

Highfields PassivHaus & Modular Housing to tackle the housing crisis

Wates

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FF
DD

 Cartrefi
Caerdydd
Cardiff
Living

 Wates

Passivhaus Highfields

 Cartrefi Caerdydd
Cardiff Living

PROSIECT TAI
PARTNERIAETH
A PARTNERSHIP
HOUSING PROJECT

 CARDIFF
CAERDYDD

 Wates
RESIDENTIAL



Creu Lleoedd Cymru
Placemaking Wales

Llofnodydd y Siarter | Charter Signatory

Introduction



- Cardiff Council's first Passivhaus Scheme
- Originally a mixed tenure development of:
 - 30 homes for sale
 - 10 for affordable rent
- Impact of COVID
 - Construction continued throughout lock down period
 - Increased demand for affordable housing
 - Sale market on hold
 - Project switched to 100% affordable
- Innovative Housing Programme Grant Funding - £1.16m
- Development Mix of 12 houses and 30 flats



Project Summary



- **Highfields - Project Summary**

- Former Water Works treatment plant
- Former Highfields Resource Centre
- Existing Care home buildings demolished by Cardiff Council
- **Passivhaus scheme:**
 - **PHI Low Energy Building for the houses (30kwh (m²A))**
 - **Passivhaus for apartments (15kwh (m²A))**
- Innovative Housing Programme Grant Funding - £1.16m
- Development Mix of 12 houses and 30 flats
 - 100% Affordable
 - 2 house types (slight change to first floor)
 - 2 flat types (1 Bed / 2 Bed)

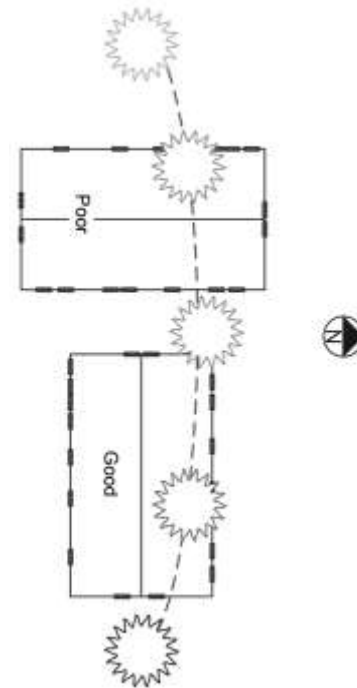
- **August 2020 Figures**

- **Project Value (JCT Contract) - £11,704,111**
- **Overall cost per m² £3,780** (including abnormals)
- **Excluding Abnormals**
(infrastructure/utilities/ground conditions)
- £8,887,703
- £2,870 per m²
- **Excluding Passivhaus**
- £6,515,468
- £2,104 per m²
- **Passivhaus circa 29% cost uplift for this project**
- **Passivhaus typical uplift circa 20-25%**

Challenges



- **Planning Restrictions**
 - **Existing Street Grid**
 - **Orientation**



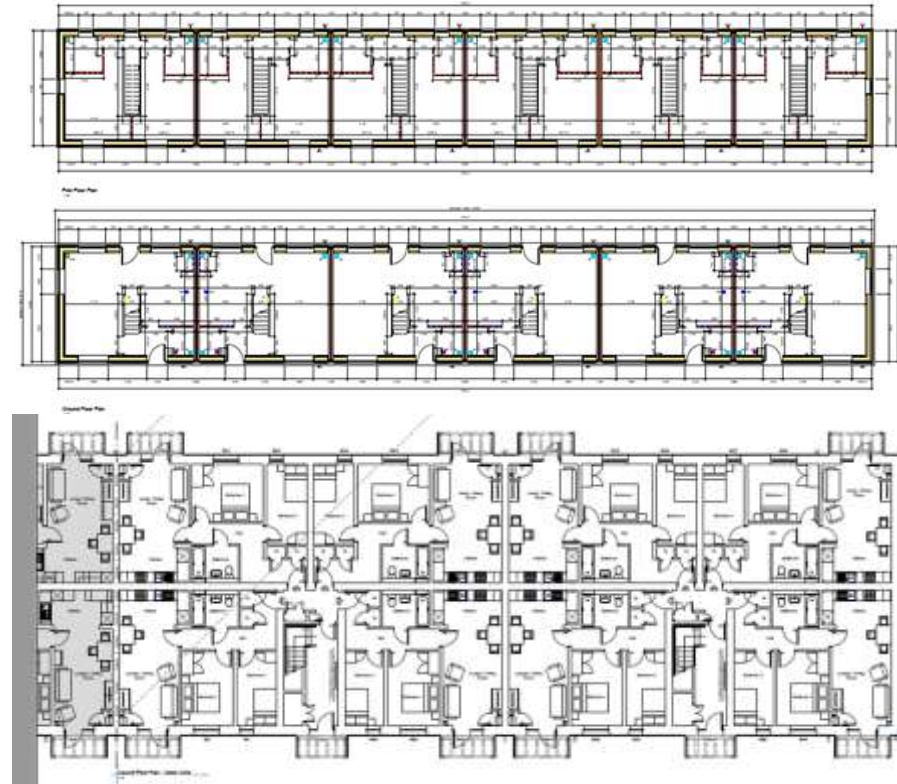
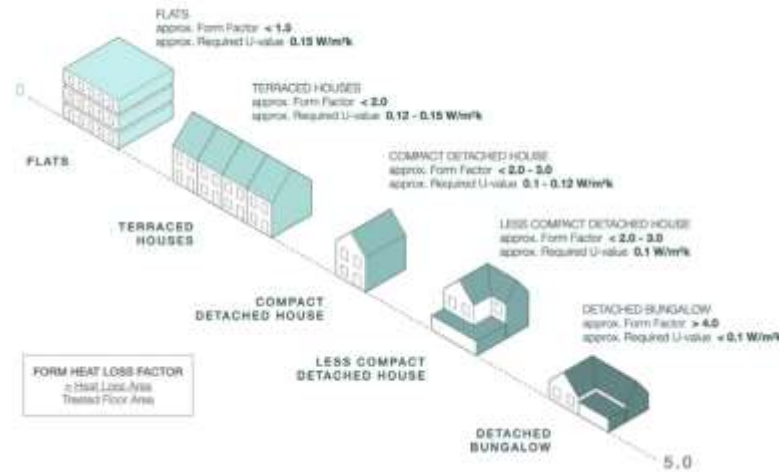
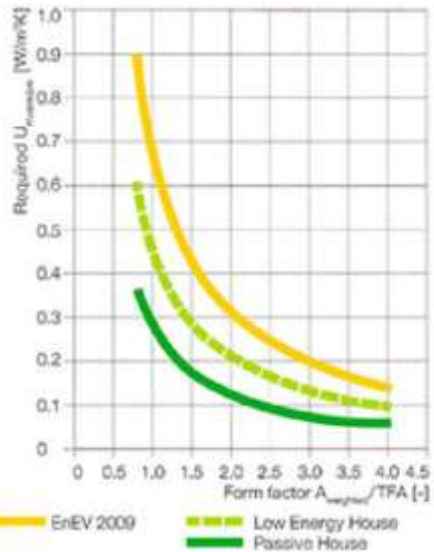
Worst possible orientation

Challenges



- **Planning Restrictions**
 - **Form Factor**
 - **<1.5 is good. Should not be above 3**

- a) **Highfield - Houses Form Factor – 3.13**
- b) **Highfields – Apartments Form Factor – 1.84**



PassivHaus Planning Package Outputs



Houses PHPP

Specific building characteristics with reference to the treated floor area				Criteria	Alternative criteria	Fulfilled?
	Treated floor area m ²	307.7				
Space heating	Heating demand kWh/m ² a	16.7	30	-	yes	
	Heating load W/m ²	11.3	-	-	-	
Space cooling	Cooling & dehum. demand kWh/m ² a	-	-	-	-	
	Cooling load W/m ²	-	-	-	-	
Airtightness	Frequency of overheating (> 25 °C) %	3	10	-	yes	
	Frequency of excessively high humidity (> 12 g/kg) %	0	20	-	yes	
Non-renewable Primary Energy (PE)	Pressurization test result n ₅₀ 1/h	1.0	1.8	-	yes	
	PE demand kWh/m ² a	127	135	-	yes	
Primary Energy Renewable (PER)	PER demand kWh/m ² a	96	-	-	-	
	Generation of renewable energy (in relation to projected kWh/m ² a building footprint area)	-	-	-	-	

PHI Low Energy Building for the houses (30kwh (m²A)
 Predicted EPC B
Apartments PHPP

Specific building characteristics with reference to the treated floor area				Criteria	Alternative criteria	Fulfilled?
	Treated floor area m ²	1858.4				
Space heating	Heating demand kWh/m ² a	14	15	-	yes	
	Heating load W/m ²	9	-	10	-	
Space cooling	Cooling & dehum. demand kWh/m ² a	-	-	-	-	
	Cooling load W/m ²	-	-	-	-	
Airtightness	Frequency of overheating (> 25 °C) %	1	15	-	yes	
	Frequency of excessively high humidity (> 12 g/kg) %	0	20	-	yes	
Non-renewable Primary Energy (PE)	Pressurization test result n ₅₀ 1/h	0.6	0.8	-	yes	
	PE demand kWh/m ² a	98	135	-	yes	
Primary Energy Renewable (PER)	PER demand kWh/m ² a	73	-	-	-	
	Generation of renewable energy (in relation to projected kWh/m ² a building footprint area)	0	-	-	-	

Passivhaus for apartments (15kwh (m²A)
 Predicted EPC B

Fabric Performance	HOUSE	APARTMENT
	PHI	Passivhaus
Ext. Walls (W/m2K)	0.135	0.173
Party Walls (W/m2K)	0	0
Semi exposed walls, incl. adjustment (W/m2K)	n/a	n/a
Floor (W/m2K)	0.062	0.0635
Roof (W/m2K)	0.071	0.15
Windows (W/m2K) (Whole Window)	0.84	0.74
Doors (W/m2K)	0.84	0.74
Air Permeability m3/ m2/h	1.0	0.64

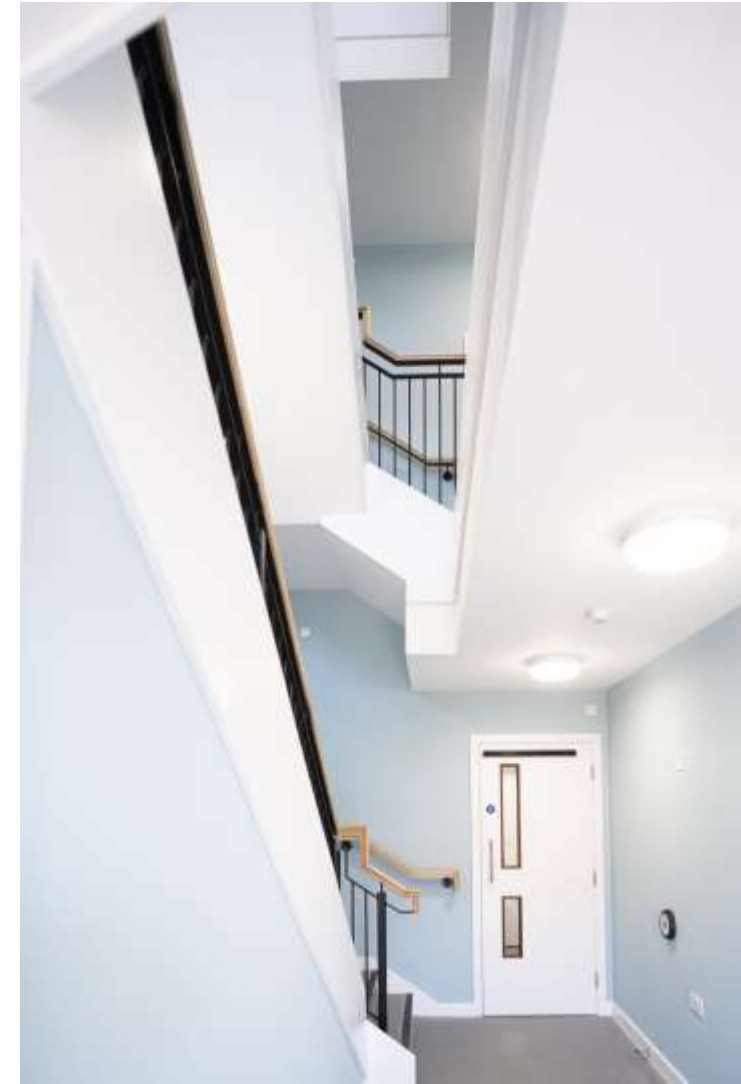
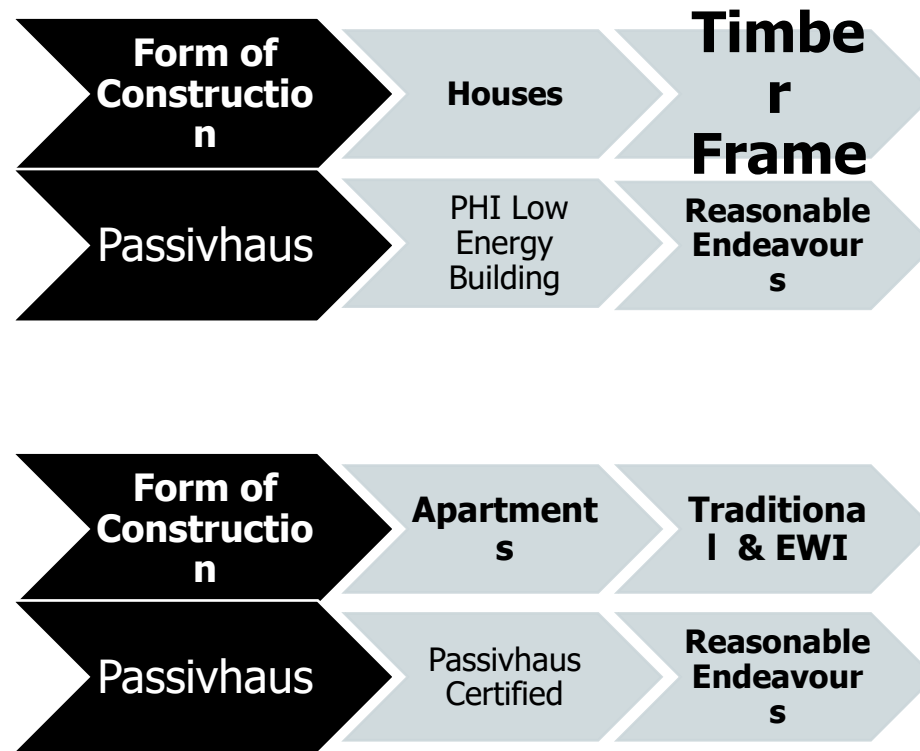
Passivhaus



Passivhaus



Construction Types



Passivhaus



Passivhaus



Contract outcomes

- Completed on time and to budget
- Exceeded Contractual Requirements

Buildings	Target Air Tightness	Actual	Target Passivhaus	Actual
Apartments	0.6 m ³ / m ² /h	0.4m³/ m²/h	Passivhaus Certified	Passivhaus Certified
Houses	1.0 m ³ / m ² /h	0.5 m³/ m²/h	PHI Low Energy Building	Passivhaus Certified

- Whole Life Carbon assessment
- Post occupancy Evaluation
- Lessons Learned

Whole Life Carbon Assessment

	GLA Benchmark	GLA Aspirational Benchmark	Highfields Development	Highfields Apartments	Highfields Houses
Form of Construction				Traditional	Timber Frame
Materials Embodied Carbon Module A1-A5	<850	<500	513	552	432
In Use and End of life Module B-C (excluding B6&B7)	<350	<300	158	150	175
A-C (excluding B6 & B7, including sequestration)	<1200	<800	646	692	550

Passivhaus

Lessons Learned



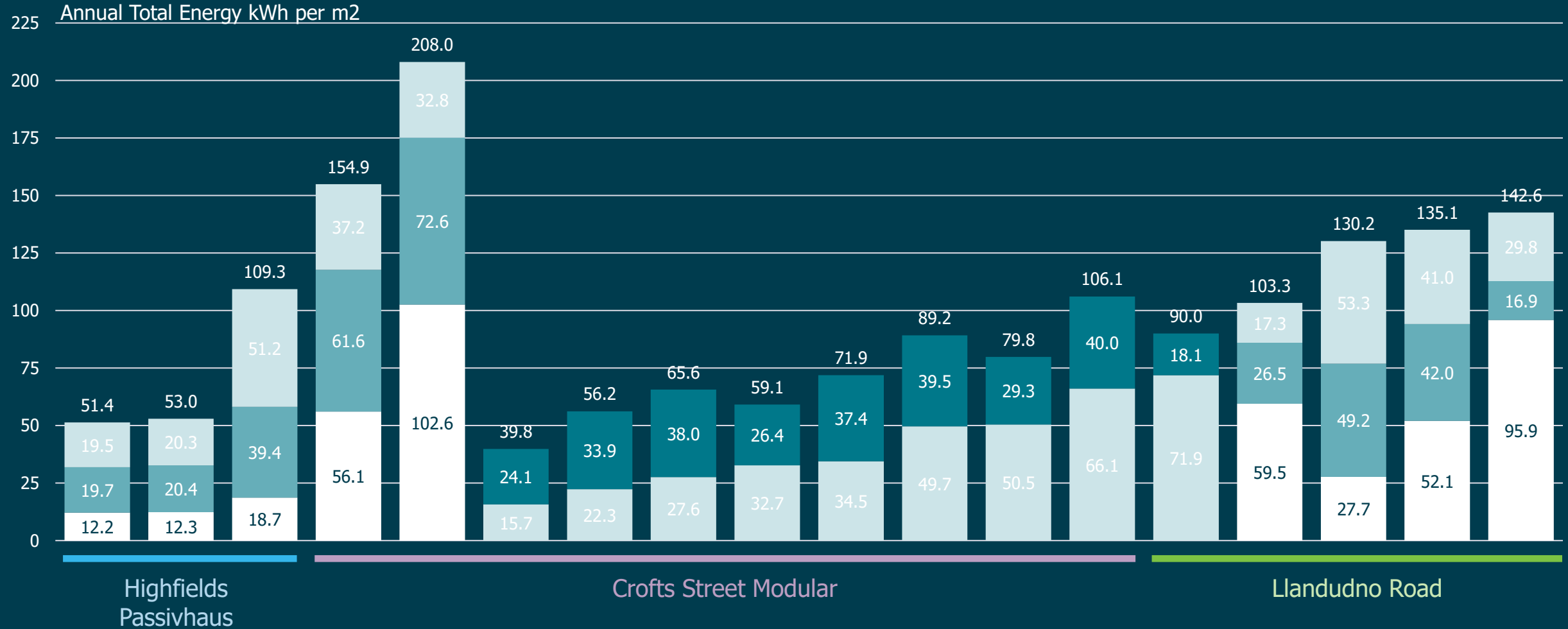
Concept Stage or Tender Stage

1. Passivhaus will not work for all projects and building typologies
2. Must be designed in at from concept Stage 1
3. What is the experience of the proposed design team
4. Is the Passivhaus consultant the architect or an independent assessor
(preference for Architect/assessor)
5. What is the orientation of the site (3.5kwh/m² difference if optimised)
6. What is the building typology and form factor
7. Are there significant projecting elements
8. MEP penetrations and specification e.g. MEVHR
9. What are the design stage PHPP outputs
10. Understand the PHPP
11. Need headroom/contingency (2-3kwh)


On Site Risk Mitigation

1. "Passivhaus Champion"
2. Passivhaus be-spoke - site specific training for the site team
3. Workshops with Passivhaus Consultant and supply chain
4. Passivhaus Test Area
5. Passivhaus Quality Control Document
6. Passivhaus Test and Inspection checklist
7. No blame culture
8. Peer review of design proposals
9. Check and hold stages
10. Buying own air testing kit and training on how to use - Air tests at key stages
11. Key stage design reviews
12. Good Programme planning - allow time for inspections, tests & remediation. Programme duration 18 weeks longer due to Passivhaus which equates to circa 20% of the overall programme duration

POE – Cardiff Met Data Energy



Cardiff Met Data Energy Costs

 Energy cost for two of the Highfields houses illustrate how important resident behaviour is.



Background & Context



- › Ukrainian Refugees & other families fleeing conflict
- › Deepening Housing Crisis
- › Use of Brownfield sites on a temporary basis
- › Increased use of temporary hotel accommodation
- › Need for additional accommodation to be made available at scale and pace
- › Static caravans proposed as immediate short-term solution on Gaswork's site
- › Modular Accommodation Proposal





Project Summary



A new product from Scratch

- › Gasworks Site
 - › Brownfield
 - › Contaminated-changing foundations
 - › Earmarked for future development
- › 155 modular units (1 – 4 beds)
- › Community hub
- › Fabric first approach
- › EPC A
- › SAB & Sprinklers...
- › No fossil fuels
- › All modules capable of being relocated
- › Private infrastructure
- › SOS 27th March 2023
- › First modular delivery August 2023
- › Completion May 2024
- › 59 weeks total (100w+ faster than trad)
- › Turnover £1m a week

Funding

- › Original Brief/Proposal June 2022 Cardiff Council Funded
 - › Meanwhile use space standards
 - › Fabric first
 - › No Fossil fuels
 - › EPC A
- › Welsh Government Transitional Accommodation Programme funding became available in August 2022
 - › Cardiff Council Submitted Bid for TAP Funding
 - › Successful bid for 50% of the capital cost of the project
 - › Grant Conditions
 - › No Fossil Fuels
 - › EPC A
 - › WDQR Space Standards & Lifetime Homes
 - › Redesign of homes required to ensure compliance



Challenges and Innovation



- › Challenge set on 20th June 2022
 - › Provide 200 homes, DQR/Lifetime homes & building regulations compliant
 - › Start on site within 6 months
 - › Temporary homes seen as solution initially
- › Review of temporary accommodation and modular providers undertaken (but often steel container type)
- › Decision to go with modular option based on:
 - › Wates & Cardiff's previous experience with modular
 - › Quality of accommodation-Apt in a box **Innovation**
 - › Reusable permeant accommodation option
 - › July 2022 3 primary modular providers identified
- › Site Challenges
 - › Site to be redeveloped in 5 years' time
 - › Site contaminated
 - › Proposed final remediation strategy long term solution
- › Site innovation
 - › Innovative foundation systems & gas barriers to limit ground penetrations
 - › Single storey design to reduce load and need for piled foundations
 - › Capping remediation strategy with no dig barrier
 - › services kept were possible in capping
 - › No-adopted infrastructure strategy to limit abortive work and costs and allow for quicker removal in future (no devesting required)
- › Planning & Speeding up...
 - › Emergency powers used to expedite the development
 - › Retrospective planning still required Lack of formal process did create some difficulties
 - › Assistance and cooperation of statutory authorities critical



Innovation Success



- › Application of modular construction (Offsite)
 - › Scale
 - › Pace
 - › Simplify onsite works
- › Design for Manufacture from outset
- › Early engagement and appointment of supply chain
 - › 3 final selected manufactures went from standing start to design and manufacture in the space of a few weeks
 - › All parties had to work differently
 - › Coordinate design modular & substructure design
 - › Parallel working not sequential working
- › Circular Economy
 - › All modules designed to be relocatable **Innovation**
 - › Designed to be stackable (flexibility for use on other sites) **Innovation**
 - › Infrastructure kept to minimum
 - › Trees in planters
- › Two major changes introduced to the brief:
 - › Welsh Government TAP funding in August 2022 – all except one bed modular redesigned to WDQR & LTH space standards
 - › Part of site reallocated for future warehouse provision required redesign of layout and infrastructure and reduction in numbers to 155
- › Selection of 3 Suppliers
 - › Multiple suppliers selected to:
 - › Provide supply chain flexibility
 - › Trial & compare different systems
 - › Security of supply from risks of failure to deliver to programme or insolvency **Innovation**
 - › Ability to switch production to maintain supply if necessary **Innovation**
 - › This adoptability was required
 - › Supply failure
 - › Insolvency

Sustainability

Circular Economy

- › Modular Design: All modules created for easy relocation
- › Stackable Units: Single-story design to bypass the need for piling
- › Future Site Strategy: Modules to be moved in 5 years for site remediation and redevelopment
- › Sustainability Focus: Minimise future waste and dismantling work, includes:
 - › Foundation strategy (no piling)
 - › Remediation/contamination strategy
 - › Gas mitigation
 - › Foul drainage used existing runs and connections were possible
 - › Reuse of site won materials
 - › No adopted roads
 - › Private services network

Energy Strategy



› **Fabric first**

› **No fossil fuels**

› **EPC A**

› **Fuel Poverty**

Wellbeing

› **Apart from meanwhile use units all units designed to be WDQR and LTH compliant**

› **High quality homes**

› **Homes permeant only the site is temporary**

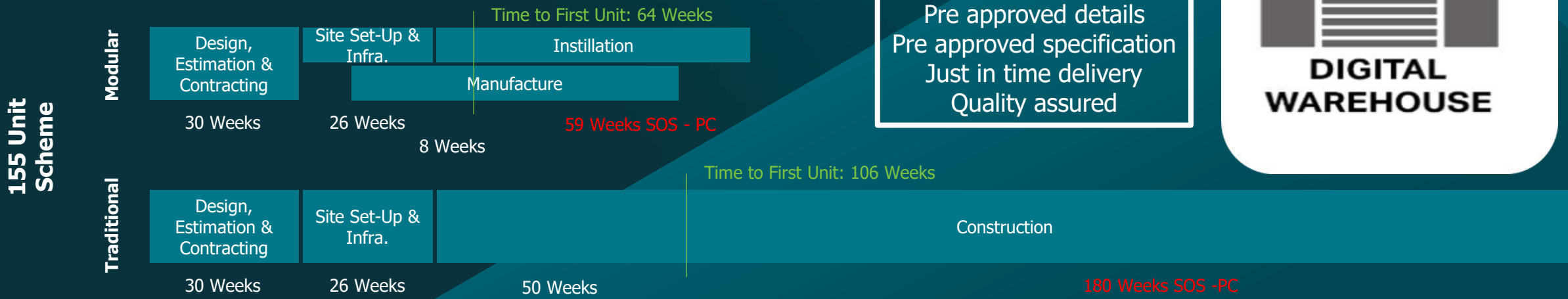
› **Community Hub**

› **Place making & sustainable communities**

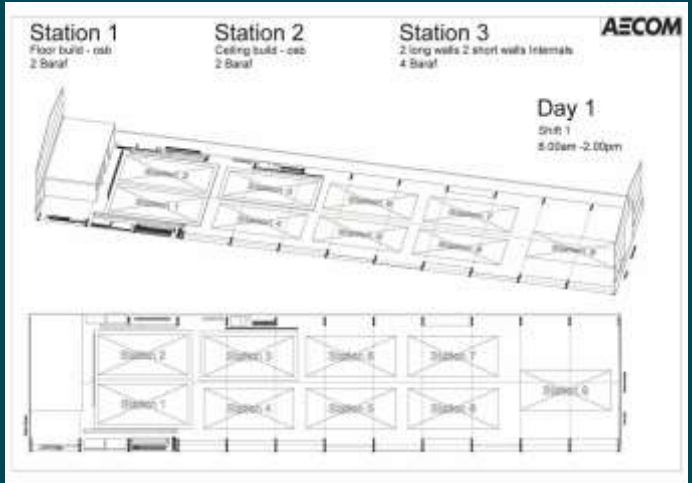
› **High-quality landscaping**

Speed of build v Traditional approaches

Indicative Timeline for MMC vs. Traditional Scheme



supply chain
innovation
Design for Manufacture
Pre approved details
Pre approved specification
Just in time delivery
Quality assured



Conclusion



- › Groundbreaking innovative project-borne out a true need in society to minimise trauma to families
- › Design for Manufacture
- › Sustainability
- › Circular Economy
- › Exemplar of public private sector partnership
- › Collaborate working at its best
- › Demonstration of how the parties reacted at speed using alternative procurement approaches to address an immediate challenge requiring an immediate and effective response
- › Innovative thinking and approaches to address the construction challenge
- › Use of modular housing to address housing crisis
- › Application of modular housing at scale
- › Delivery of high quality accommodation at speed and pace-with efficiencies for next workstream



Gas Works



Summary	
Client	Cardiff Council
Units	157 (incl communal support buildings)
Contract Value	£42m
Contract	JCT DB 16
Duration	weeks
Mix	100% Affordable
Type	Transitional Accommodation
Funding	Cardiff Council Welsh Government



THANK YOU

Questions

