SUPPLY CHAIN SUSTAINABILITY SCHOOL

Offsite

Offsite: For Highways

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18 FEBRUARY 2022

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Offsite

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Webinar Content

Offsite:
For Highways

Offsite Definitions
Explanation of the Categories & Materials

Implementing Offsite
Identifying opportunities & potential solutions

Construction Industrialisation
The overall process

Offsite in Practice
Case Studies

Future Workshop Topics
Open discussion session

SUPPLY CHAIN SUSTAINABILITY SCHOOL

Running Order

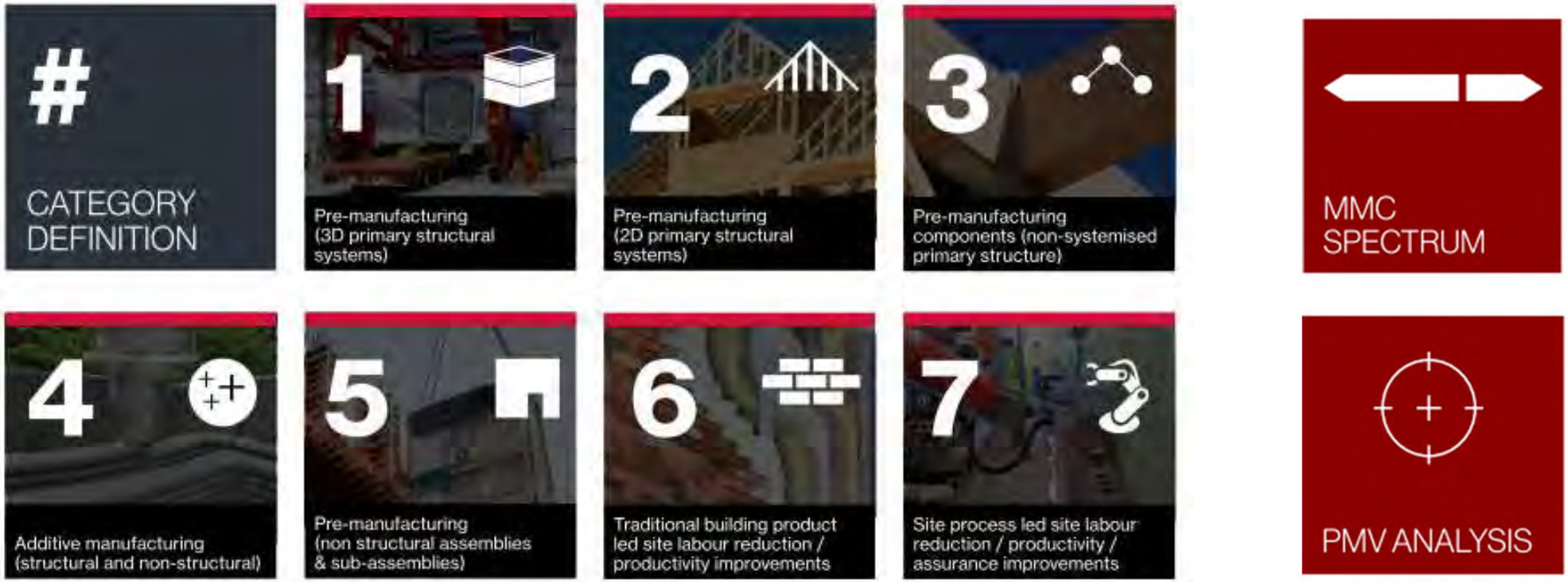
- Introduction
- Offsite Definitions – MMC Framework
- Construction Industrialisation
- Offsite Manufacturing in Practice
- Implementing Offsite Methodology
- Discussion – Topics for Future Workshop
- Q&As

Part 1
Offsite Definitions

- Definition Framework

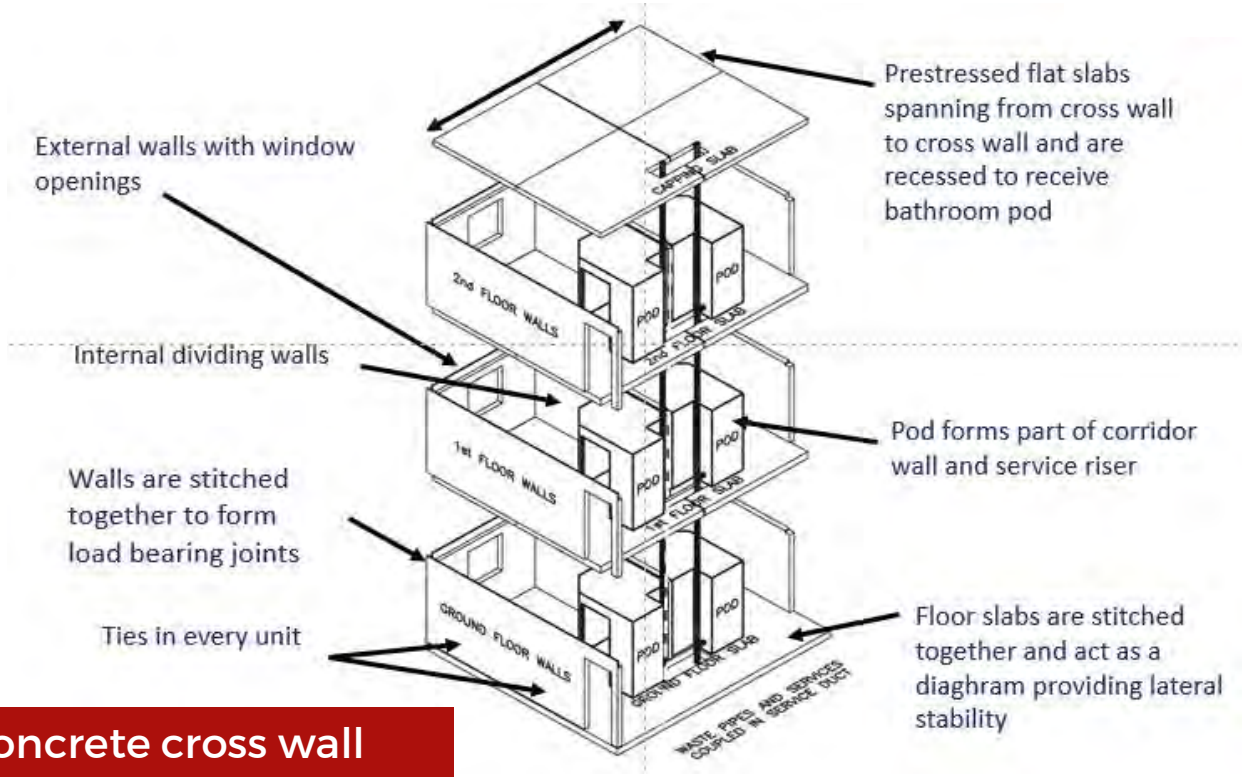
MMC Definition Framework – Gov.uk - Modern Methods of Construction Working Group

The Categories



Pre-manufacturing – Category 1
3D Primary Structure

Pre-manufacturing – Category 2
2D primary structure



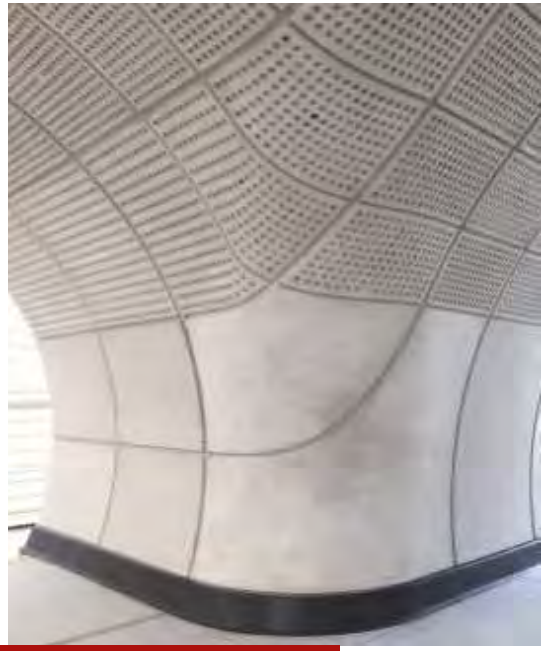
Concrete cross wall construction system

Cross wall student residences

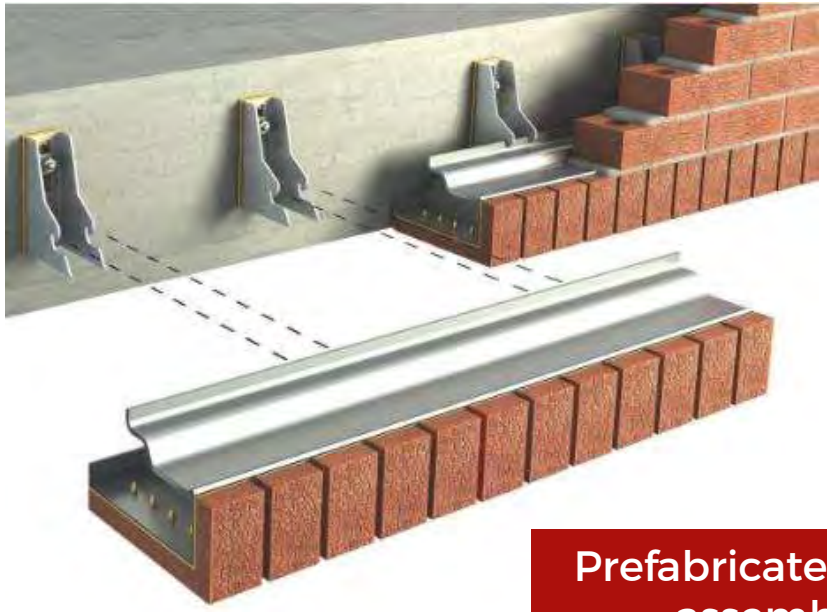
Pre-manufacturing – Category 3
Non-systemised primary structure

Additive Manufacturing – Category 4
Structural & non-structural

Pre-manufacturing – Category 5
Non structural assemblies and sub-assemblies

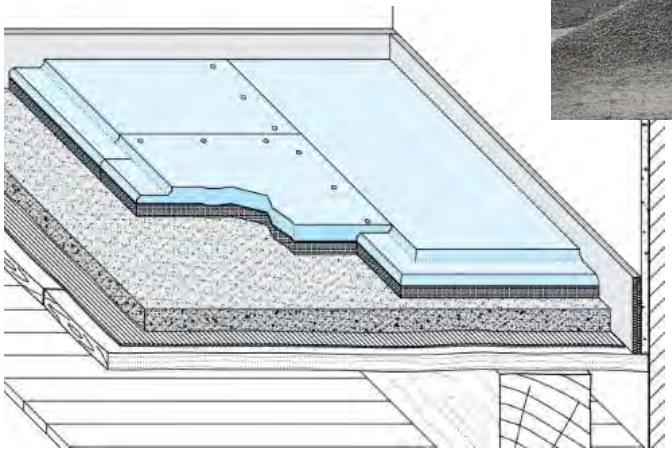


Precast concrete tunnel lining panels



Prefabricated lintel assembly

Building product led site labour reduction and/ or productivity improvements – Category 6



Site process led labour reduction/productivity & assurance improvements – Category 7

MMC Spectrum

A range of approaches which spans off-site, near site and on-site pre-manufacturing, process improvements and technology applications

Part 2

Construction Industrialisation

Construction Industrialisation

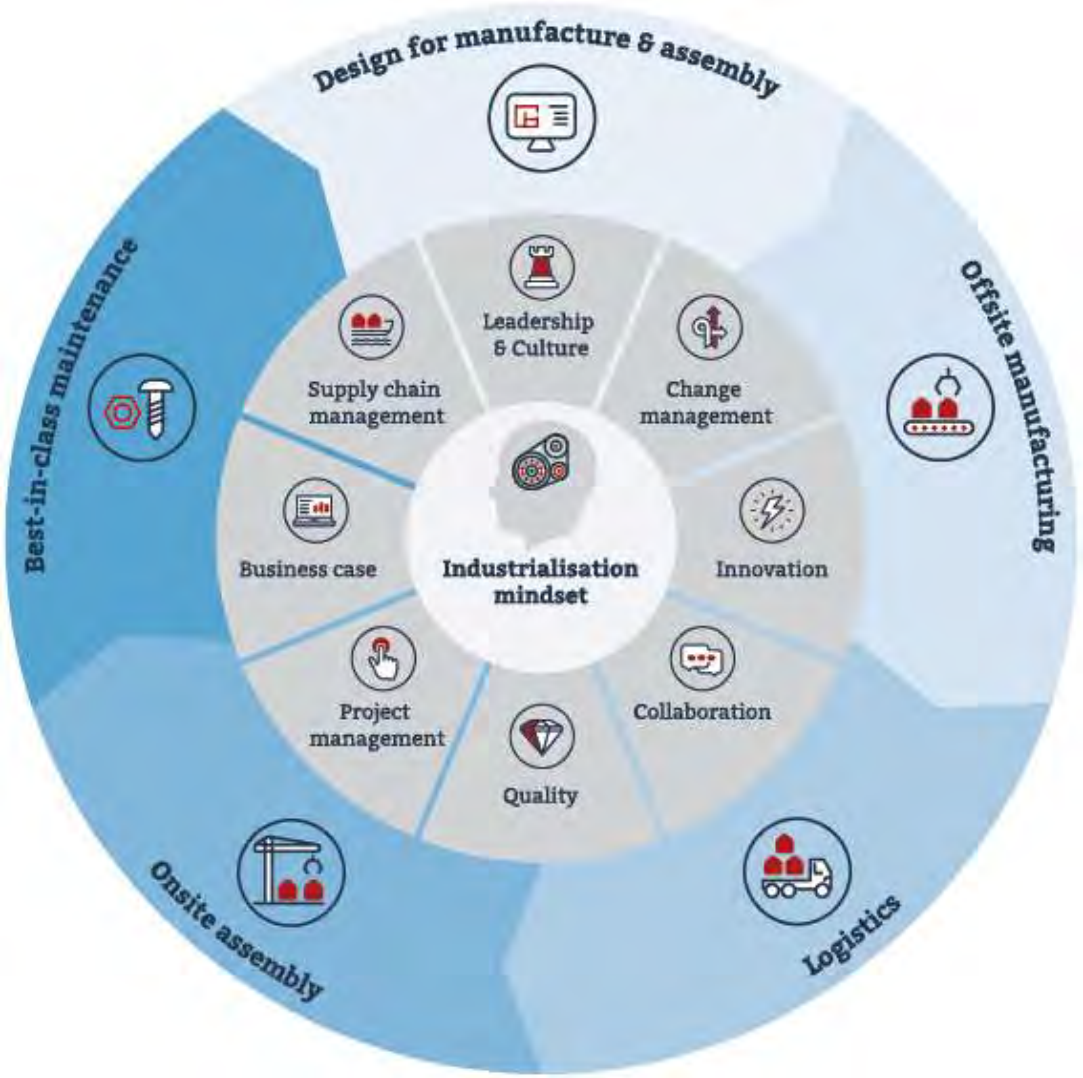
"Industrial processes are characterised by a systematic approach; to increase capability and achieve a repeatable result; striving for maximum effectiveness."

"It is the relentless drive to discover how a process is optimally done then doing it exactly the same way every time."

"Industrialisation drives out waste, automates and standardises ***where possible.***"

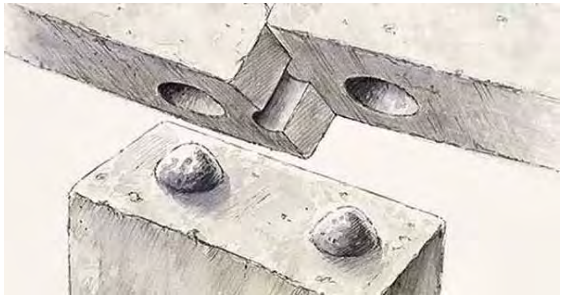
Construction industrialisation

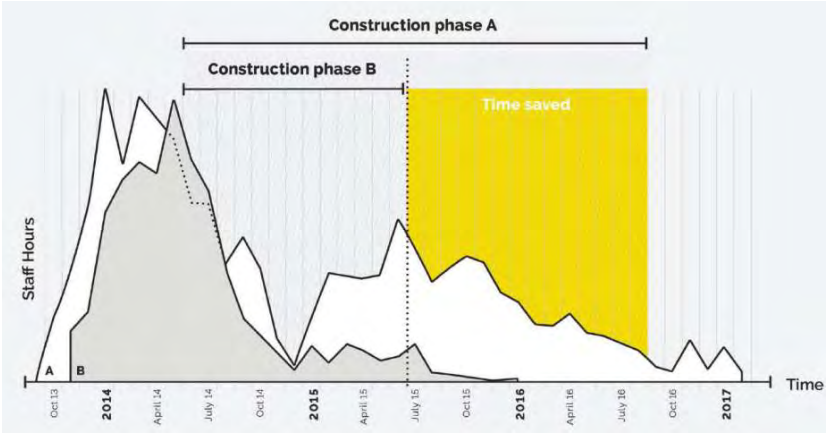
- Design (DfMA)
- Standardise & Manufacture
- Deliver (Logistics)
- Assemble & Install
- Maintain, Measure & Refine
- Repeat, Re-purpose, Recycle



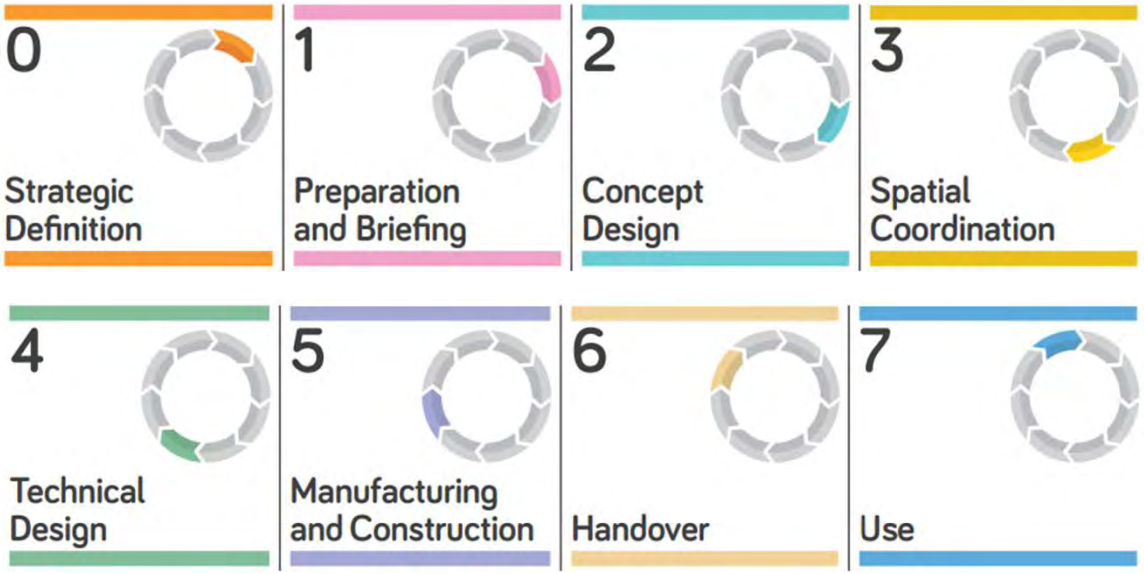
DfMA

- When to Start
- The Art of the Possible
- Design Freeze Implications
- BIM Protocols
- Concurrent Activities
- Client Objectives
- Environmental Policy
- Future Proofing
- Collaboration



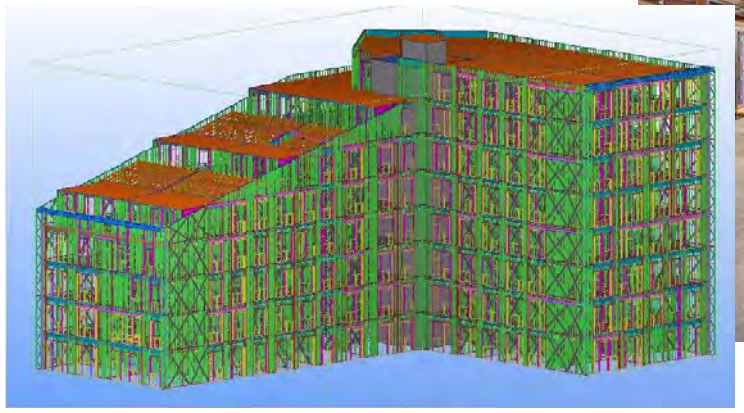


Royal Institute of Architects Plan



Offsite manufacture

- Digital Information Format
- Product Availability / Market Capacity
- Materials Procurement
- Lead-in Periods
- Buildability
- Stock Piling Capacity



Logistics

- Abnormal Load
- Height, Width & No. of Loads
- Time Limitations
- Solution – VR Logistics?

Onsite assembly

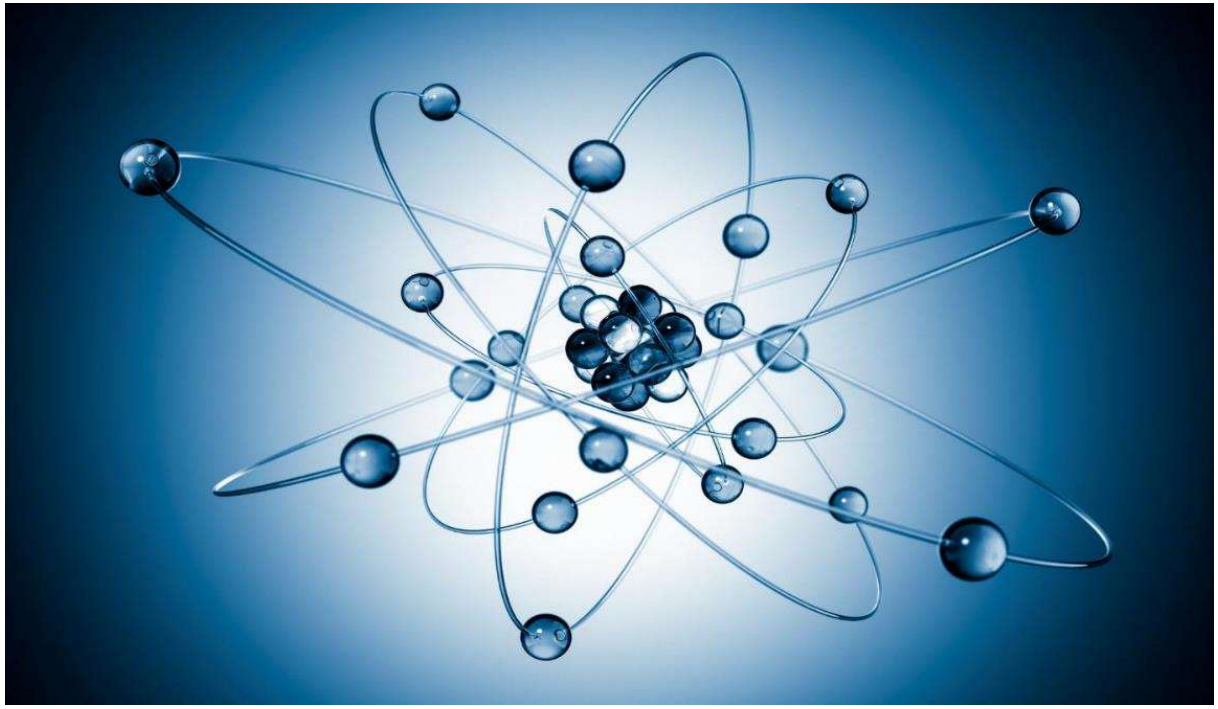
- Vehicle/Load Site Access
- Construction Area Access
- Crane Lifting Capacity & Hook Time
- Simplicity of Assembly
- Compliance (Offsite?)
- Testing & Commissioning (Offsite?)

Maintenance and operation

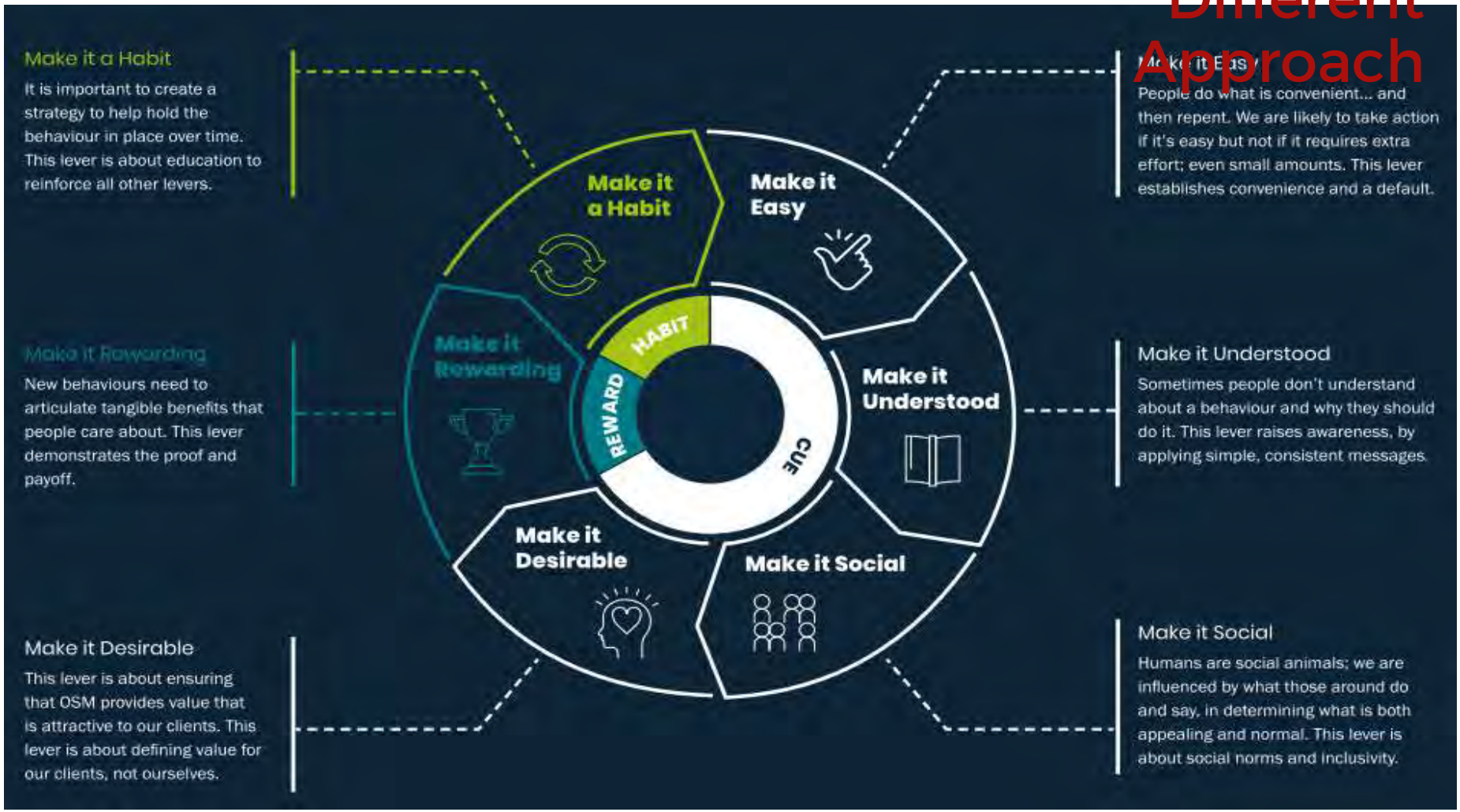
- Planned Maintenance
- Maintenance Access
- Running Costs
- User/Worker Safety & Comfort
- Green Energy
- IT Systems (Internet of Things)
- Repair & Replacement
- Removeable Sub-Assemblies
- Performance Compliance (POE)
- Digital Twin

Other considerations

- Digitally Enabled Construction / Digital Twin
- Collaboration and Alliancing
- New Business Models
- Different Behaviours
- New Forms of Contract
- Teamwork



Offsite - A Different Approach



Part 3
Offsite in Practice

Project	Two Fifty One Southwark
Client	Oakmayne
Architect	Allies & Morrison
Sector	Residential
Technology	Concrete “Kit of Parts” with MEP Assemblies

876 precast concrete columns

1,441 precast TwinWall units

11 multiservice vertical riser modules

346 precast beams with E6 connectors

539 precast lattice slabs

499 offsite manufactured bathroom pods

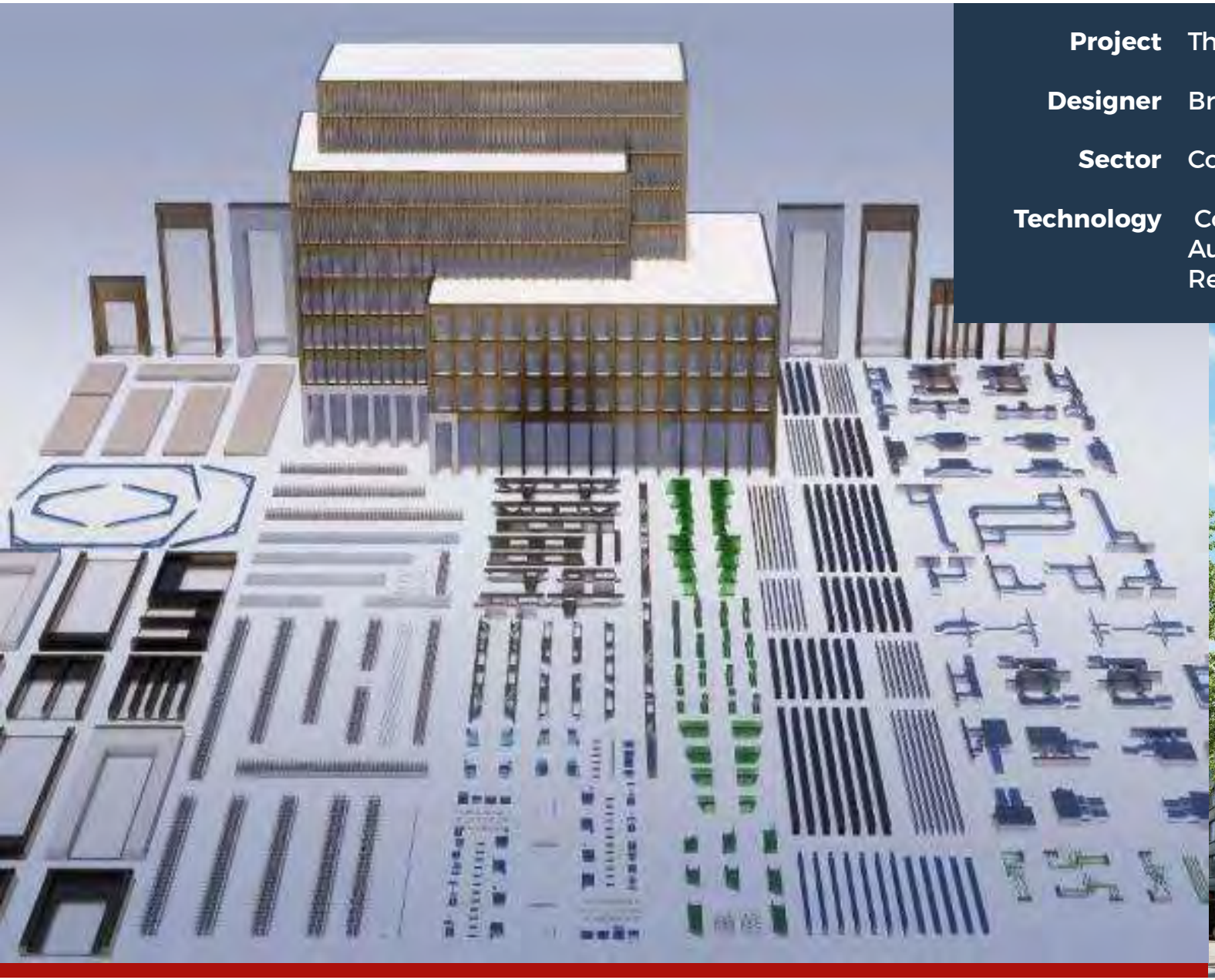
204 balcony precast slabs

382 precast solid wall units

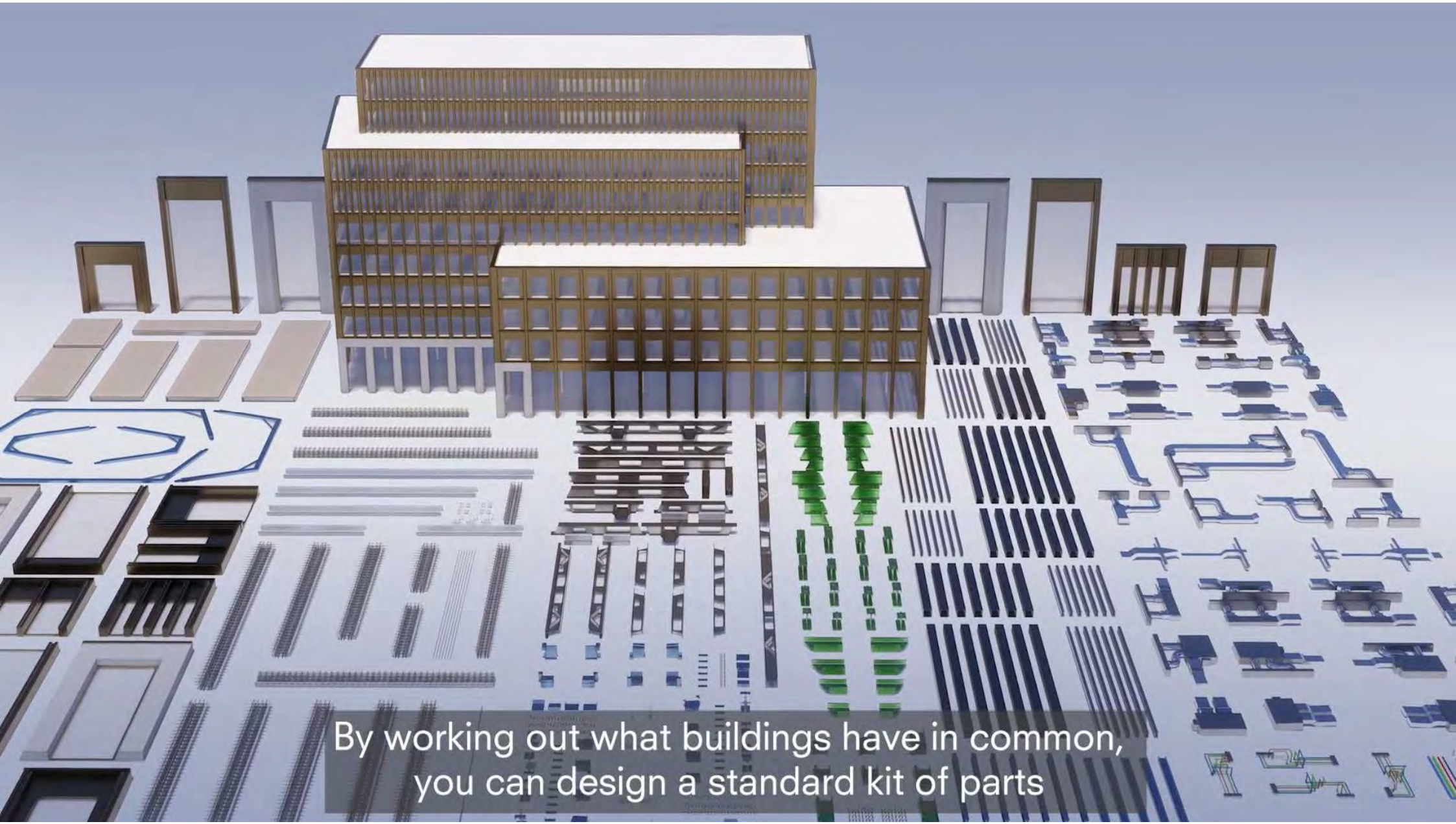
2,411 precast hollowcore planks with 85% incorporating E6 connectors

11 offsite manufactured plant room and switchroom units

1,082 precast architectural facade panels



Project	The Forge, Sumner St, London
Designer	Bryden Wood
Sector	Commercial
Technology	Components & Assemblies Automated Component Lifting Remote monitoring of slab temperature


By working out what buildings have in common,
you can design a standard kit of parts





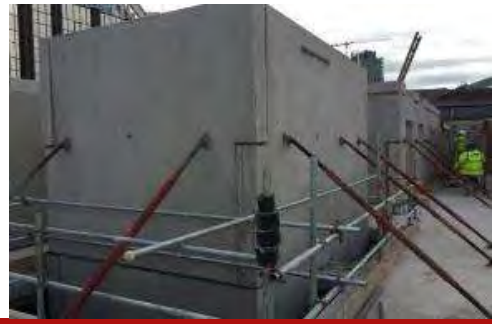












Description		Floor cycle	Total man days	Men per week	Total days
DfMA Solution	40 floors	6 days	5,280	22	240
Insitu Solution	40 floors	9 days	13,320	37	360
Variance			8,040	15	120
Reduction/saving			60%	41%	33%

Project	Two Fifty One Southwark
Client	Oakmayne
Architect	Allies & Morrison
Sector	Residential
Technology	Concrete “Kit of Parts” with MEP Assemblies

Project	M6 J13 to J15 Stafford
Client	Highways England
Sector	Transport Infrastructure
Technology	Pre-cast Concrete
Manufacturer	StantonBonna

Project	Pant y Cadno Reservoir
Client	Welsh Water
Sector	Utilities Infrastructure
Technology	Pre-tensioned Concrete
Specialist	Shay Murtagh

Project	London Bridge Station
Client	Network Rail Thameslink Programme
Designers	Grimshaw Architects, Arcadis &WSP
Sector	Transport Infrastructure
Technology	Offsite Prototype

DfMA / Precast

6 man team
2,500 hours

Insitu Concrete

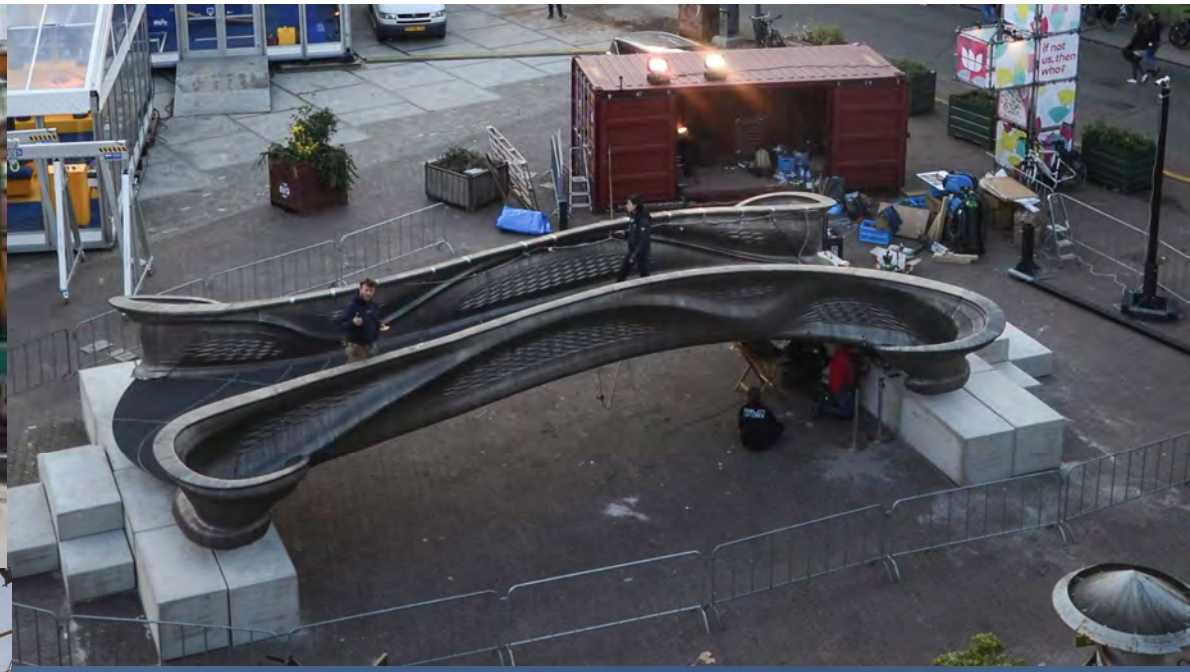
80,000 hours

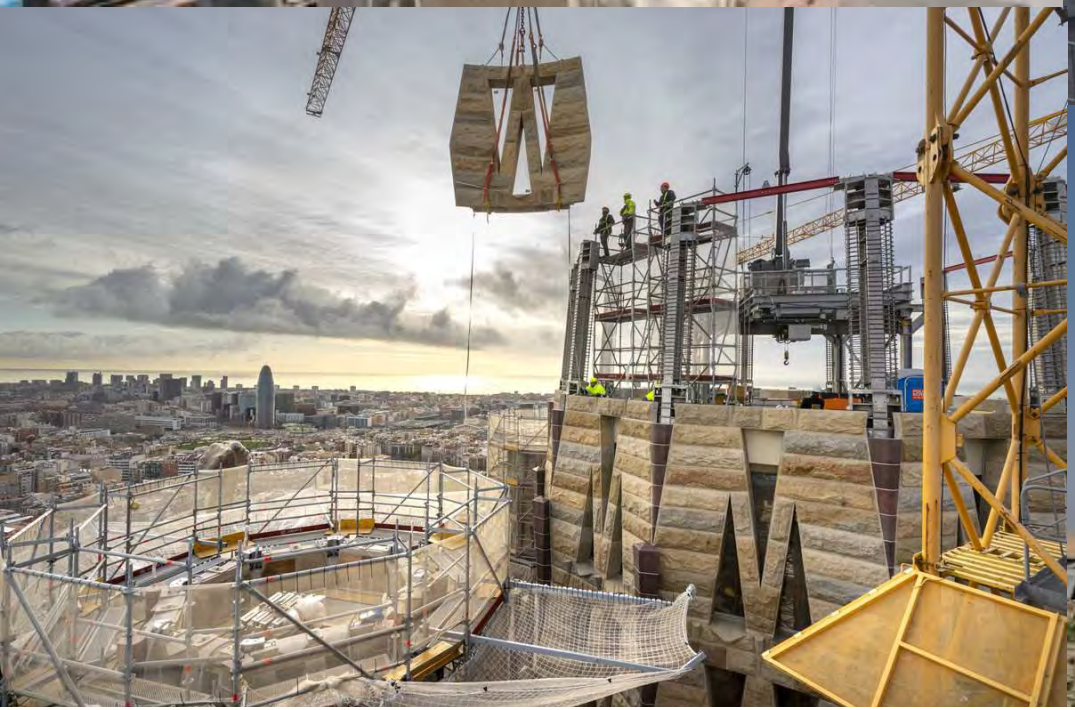
Project	Liverpool Street Station
Sector	Transport Infrastructure
Designers	Arup
Technology	Pre-cast concrete
Constructor	Laing O'Rourke

Project	Queensferry Crossing
Client	Transport Scotland
Sector	Transport Infrastructure
Technology	Bridge Deck Prefabrication

Project	Swing Bridge
Designers	Tonkin Liu & Arup
Sector	Infrastructure
Technology	Laser Cut Skeletal Comb

Project	Ironbridge
Client	Abraham Darby III
Sector	Infrastructure
Technology	Cast iron
Specialist	Abraham Darby III


If not us, then who?



Part 4
Implementing Offsite Methodology

Residential Development

- Choosing a System – Primary Structure

Modern Methods of Construction Definition Framework Category (UK)

Construction Option	Volumetric (HRS) 1	Volumetric (LGS) 1	Volumetric (MET) 1	Volumetric (Timber) 1	Volumetric (Concrete) 1	Panels (SIPs) 2	Panels (MET) 2	Panels (Timber) 2	Panels (Concrete) 2	Panels (LGS) 2	Kit of Parts (LGS) 6	Kit of Parts (Concrete) 3
Health & Safety: risk	Low	Low	Low	Low	Medium	Medium	Medium	Medium	Medium	Medium	High	High
Construction Rates: per week	25 to 30 modules	25 to 30 modules	25 to 30 modules	25 to 30 modules	25 to 30 modules	Up to 500m²	Up to 500m²	Up to 700m²	Up to 400m²	Up to 700m²	Up to 500m²	Up to 700m²
Offsite Completion	Circa 80%	Circa 80%	Circa 80%	Circa 80%	Circa 80%	Circa 30%	Circa 30%	Circa 20%	Circa 45%	Circa 20%	Circa 5%	Circa 5%
Current Height Limitation: storeys	28	40	18	7	40	10	18	7	30	20	20	40
UK Limitation: storeys (Grenfell Impact)	N/A	N/A	6 (exterior walls)	6 (exterior walls)	N/A	6 (exterior walls)	6 (exterior walls)	6	N/A	N/A	N/A	N/A
Immediately Stable Structure	Y	Y	Y	Y	Y	N	Y	N	N	N	N	N
Immediately Load Bearing Structure	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y
Loading Principles	Point	Line	Line	Line	Line	Line	Line	Line	Line	Line	Line	Line
Logistics Considerations	Module size and deadload	Module size	Module size	Module size and stability	Module size and deadload	Delivered flat pack	Delivered flat pack	Delivered flat pack	Delivered flat pack	Delivered flat pack	Packaged for site assembly	Packaged for site assembly
Fire Compliance Measures	Simple	Simple	Simple	Complex	Simple	Complex	Simple	Complex	Simple	Moderate	Moderate	Complex
Sound Attenuation	Simple	Simple	Simple	Complex	Simple	Moderate	Simple	Complex	Simple	Moderate	Moderate	Complex
Pre-installed components & exterior envelope	Y	Y	Y	Y	Y	Y	N	N	Y	Y	N	N
Construction Carbon Footprint	Low	Low	Very Low	Low	Moderate	Moderate	Very Low	Low	Moderate	Moderate	Moderate	High
Market Availability: manufacturers	UK & EU	Limited number of UK & EU	Growing number of UK & EU	UK & EU	Limited number of EU & Overseas	UK & EU	EU	UK & EU	Limited UK & EU	UK & EU	UK & EU	UK & EU
Skills Shortage: Impact	Unaffected	Unaffected	Unaffected	Unaffected	Unaffected	Limited	Limited	Major	Limited	Major	Limited	Major
Holistic Benefits	Finish quality, fewer Interfaces & erect without scaffolding	Finish quality, fewer Interfaces & erect without scaffolding	Finish quality, fewer Interfaces & erect without scaffolding	Simple technology	Finish quality, fewer Interfaces & erect without scaffolding	Fewer Interfaces	Lightweight Structure	Lightweight Structure	Erect without Scaffolding	Lightweight Structure	Lightweight Structure	Lightweight Structure

Major Hospital – Worked Example

Identify Opportunities – Element Approach

		Assessment Criteria							
	Element/Component	**Time Consuming**	**High Risk**	**Skills Shortage**	**Complex Areas**	**Time Critical**	**Gross Floor Area**	**Score**	**Impact**
Construction Elements	Foundations								
	Frame								
	Secondary Steelwork								
	Building Envelope								
	Interior Fabric								
	Specialist Equipment								
	Vertical Circulation								
	Atrium								
	Bridges								
	Site Works								
MEP	Plant Rooms								
	Horizontal Service Runs								
	Vertical Service Runs								
	Under Ground Services								
	Testing and Commissioning								
Other	ICT								
	Soft Landings								
	BIM								

Major Hospital – Worked Example

Identify Opportunities – Element Approach

		Assessment Criteria							
	Element/Component	**Time Consuming**	**High Risk**	**Skills Shortage**	**Complex Areas**	**Time Critical**	**Gross Floor Area**	**Score**	**Impact**
High	Horizontal Service Runs	1	1	1	1	1	1	6	High
	Plant Rooms	1	1	1	1	1	1	6	High
	Vertical Service Runs	1	1	1	1	1	1	6	High
	ICT	1	1	0.5	1	1	1	5.5	High
	BIM	1	1	1	1	1	0	5	High
	Testing and Commissioning	1	1	1	1	1	0	5	High
Medium	Atrium	1	1	0	1	0	1	4	Medium
	Building Envelope	1	1	0	1	1	0	4	Medium
	Interior Fabric	1	0	0	1	1	1	4	Medium
	Secondary Steelwork	1	1	0	1	1	0	4	Medium
	Frame	1	1	0	0	1	0.5	3.5	Medium
	Specialist Equipment	0.5	1	0	0	1	1	3.5	Medium
	Foundations	1	1	0	0	1	0	3	Medium
	Soft Landings	1	0.5	0	0	1	0	2.5	Medium
	Under Ground Services	1	1	0	0	0.5	0	2.5	Medium
	Vertical Circulation	0	0	0	1	0.5	1	2.5	Medium
Low	Bridges	1	1	0	0	0	0	2	Low
	Site Works	0	1	0	0	0	0	1	Low

Major Hospital – Worked Example

Offsite Potential – Elemental Approach

Element/Component	Potential Opportunities/Solutions	Impact
BIM	Enable DfMA, clear protocol definitions; integration of component information; encourage supply chain design input; agree demarcation	High
Horizontal Service Runs	Partition head prefabricated services modules; height and width balance between floor to floor height and GIFA	High
ICT	Packaged and pre-assembled IT Hubs	High
Plant Rooms	Prefabricated pumps sets; pipe spools; plant skids with pre-assembled kit; pre-wired AHUs; packaged sub-stations; package stand-by generators; modular tanks; LV voltage package units	High
Testing and Commissioning	Off-site assemblies and mock ups; factory testing; off site witnessing; pre-commission testing and training; use of precedents to demonstrate compliance	High
Vertical Service Runs	Self supporting prefabricated service risers; dual purpose structure (use riser structure to support other components); assess potential duplication of structure; bolt on options	High
Atrium	Modular panel options - glazing, photo-voltaic cells and fabric; regular structural grid with bolt-on assemblies	Medium
Building Envelope	Panel options - unitised, SFS for inner leaf; composite cladding; prefinished roof elements.	Medium
Frame (Car Park)	Insitu concrete using standardised grid; maximise repetition of formwork	Medium
Frame - Clinical/Operations Areas	Insitu concrete using standardised grid; maximise repetition of formwork	Medium
Frame - Ward Areas	Traditional steel frame with pods; prefabricated modules; pre-assembled steelwork components	Medium
Interior Fabric	Bathroom/toilet pods (areas other than wards); modular theatres; smart walls; imaging control room; theatre leadwork	Medium
Secondary Steelwork	Minimise requirement; rationalise design to eliminate; considered multi-function elements/parts of assemblies	Medium
Soft Landings	Integration of maintenance information into BIM along with 8 week programme of training, proving and testing prior to handover; follow up evaluation meetings to verify that design parameters are being achieved during operation	Medium
Specialist Equipment	Integration of BIM information; off-site and on-site training; off-site sign off (See also Testing & Commission and Soft Landings); standard partition panels (off-site fabrication or on-site production capability); prefabricated and plumbed in IPS;	Medium
Under Ground Services	Prefabricated service trenches (where protection and access is required)	Medium
Vertical Circulation	Co-ordinated routes for movement of people, goods and building services; prefabricated service risers; stacked server rooms possibly pre-fabricated	Medium

Granular Assessment

Identifying Potential Solutions

			Assessment Criteria													
Construction Elements	**MMC Category/ Type**		**Suitability**	**Statutory Compliance**	**Brief/Design Objectives**	**Potential Flexibility**	**Carbon Reduction**	**Cost Certainty**	**Critical Path & Programme**	**Sequencing & Complexity**	**Supply Chain Capacity**	**Offsite Logistics**	**Nuisance Reduction**	**Site Operations & Logistics**	**Score**	**Impact**
Over Bridges (Concrete)	MMC 3	3D														
Over Bridges (Steel)	MMC 3	3D														
Under Bridges (Concrete)	MMC 3	3D														
Under Bridges (Steel)	MMC 3	3D														
Overhead Gantries & Signs	MMC 3	3D														
Culverts	MMC 5	3D														
Retaining Walls	MMC 2	2D														
Open Water Courses (Concrete Canvass)	MMC 5	2D														
Hydro Brakes	MMC 5	2D														
Attenuation Pond Fixtures & Fittings	MMC 5	2D														
Fencing Elements	MMC 5	2D														
Screens & Baffles	MMC 5	2D														
Stiles & Gates	MMC 5	2D														
Drainage Channels	MMC 5	2D														
Barriers	MMC 5	2D														
Pumping Chambers	MMC 5	3D														
Lighting	MMC 5	2D														
Power & Control Cabinets	MMC 5	3D														
Cable Ducts	MMC 5	3D														
HV/LV Sub-stations	MMC 5	3D														

Granular Assessment

How to Adopt Offsite – Assessment Criteria

Assessment Criteria	Comment/Rational
1. Suitability	Is a structural system or prefabrication appropriate for the project type and functional requirements?
2. Statutory Compliance	Can/Will a structural system or prefabrication meet statutory requirements & comply with extant regulations?
3. Design Integrity	Can/Will prefabrication satisfy client & design team objectives & aspirations?
4. Potential Flexibility	Can/Will prefabrication allow future flexibility or simple reconfiguration? Can potential components, products & assemblies be easily maintained & refurbished?
5. Carbon Reduction	Can/Will prefabrication reduce the carbon footprint?
6. Cost Certainty	Can/Will prefabrication help achieve cost certainty & reduce variations?
7. Critical Path & Programme	Can/Will prefabrication simplify the critical path, reduce overall timescales & increase the probability of completion on programme?
8. Sequencing & Complexity	Can/Will sequencing be simplified & package interface issues be reduced or eliminated by prefabrication?
9. Supply Chain Capacity	Does the supply chain have the capacity to manufacture & deliver the products & assemblies within the required timescale to the required quality?
10. Offsite Logistics	Can/Will prefabrication resolve delivery access & other offsite constraints?
11. Nuisance Reduction	Can/Will prefabrication minimise on-site dust, noise, vibration and & other site related sources of annoyance, irritation & pollution?
12. Site Operations & Logistics	Can/Will prefabrication resolve local labour shortages & other on-site constraints?

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