- **Title:** Industrialised Construction: A New Chapter Beyond MMC
- **Subtitle:** Understanding the Shift from Modularity to Process-Driven Assembly
- **Presented by:** Strata | May 2025

- **What is Industrialised Construction?**
  - Process-driven, not product-led
  - Applies advanced manufacturing principles (standardisation, automation, DfMA)
  - Focuses on repeatable components assembled onsite
  - Aims for improved speed, quality, compliance, and cost-efficiency

- **Why Industrialised Construction Now?**
  - Addressing legacy inefficiencies in construction
  - Enabling decarbonisation and whole-life value
  - Aligning with Government frameworks and mandates (e.g. Construction Playbook, BSA)
  - Mitigating skills shortages via factory-based roles

# Industrialised vs Modular Construction

| Aspect | Industrialised Construction | Modular Construction |
|---|---|---|
| Form | Kit-of-parts / components | Whole-box volumetric modules |
| Flexibility | High – hybrid/panelised/volumetric | Low – fixed dimensions/layouts |
| Supply Chain | Open, non-proprietary | Closed, vertically integrated |
| Assembly | Onsite assembly | Modules delivered 80–90% complete |
| Logistics | Flat-pack, and pods, efficient | Bulky transport needs |
| Risk Profile | Low – diversified suppliers | High – single point of failure |

- **MMC Didn’t Fail – Execution Did**
  - Over-promised, under-delivered
  - Key reasons modular housing failed:
    - Unrealistic investor expectations
    - Closed, IP-heavy systems
    - Factory overheads + demand uncertainty
    - Supply chain resistance
    - Regulatory headwinds (post-Grenfell)
    - Cultural scepticism (planning/funding)

Caledonian Modular

ilke HOMES

TopHat

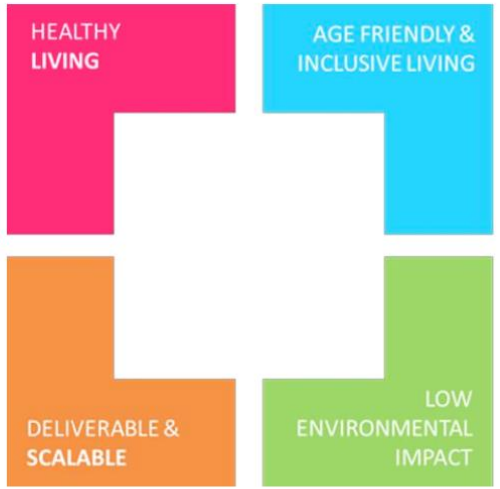
Legal & General MODULAR HOMES

| TOP TEN MMC ERRORS | THE PROBLEM | THE SOLUTION |
|---|---|---|
| Wrong Team & Collaboration | Not employing the right team members from day one and unable to think from first principles | Get the right team together! Find experienced and proactive consultants who share your values |
| Procurement Routes | A D&B procurement route is problematic unless contractors are brought onboard early | Use sub-contractors, work with manufacturers, using a PCSA from early in the design process |
| High capital expenditure & funding gaps | Spending too much money upfront increases the risk of catastrophic failure | Start small, test, feedback mistakes and then scale. Look for funding opportunities |
| Too much complexity | Choice is good, but can also be bad – too much choice creates manufacturing process inefficiencies and errors | Narrow down the choice to only what is essential to offer consumers and has the greatest impact |
| Over Designed and Engineered | Too much material through over engineering creates increased costs plus bad architecture! | Keep it simple. Don't over think it and overdesign. Consider aligning with NHBC etc |
| Lack of Pipeline & availability of Land | No ownership of land or insufficient pipeline of clients with land | Owning suitable land is king, safeguarding your own pipeline. Only produce what is required |
| Site conditions & transport | Site topography, other features and access can be problematic meaning viability is an issue | Consider designing elements to be small and nimble and design in for difficult sites |
| Built in Design Flexibility | Spending time and money creating a design which can't be adapted to future needs | Design in for flexibility without returning to the drawing board and consider iterations |
| Design and manufacturing interaction | Lack of communication between the design team and manufacturing team getting it built | Close collaboration is essential, keeping golden thread of communication clear and |

HOME OF 2030

bre | Design Council | MOBIE Ministry of Building Innovation and Education | RIBA | HM Government

1. **Age Friendly and Inclusive Living** - address a gap in the housing market for new homes which appeal to and cater for a variety of age groups, adaptable to changing uses and needs over lifetime for a healthy and inclusive community.
2. **Low Environmental Impact** – applying technology and construction techniques that will deliver net zero emissions and high quality outcomes, reduced fuel bills and improved occupant health.
3. **Healthy Living** – promoting better health and wellbeing to enhance quality of life within homes.
4. **Deliverable and Scalable** – solutions that can deliver market needs at scale and are cost-effective.




Design Council

HOME OF 2030

# A Public Vision for the Home of 2030





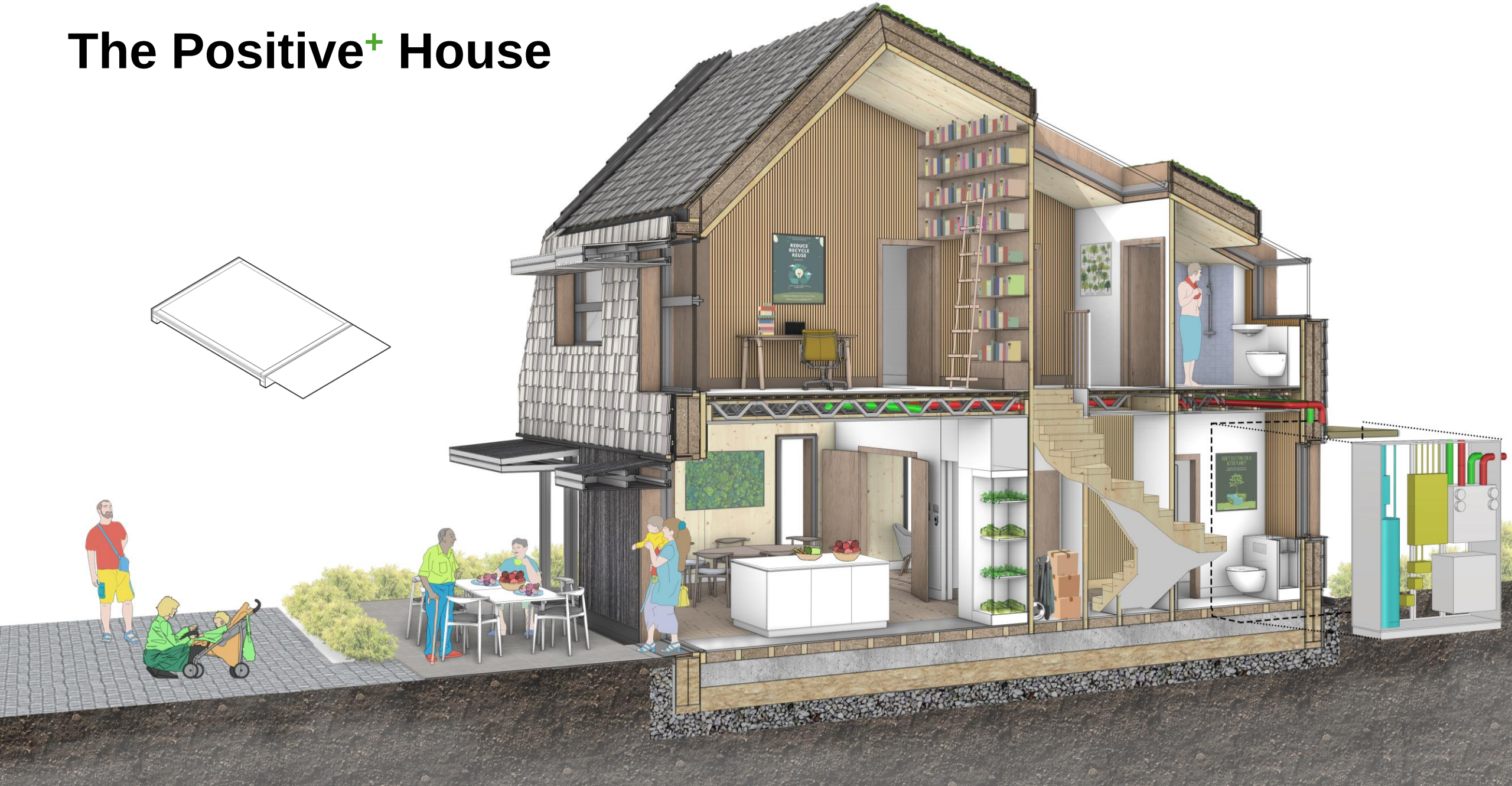




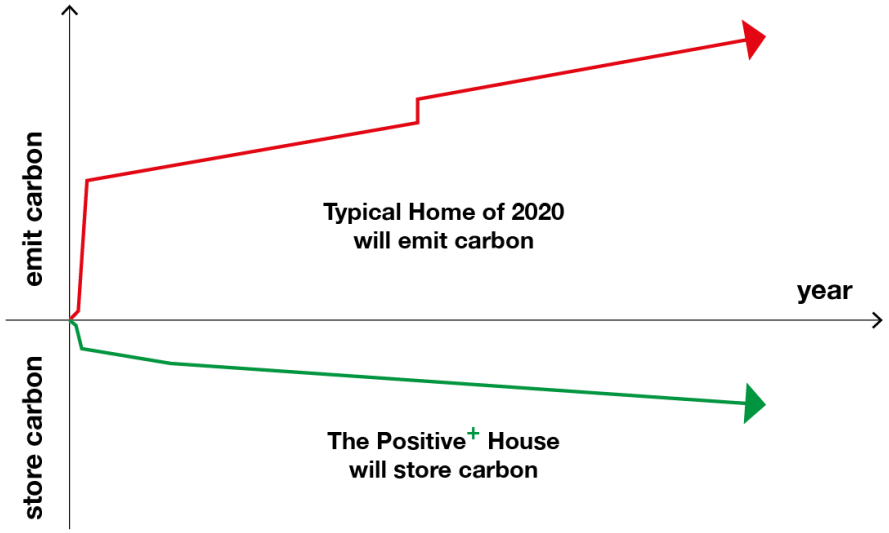



# The Positive+ House

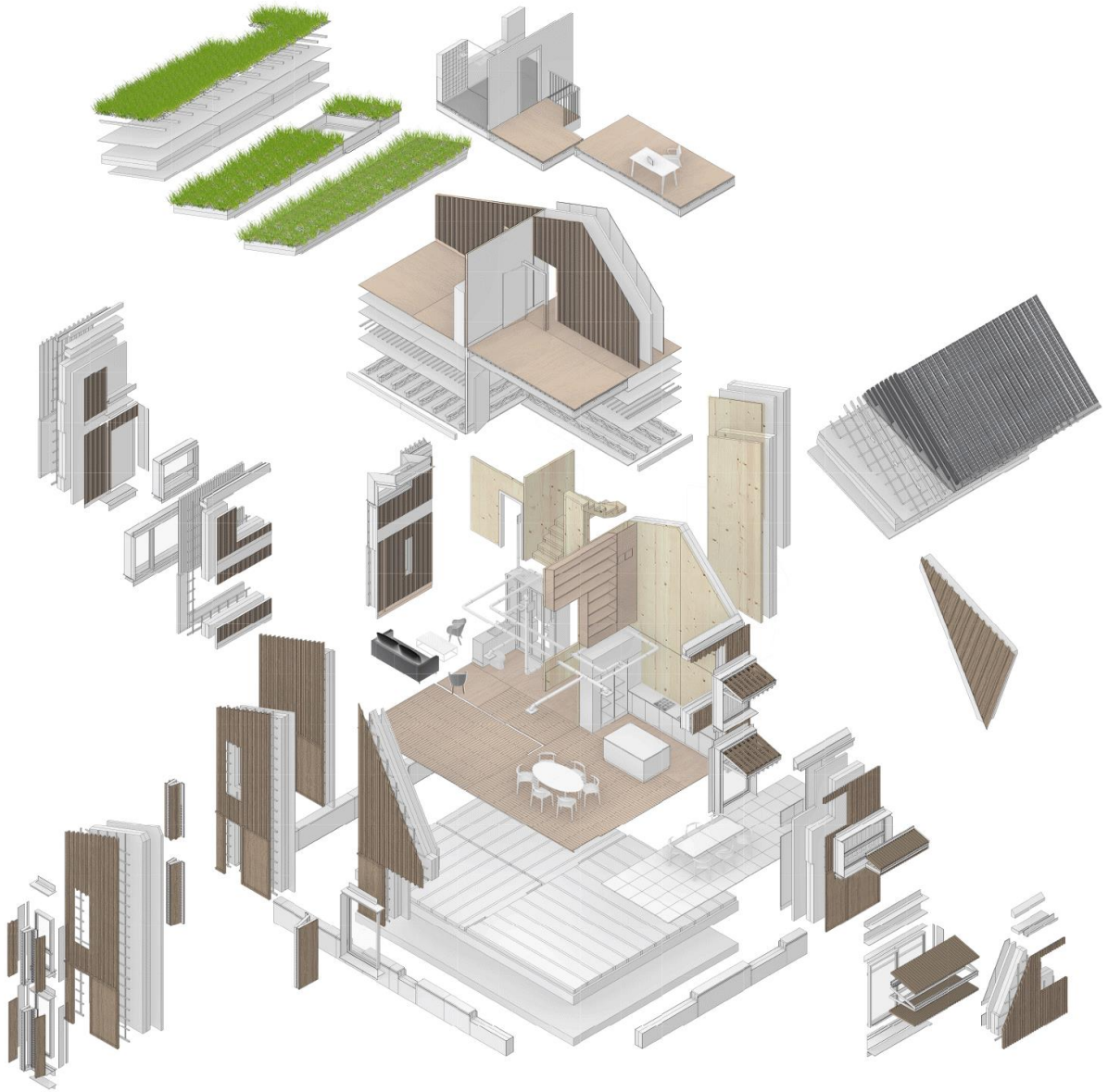




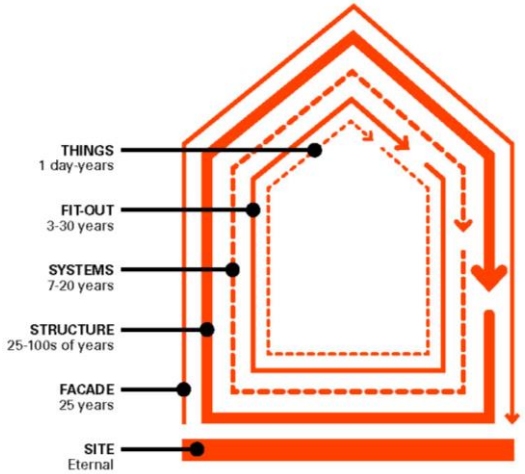
# Integrated digital process

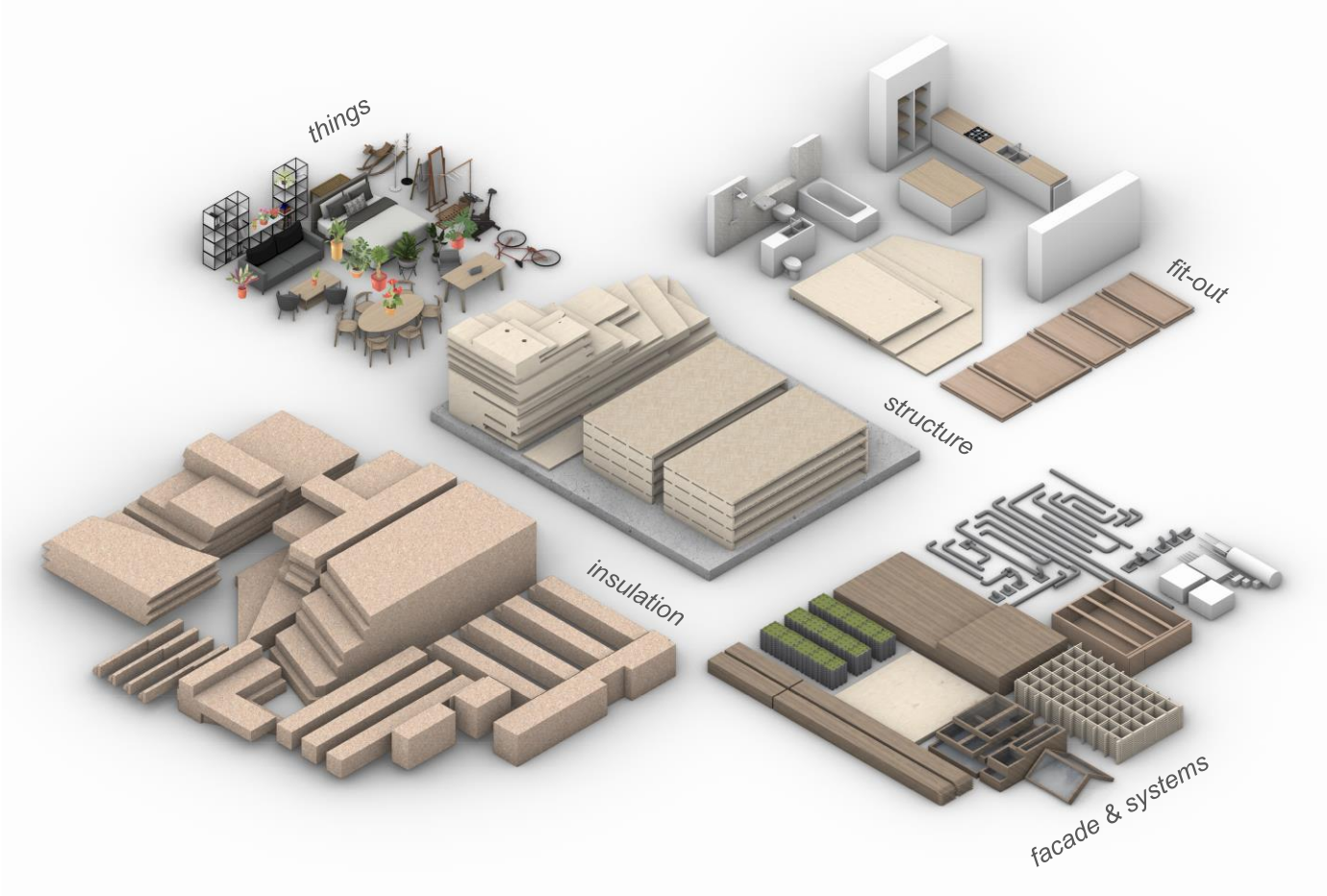



Adopting a distributed manufacturing approach, enables component-driven flexibility through a fully integrated digital process working directly with suppliers and manufactures.



# Getting the ingredients right

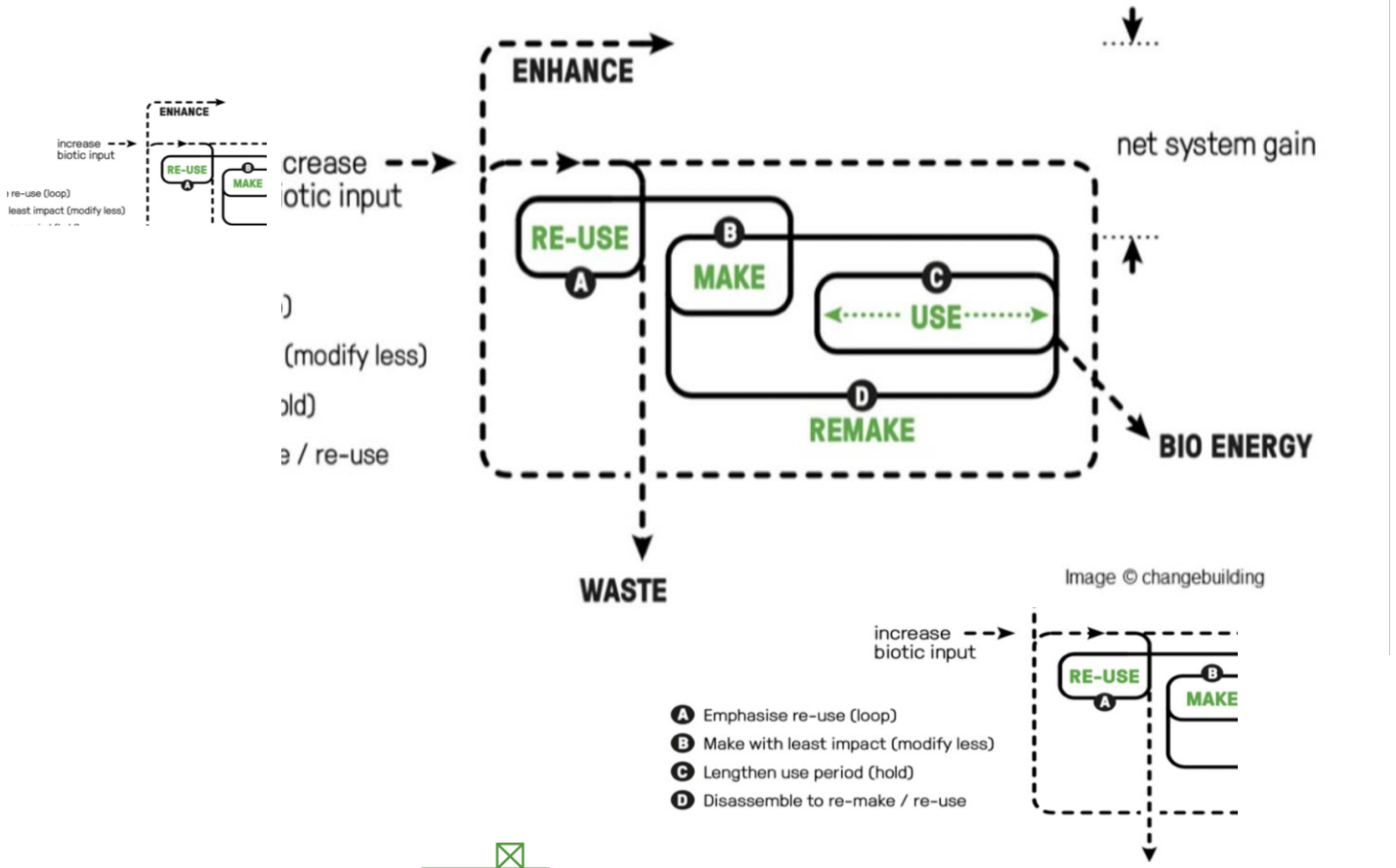



Understanding the building's constituent parts allows for future flexibility to accommodate user changing needs and allows for easier disassembly and component re-use at end of life.

# Reducing waste

Our unified approach absorbs carbon emissions, promotes low toxicity and highlights the value of future resources. People are increasingly adapting their consumption habits to make their own personal contributions to addressing climate change. Our design approach anticipates and enables this transition. We aim to enhance the entire production process, using biogenic resources to redress environmental failures in our built environment.




1. MATERIAL EXTRACTION
2. MANUFACTURING
3. TRANSIT
4. CONSTRUCTION
5. USE
6. END OF LIFE

# Procuring Value

**Embodied Carbon Storage Benefit of £21/m2**

**Savings to the NHS**

**£750/year saving on energy bills and £33/m2 saving on carbon over 60 years**

**Local employment opportunities in near site factories**

| Natural | Human | Social | Manufactured | Economic |
|---|---|---|---|---|
| *Preference for bio-based (natural) material for embodied carbon reductions and carbon storage.* | *Breathable facade and natural material provides increased respiratory and health benefits to users.* | *Local assembly employment opportunities and skills training at near-site flying factory* | *Distributed manufacturing and 'Panel & Chunk' approach for easier adoption of advanced MMC methods and multiple supplier sourcing delivering PMV of c.76%.* | *Reduced capital investment for MMC methods using supplier manufacturing approach.* |
| *Design for manufacture, assembly and disassembly (DfMA+D) approach using standardised products, and end of first use approaches to enhance circular economy opportunities.* | *Connection to landscaping at home and in the community level provides enhanced well being.* | *Balance between open shared urban spaces and private gardens for peace and privacy.* | *Mass timber and joisted floor approach allows easier adaption by users or builders using simple carpentry methods Demountable walls allow reconfiguration of spaces. Services upgradeable and accessible for maintenance.* | *Reduced site rework and rectification of defects through 'field factory' quality control and simplification of detailing requirements to meet Passivhaus standards. Reduction in claims and costs.* |
| *UK specific species grades adopted to make demand side changes to promote home grown timber. CLT tested for UK specific C16+ and native Douglas Fir use. Partnering with local CLT producer start-up for supply.* | *Improved thermal comfort in future extreme weather events by improved fabric standards and use of external shading.* | *Community sharing centre and repair cafe, communal areas and 'edible landscaping' and allotments sites support a community circular economy, the use of products as service, local producers, seasonal food.* | *Adoption of digital twin and supply chain own digitalisation as methods for coordination, delivery and retention of material data.* | *Low energy bills for occupants using Passivhaus standards.* |
| *Improved resource use and transport impact reductions through standardisation, optimisation and rationalisation and reduction of transport and assembly impacts in other off-site methods.* | *High levels on internal natural daylighting by consideration of window location and sizes.* | *Re/up-skilling opportunities within communities and regions around assembly methods rather than multiple site trades.* | *User focused quality providing added comfort through passive fabric design, shading and simple controls.* | *Incorporated climate resilience to avoid future upgrade costs.* |
| | | *Masterplan encourages walking and cycling for improved health and wellbeing.* | *Option for basic shell delivery to allow fit out by users based on their own design, needs and budgets.* | |

# The Positive+ House

## DASHBOARD

Premanufacturing Value (PMV ) of 77%

Consumes 1830 kWh per year for heating,
about 15% of the average UK household

(A1-A3) is 198 kgCO2/m2,
and biogenic storage of 340 kg/cO2/m2

Net A1-A3 + biogenic
-142 kgCO2/m2

Passivhaus Plus

PER demand 55kWh/($m^2$TFA.a)
PER generation 68kWh/($m^2$Projected.a)

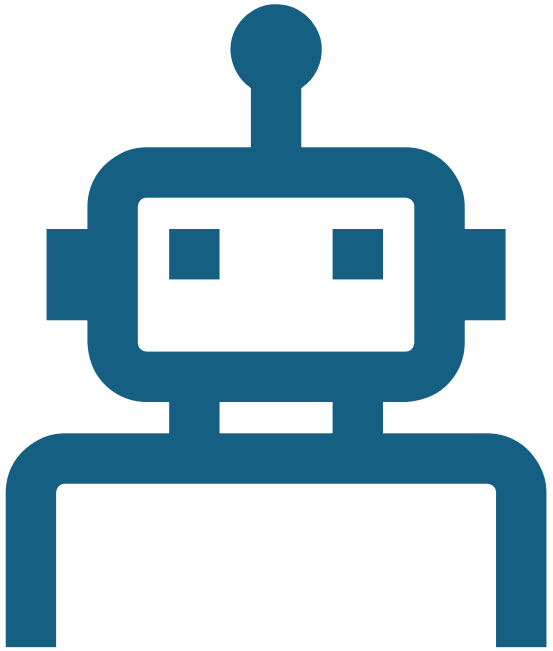
£2,075/m2 net construction cost

| Waste type (see examples below) | Total mass in house (kg) | Assumed waste rate % (by mass) * | Expected waste amount (tonnes) per average 100m2 house |
|---|---|---|---|
| Compacted (clean) hardcore | 19,665.00 | 10.00% | 1.425 |
| Concrete in ground floor | 49,680.00 | 6.00% | 2.16 |
| CLT | 16,187.50 | 5.00% | 0.59 |
| Woodfibre insulation | 7,931.00 | 5.00% | 0.29 |
| Treated timber facade | 1,595.54 | 10.00% | 0.12 |
| Triple glazing | 1,398.30 | 5.00% | 0.05 |
| Plasterboard | 3,096.00 | 15.00% | 0.34 |
| Cabling | not measured | 10.00% | |
| CLT plastic packaging | not measured | 100.00% | |
| Timber battens (facades/floors) | 2,571.26 | 15.00% | 0.28 |

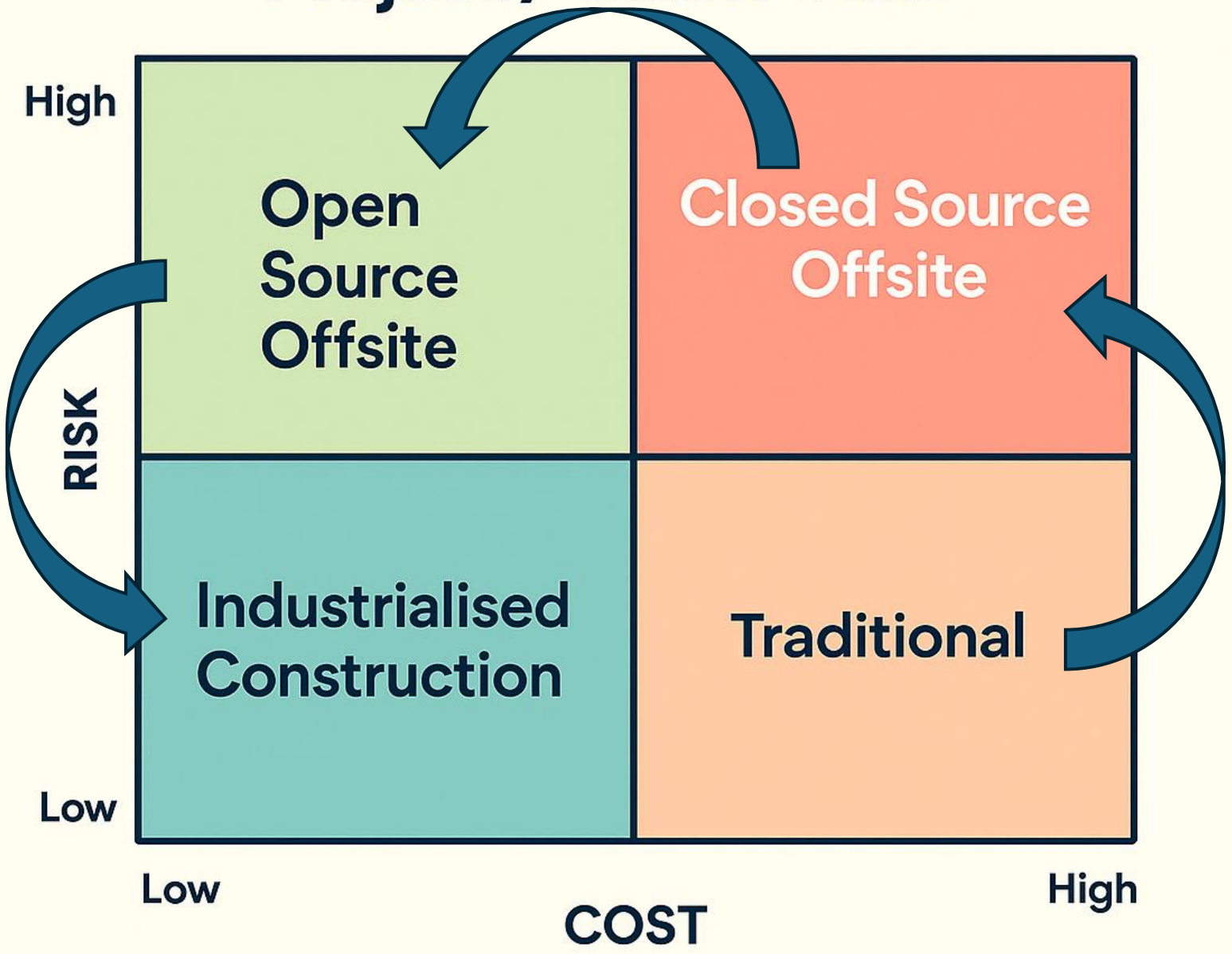
- **Why Industrialised Construction is Different, or is it just rebranding of the tired term MMC**
  - Open, interoperable component systems
  - Factory capacity already exists in UK (hundreds of suppliers)
  - Lower risk, non-binary adoption: no “live or die” dependency
  - Enables step-by-step integration into Tier 1 workflows

- **Global Drivers for Industrialised Construction**
  - Housing shortages
  - Need for faster, safer, cleaner delivery
  - Ageing and shrinking construction workforce
  - Carbon and waste reduction imperatives
  - Digitisation (BIM, digital twins, Industry 4.0)
  - Policy drivers: Playbook, UN SDGs, Green Deal

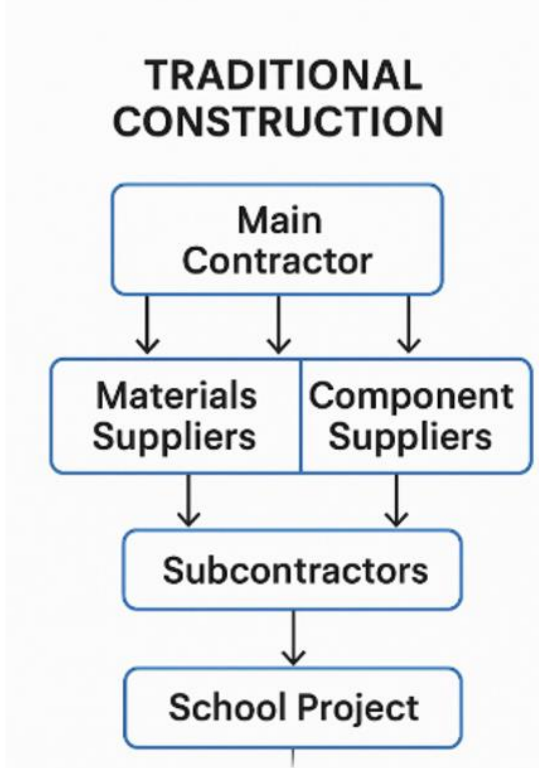
- **Is Industrialised Construction Still MMC?** Yes, but broader in scope:
  - **MMC Category 2:** Panelised structural systems
  - **MMC Category 5:** Sub-assemblies (pods, stairs, facades)
  - **MMC Category 7:** Site process improvements
- **BUT:**
  - Industrialised Construction avoids MMC's stigma
  - Focuses on outcomes: compliance, cost, carbon, delivery

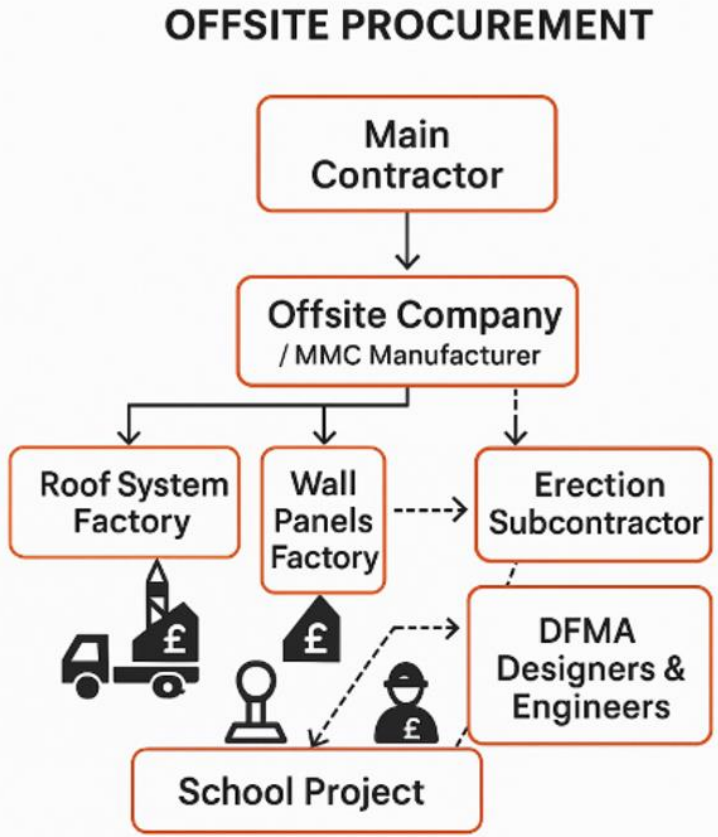


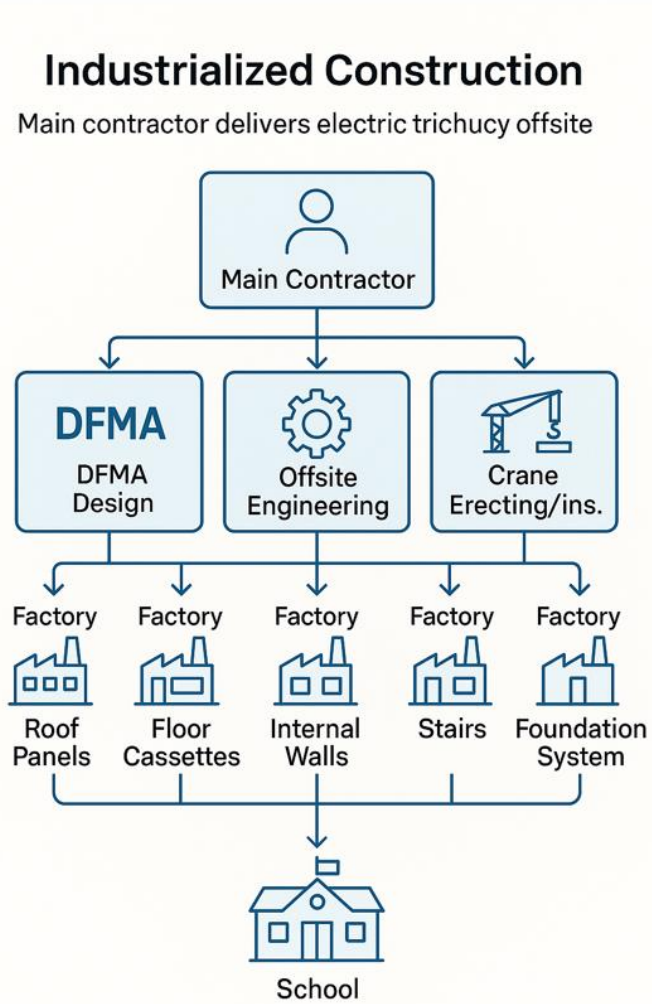
# Project / Client View



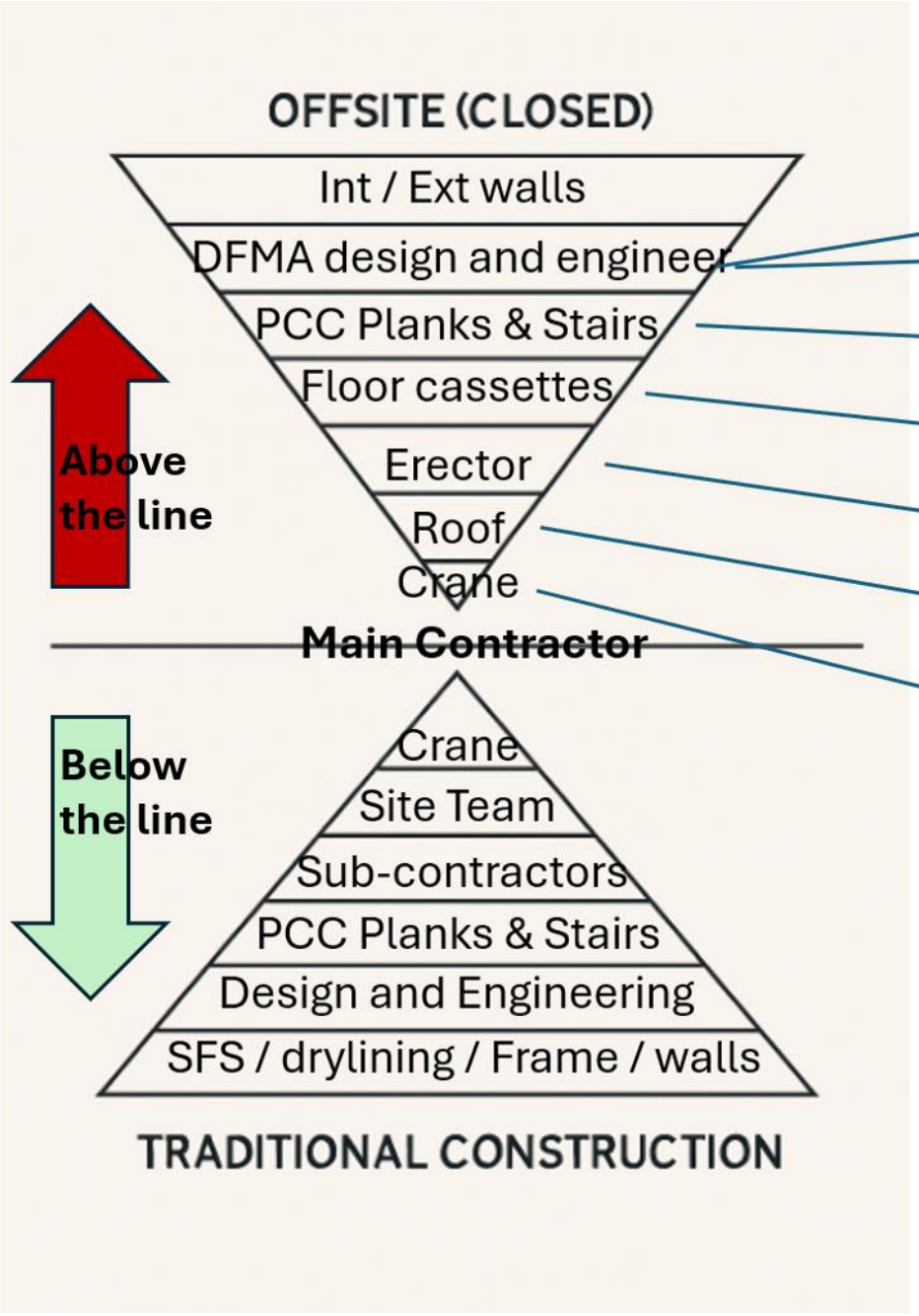
# Direction of travel, Traditional,  closed offsite, open offsite and Industrialised



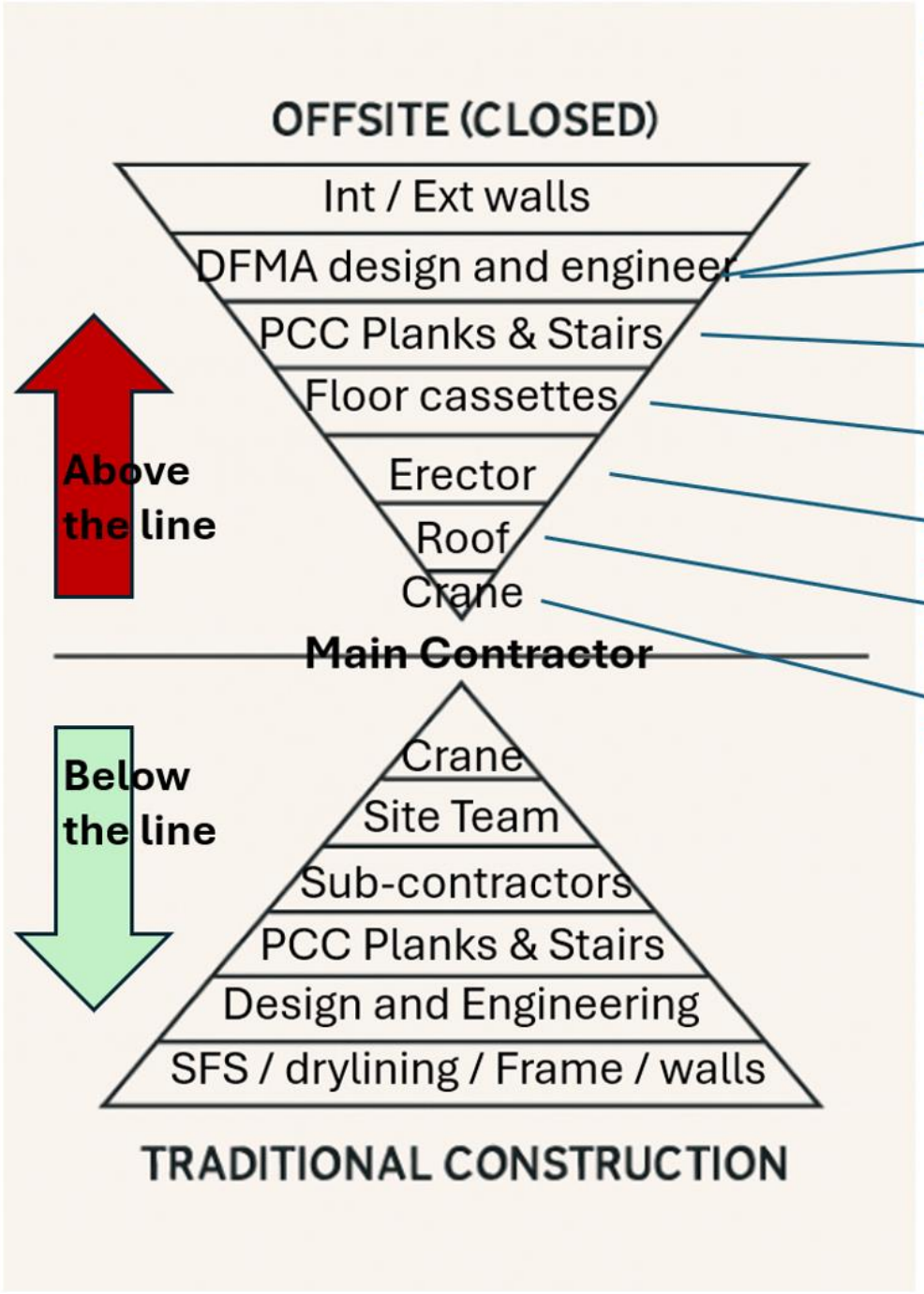



# Closed Offsite risks versa Traditional.




- Designer
- Engineer
- PC design — PC Factory
- Floor designer — Floor factory
- Installer
- Roof designer — Roof Factory
- Plant

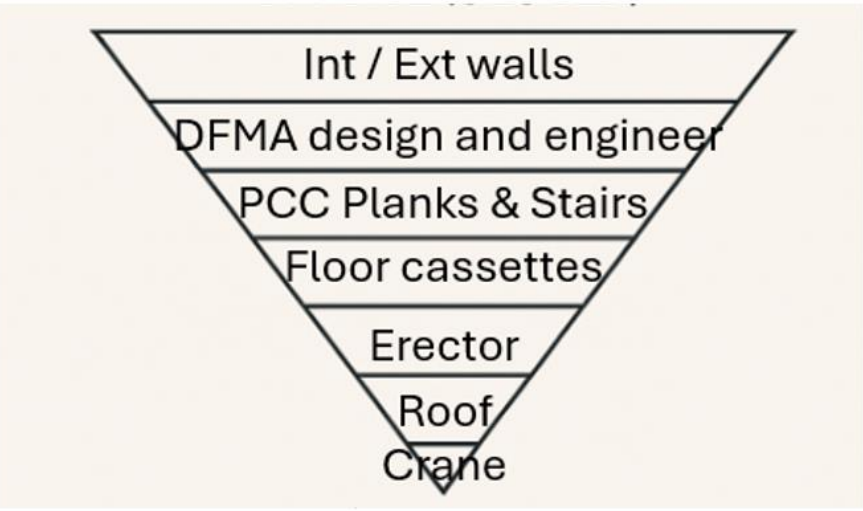
# Industrialised Construction.



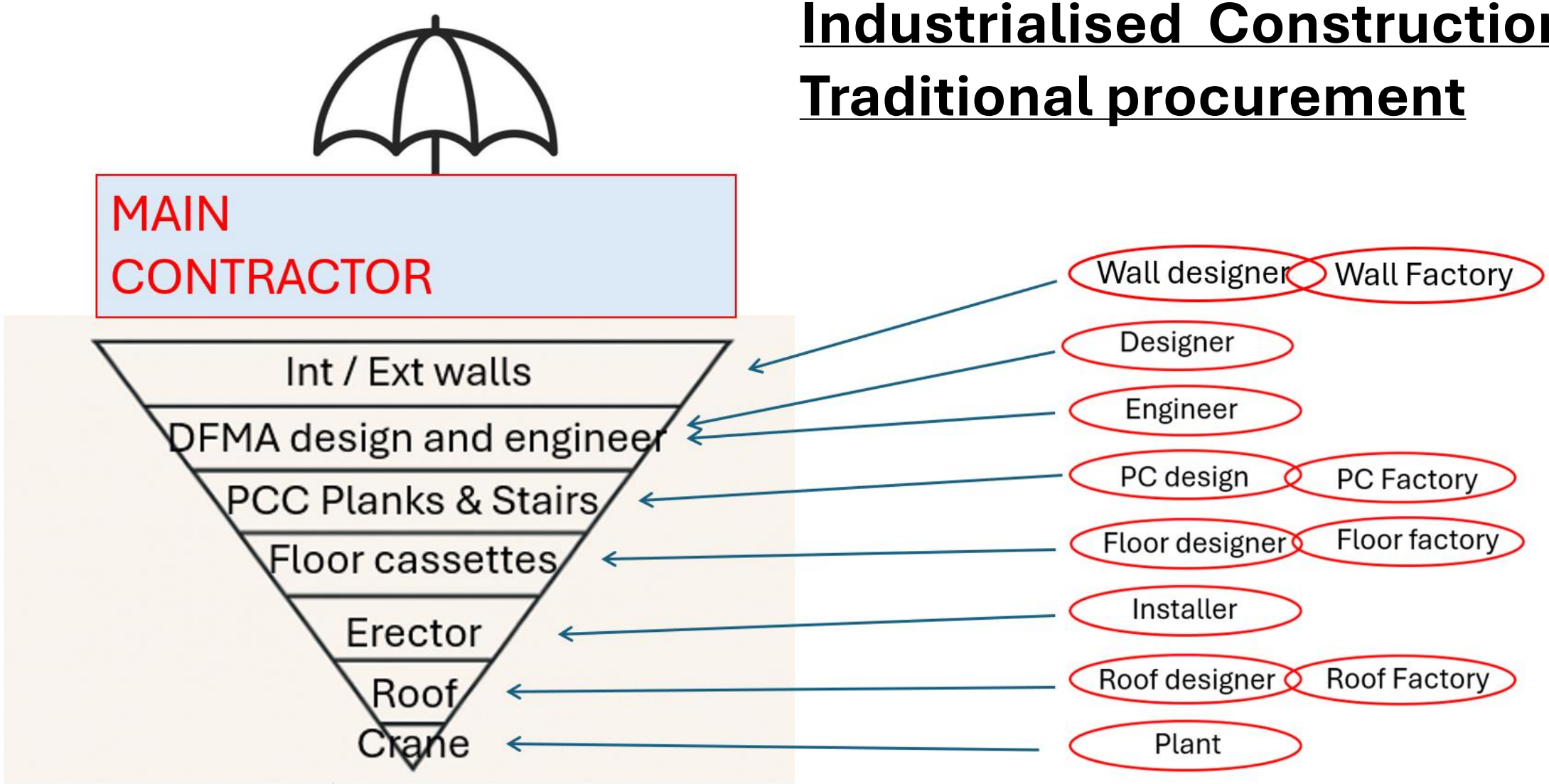

OUT-SOURCING, ONCE AND SOMETIMES TWICE

- Designer
- Engineer
- PC design — PC Factory
- Floor designer — Floor factory
- Installer
- Roof designer — Roof Factory
- Plant

MAIN CONTRACTOR



# Industrialised Construction / Traditional procurement



# A Modular House

For an SME developer in the East Midlands

- Micro-volumetric Modular
- Kit-of-parts design approach
- Affordable @ £1,300/m2
- Passivhaus Classic homes
- Octopus Zero-bills Tariff
- Biogenic materials used
- Ability for owners to adapt
- Designed for disassembly
- Designed to minimize waste

# A Modular House

For an SME developer in the East Midlands

- Micro-volumetric Modular
- Kit-of-parts design approach
- Affordable @ £1,300/m2
- Passivhaus Classic homes
- Octopus Zero-bills Tariff
- Biogenic materials used
- Ability for owners to adapt
- Designed for disassembly
- Designed to minimize waste

perpendicular

ENGENUITI

Integration

Vale Consultancy
CONSULTING CIVIL & STRUCTURAL ENGINEERS

planningprospects
planning and development consultancy

ACOUSTIC CONSULTANTS LTD

CHPK/ACT
building control & fire engineering

ICW
Insurance

Chris Gaze

**What is open source ..... OSKOP?**

A **non-proprietary, standardised** approach to component-led offsite construction.

Enables **interoperability across multiple UK factories** (e.g. NZP, OEP, Timber Innovations).

Developed to support compliance with **DfE Output Specifications**, **Building Safety Act 2022**, and **Construction Playbook** principles.

Freely shared format to **de-risk procurement**, especially for **Tier 1/2/3 contractors** and **public sector clients**.



## Key Features

- **Component-led**, not system-led: internal walls, external walls, floors, roofs, stairs, and services coordinated as interchangeable sub-assemblies.
- Supports **hybrid panel systems** (e.g. concrete floors, steel composites, Timber and so on), while specific.
- Developed around **tested wall build-ups** for public buildings, including affordable housing, robust acoustic and thermal compliance.
- Compatible with **multiple insulation formats**, 60-year design life, structural element protection and tested wall build ups.

**Supply Chain & Procurement Advantages**

**Open access** means components can be competitively sourced from multiple regional factories.

Reduces over-reliance on vertically integrated or proprietary systems (e.g. modular boxes).

Compatible with **DfMA workflows** and digital tools (Revit, IFC, COBie formats).

Enables **direct contractor-led procurement** of compliant components (e.g. roof panels from A, walls from B, floor cassettes from C).

De-risks mini-competition and direct award on frameworks like **CF25**, **Crown Commercial Services**, and **NHS SBS**.


**Adaptable and Future-Ready**

Designed for **incremental adoption**—can start with a single element (e.g. standardised wall) and scale.

Integrates with **Foundation systems**, **SIPs alternatives**, and **low-carbon retrofit** strategies.

Promotes a **circular economy** model through repeatable design, disassembly potential, and material transparency.

**Enables localisation**—Welsh timber, Kent offsite firms, Northern innovation hubs.

**FINAL THOUGHT**

“INDUSTRIALISED CONSTRUCTION ISN’T A METHOD—IT’S A MINDSET. ONE THAT SEES THE FUTURE OF BUILDING NOT AS DISRUPTION, BUT EVOLUTION.”

STRATA DOESN’T DEFINE ITS BUSINESS BY METHODS—BUT BY OUTCOMES. WE’VE WALKED THE PATH FROM MODULAR HYPE TO INDUSTRIALISED MATURITY. LET US HELP YOU NAVIGATE WHAT’S NEXT.

STRATA

# Solutions For Real Estate

Solutions for the Real Estate and Construction Industry

Contact Us

- **Why Choose Strata**
  - Board  has 35+ years of MMC and Industrialisation expertise
  - Balanced view: traditional vs modern methods
  - Not wedded to a single system or solution
- Supports clients through:
  - Supply chain integration
  - Risk and compliance management
  - DfMA and digital workflows
  - ESG and cost analysis

www.perpendicular.co.uk
hello@perpendicular.co.uk