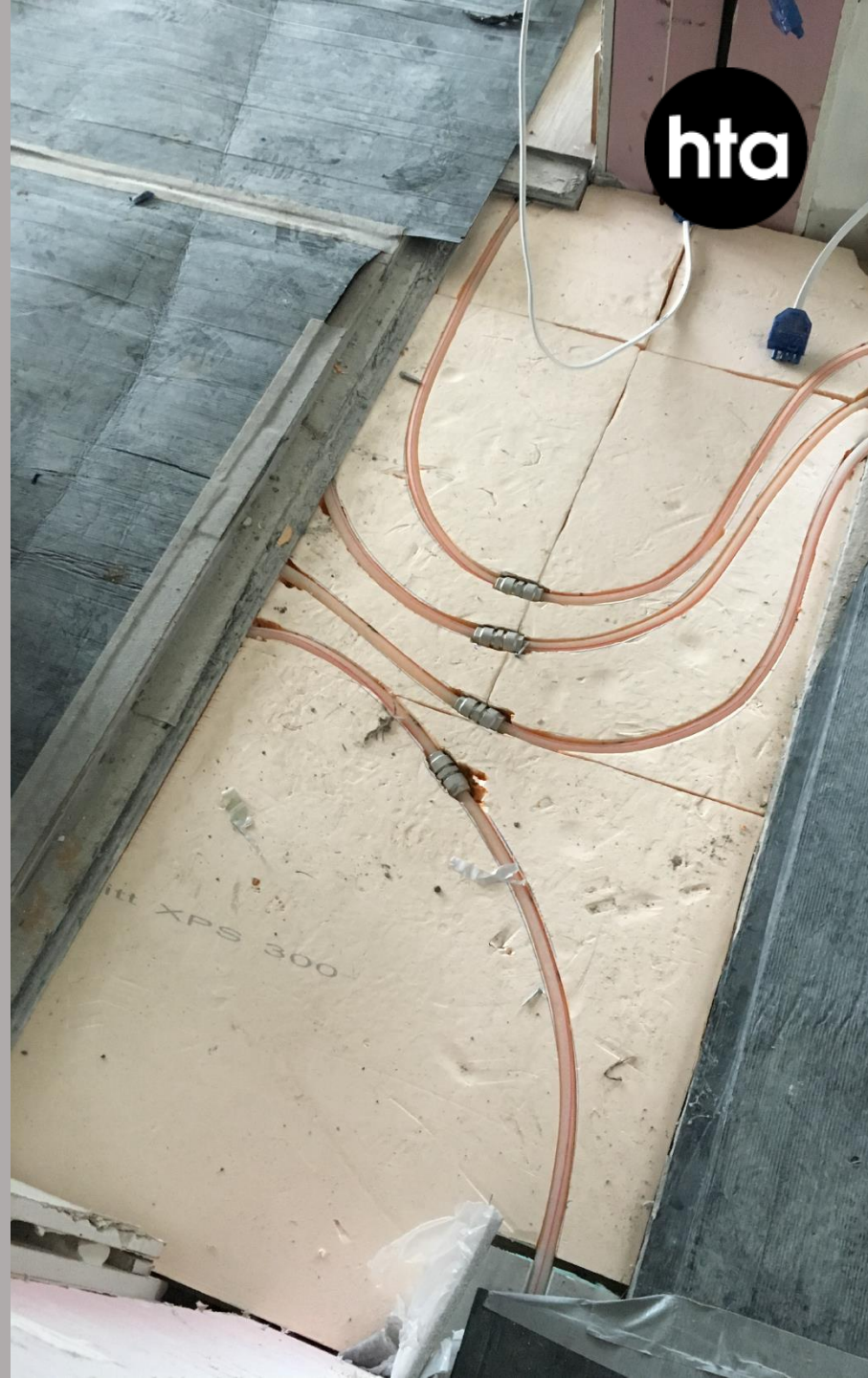

elements europe



Standardising Modular



Standardising Modular



Standardising Modular



Standardising Modular



Standardising Modular



Standardising Modular



Standardising Modular



Standardising Modular



3.0

WHY STANDARDISE?

Standardising Modular



Benefits of Switching to Modular construction

Speed and Cost

- Faster delivery on site
- Reduced exposure to unpredictable weather
- Improved cost certainty
- Faster delivery reduces site costs and prelims
- Quicker return on investment
- Greater programme certainty reduces risk

Environmental

- Reduced use of materials and energy
- Lower levels embodied carbon
- Predictable environmental performance
- Achievable higher energy efficiency
- Reduced energy in use
- Reduced local environmental pollution
- Reduced movement to site - lower transport impact

Productivity, quality and choice

- Reduced need for on-site labour
- Improved quality control ensures performance of critical elements e.g. fire safety
- Reduced management and coordination workload
- Enables culture of continuous improvement
- Support repeat working - builds partnerships
- Capacity for just in time commissioning
- Easier building management and maintenance
- Improved data management and building information
- Reduced defects
- Options for pre-commissioning and testing offsite

Welfare

- Improved health and safety through project lifecycle and in use
- Improved working conditions - better retention

Standardising Modular



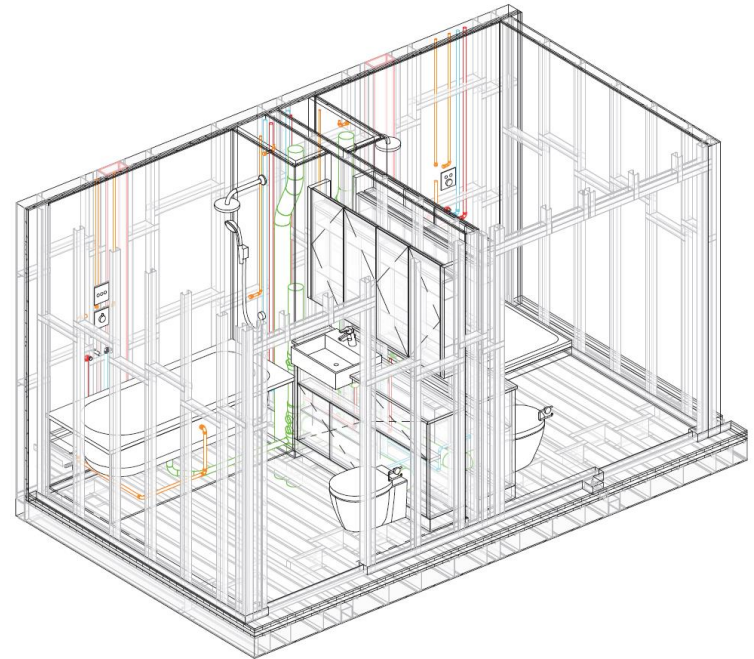
Key benefits to building operators / 1

Certainty of construction

- Built as specified - low or no product substitution
- Built as arranged - high degree of accuracy of records
- Offsite commissioning and testing drives improved services efficiency and reliability
- Reduced building defects due to factory quality control
- Performs closer to specification

Better data

- As built drawings mean as built
- Better supply chain management makes maintenance and replacement easier
- Greater accountability for failure or defects



Standardising Modular



Key benefits to building operators / 2

Manufacturing mindset and culture

- Culture of continuous improvement
- Capability to learn and improve
- Benefits returned to client

Post Occupancy Evaluation / soft landings

- POE feedback value increased for repeat clients
- Repeatable performance of modular enables lessons learnt to be captured effectively.
- Enables benchmarking of performance
- Improved data enables source of defects and problems in use to be resolved at lower cost and more effectively

Advanced Product quality planning

- Modular opens up opportunities for new value add process
- APQP - car industry origins, focused on client satisfaction

Five Key phases

- Planning and programme definition
- Product design and development
- Designing process for product manufacture
- Validate process and product
- Launch, assess, continually improve

**So WHY isn't
everybody doing
this already?**

Standardising Modular

There are complex issues with growing an efficient offsite manufacturing sector:

- Economic cycles and investment
- Fixed overheads
- Confidence in capturing benefits
- Confidence in knowing how to procure offsite modular with confidence
- A difficult feedback loop
- Low market capitalisation of manufacturers size of project versus size manufacturer

We have been looking at:

- Why this is (what is the problem?); and,
- What to do about it



Standardising Modular

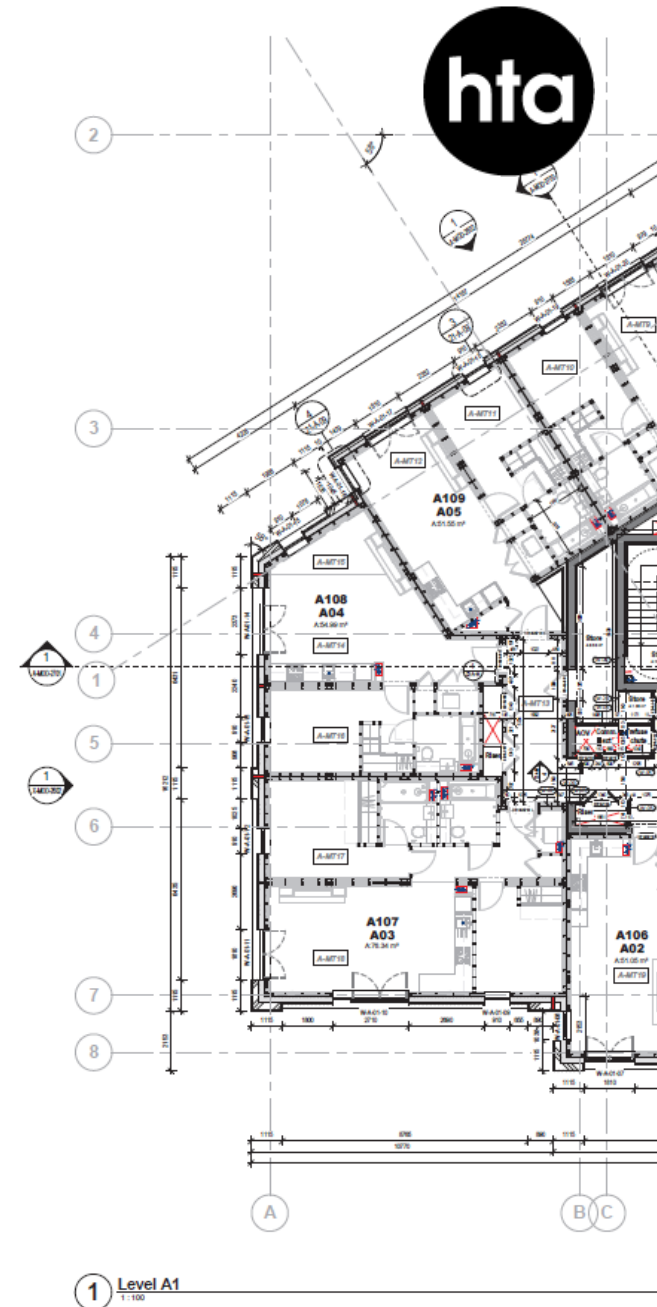
Key Client side Barriers

Scale and critical mass

- Lack of volume commissioning by large scale developers
- Lack of consistent and predictable commissioning pipeline

Client knowledge and confidence

- Lack of familiarity / confidence in how to commission modular
- Need for high degree confidence in supply capability
- Unwilling to commit to single suppliers
- Uncertainty around warranty transfer mechanisms
- Difficulty managing uncertainty (planning) with manufacturing pipeline
- Understanding of comparative quality and durability
- Nervousness about imported system QA



Standardising Modular

Key Client side Barriers

Finance and cost

- Finance required earlier in investment cycle - unfamiliar spending profile
- Potentially higher finance cost because of perception of risk
- Mortgage markets and availability
- *Demonstrating* value for money at procurement stage through better evidence of benefits
- Familiarity of client and procurement professionals
- Different ownership transfer mechanisms and payment

Insurance and risk

- Chain of ownership insurance requires different approach to valuation and management process
- Insurers need to improve understanding of how to manage risk - and that risk may be lower

Apex House Wembley

Europe's
tallest
modular
building



Standardising Modular

Key industry side Barriers

Realising economies of scale

- Need steady growth in demand to support investment in capacity whilst maintaining quality
- Need continuity of demand to capture increased productivity

Structural issues

- Strategic leadership and collaboration counterintuitive
- Client custom and practice of late changes
- Absorption rates narrow market likely to benefit most from offsite
- Challenge of moving away from diversified supply chain model
- Need for alternative contractual mechanisms

Economic

- Fixed costs (factory, direct staff cost) increase exposure to economic cycle
- Investment cost can be a barrier to entry for new entrants
- Still building confidence in warranty sector



Standardising Modular

Key industry side Barriers

Permissions

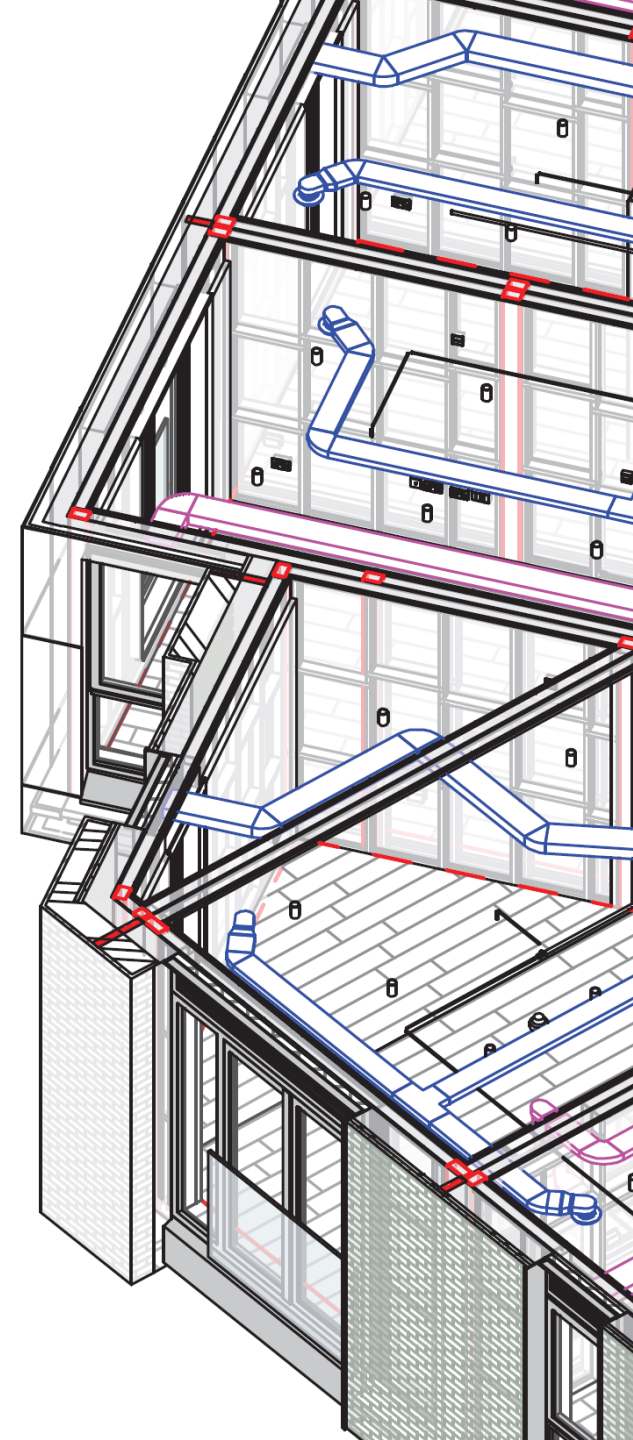
- Planning conditions unfavourable to modular / offsite e.g. local labour
- Need to revise planning permission to suit modular reduces speed benefits
- Planning uncertainty impacts on programmed factory throughput
- Lack of optimisation pre-planning reduces benefits of Modular
- Different approach needed to building control sign off

Standardisation

- Lack of standardised approach to commissioning
- Culture of late changes rather than early decisions works against standardisation
- Too much flexibility in demand weakens benefits of manufacturing approach
- Need to balance site specific conditions with standard products
- Lack of design team / contractor familiarity with offsite

Construction

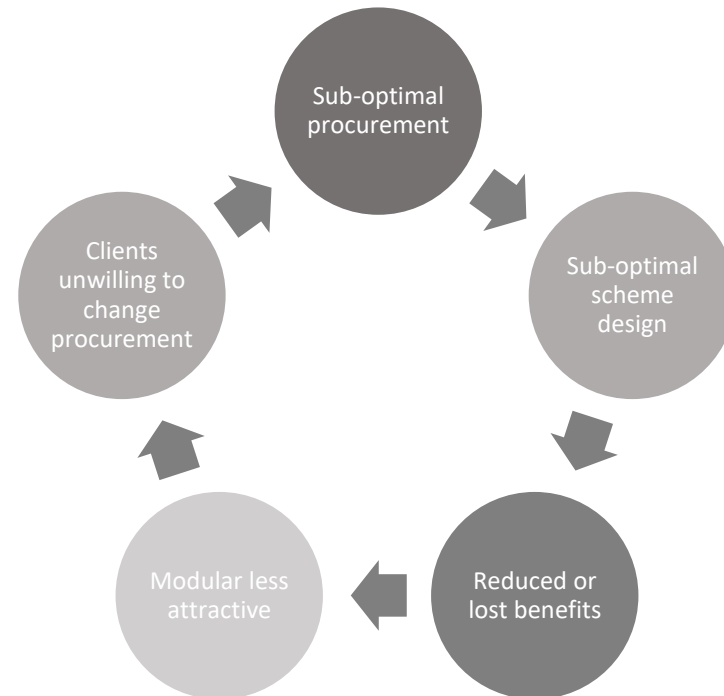
- Main contractor delays (enabling or structural) impact on factory throughput
- Traditional contractor lack of familiarity with modular / offsite construction process



Key Barriers - sub optimal cycle

In practice these factors combine to create a negative cycle:

- Clients are unwilling to commit at inception to use of a single modular supply chain (unfamiliarity, single supplier concerns) or amend procurement practice
- Briefing, finance and scheme designs emerge from planning sub-optimal for modular systems
- Re-design (and potentially planning re-negotiation) required which marginalises benefits, particularly speed
- Modular manufacturers struggle to achieve continuity of throughput which reduces savings and efficiency
- Lack of production continuity reduces capacity for investment
- Harder to maximise benefits for clients
- Modular less attractive to clients mitigating willingness to change procurement practice



Standardising Modular

Summary of issues

“ There is no lack of demand for new sources of supply - but there is a lack of understanding as to how to engage effectively with new supply chains.

We need to improve client competence in the procurement cycle so that they can be confident that they will get what they need.

And industry needs to be confident that clients will provide continuity in demand to make the long term investment in capacity that is required”



Key Barriers

Most of these key barriers are about

confidence

...and are founded in the challenges for all emerging markets of how to impart new

knowledge

Standardising Modular

How Standardisation can help

Standardising process

- Confidence in good practice
- Reduced errors
- Supports necessary culture change
- Opportunity to address concerns (finance, warranty, insurance)
- Early optimisation to enable use of modular
- Maximises opportunity to capture benefits
- Opportunity to learn and improve

Standardising Product

- Scheme commissioning without commitment to single supplier
- Diversification of modular system choice available to client
- Improves continuity of manufacture for system suppliers
- Improves market structure to incentivise investment
- Further enables economies of scale; and
- Maximises benefits of manufacturing approach



Standardising Modular



Standardised glossary
of terms and
definitions

How to use this
standard

Introduction

Guidance –
procurement
strategies for
modular systems

Generic design
parametrics for
modular systems

Design rules for
modular systems

Overview of offsite
systems and benefits

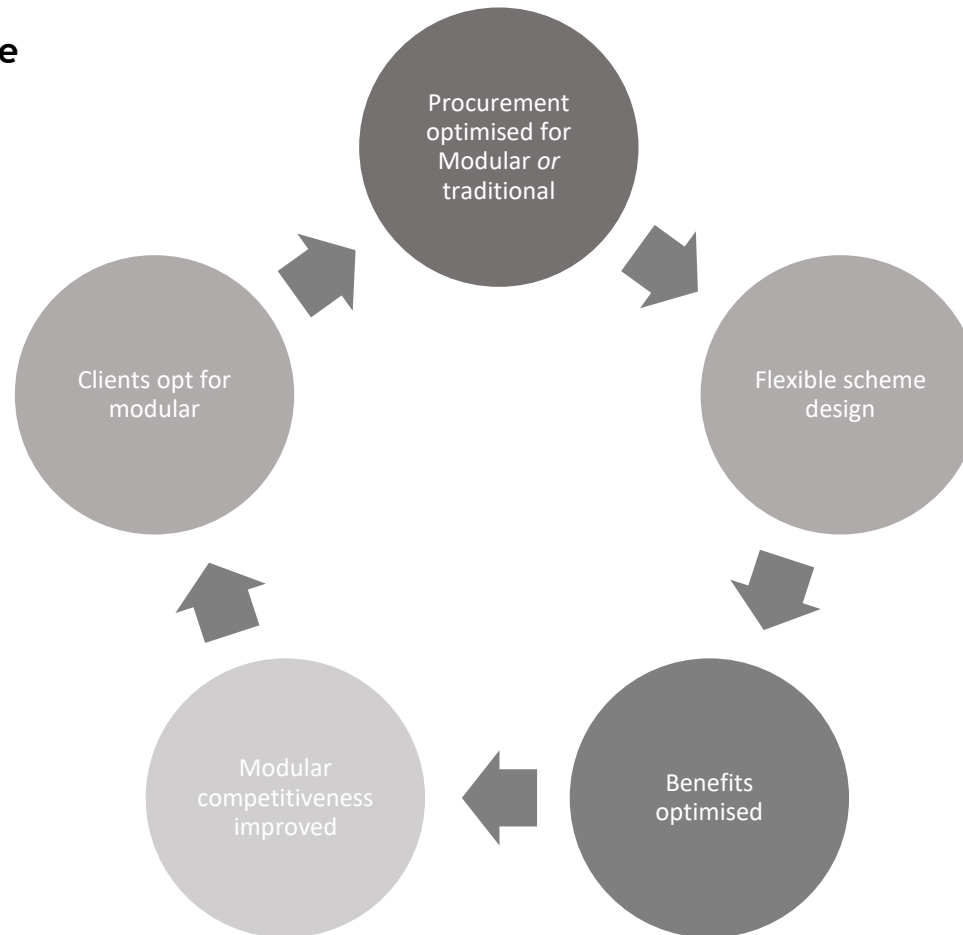
Informative guidance
planning, finance and
warranty

Introduction

Standardising Modular



Establishing a virtuous cycle



4.0

FURTHER CASE STUDIES



**£100k
to build**

**100 hours
build time**

**to last over
100 years**

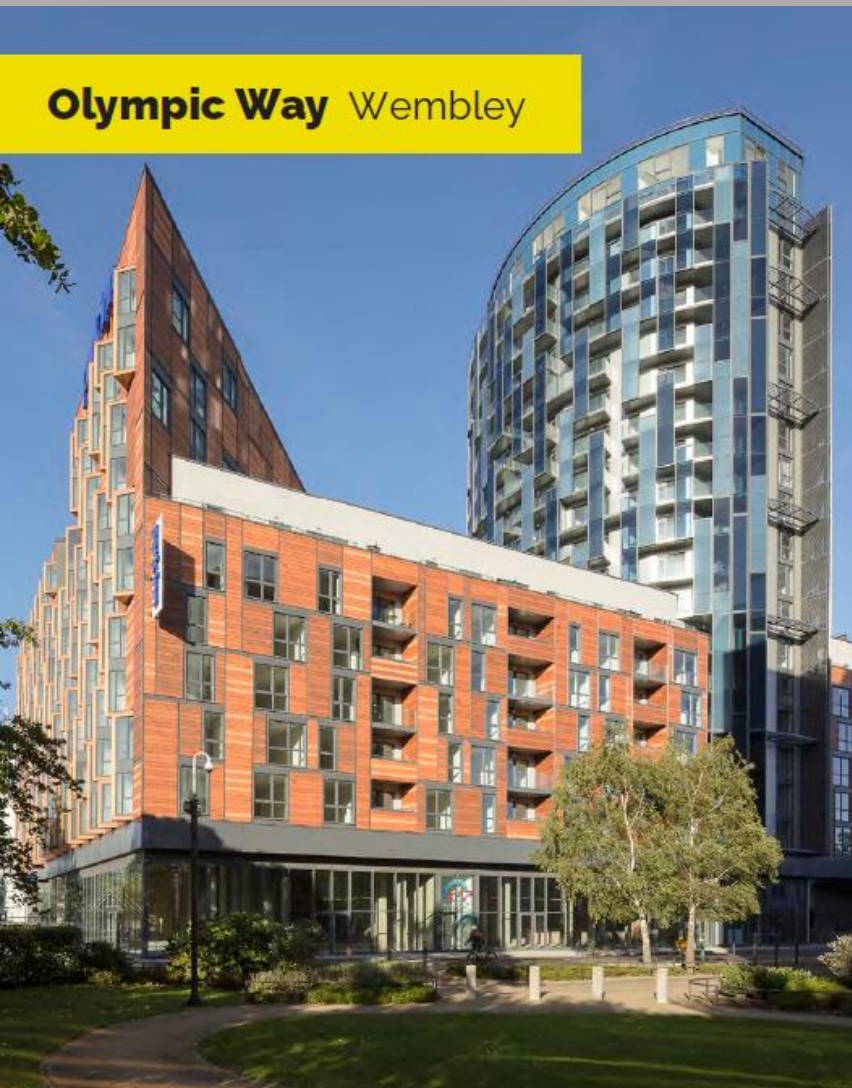


a project in
collaboration
with ilke
homes

winner
Sunday Times
British Home
awards 2018

The logo consists of the lowercase letters 'htc' in a white, sans-serif font, centered within a solid black circle.

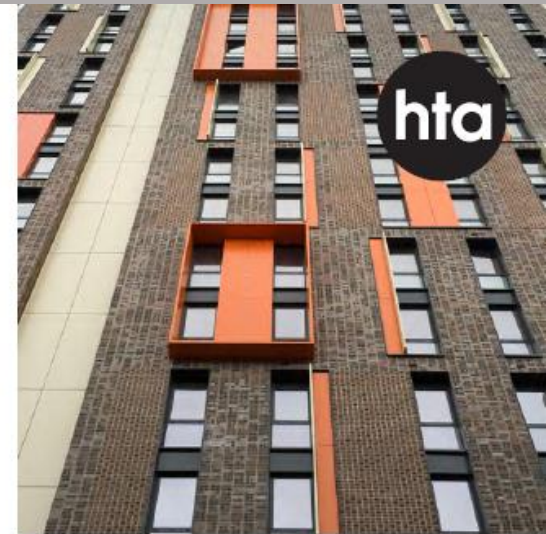
Olympic Way Wembley



Karma House Wembley



Dexion House Wembley



Apex House Wembley

hta

679
Indv. Modules

558 homes
0.18 ha
3100 dw/ha

Tide
Construction

Greenford Green Ealing

shops, cafes & restaurants, a health centre & primary school

new offices & employment opportunities

a new pedestrian bridge over the Grand Union canal

Improved accessibility, new streets & better transport links

refurbishment of Glaxo House



Holloway Road Islington

hta

310
Indv. Modules

257 homes
0.79 ha
325 dw/ha

Tide
Construction

Savoy Circus Hammersmith

hta



338
Indv. Modules

306 homes
1.6 ha
191 dw/ha

Tide
Construction

George Street Croydon



1400
Indv. Modules

546 homes
0.22 ha
2482 dw/ha

Tide
Construction

THANK YOU!

