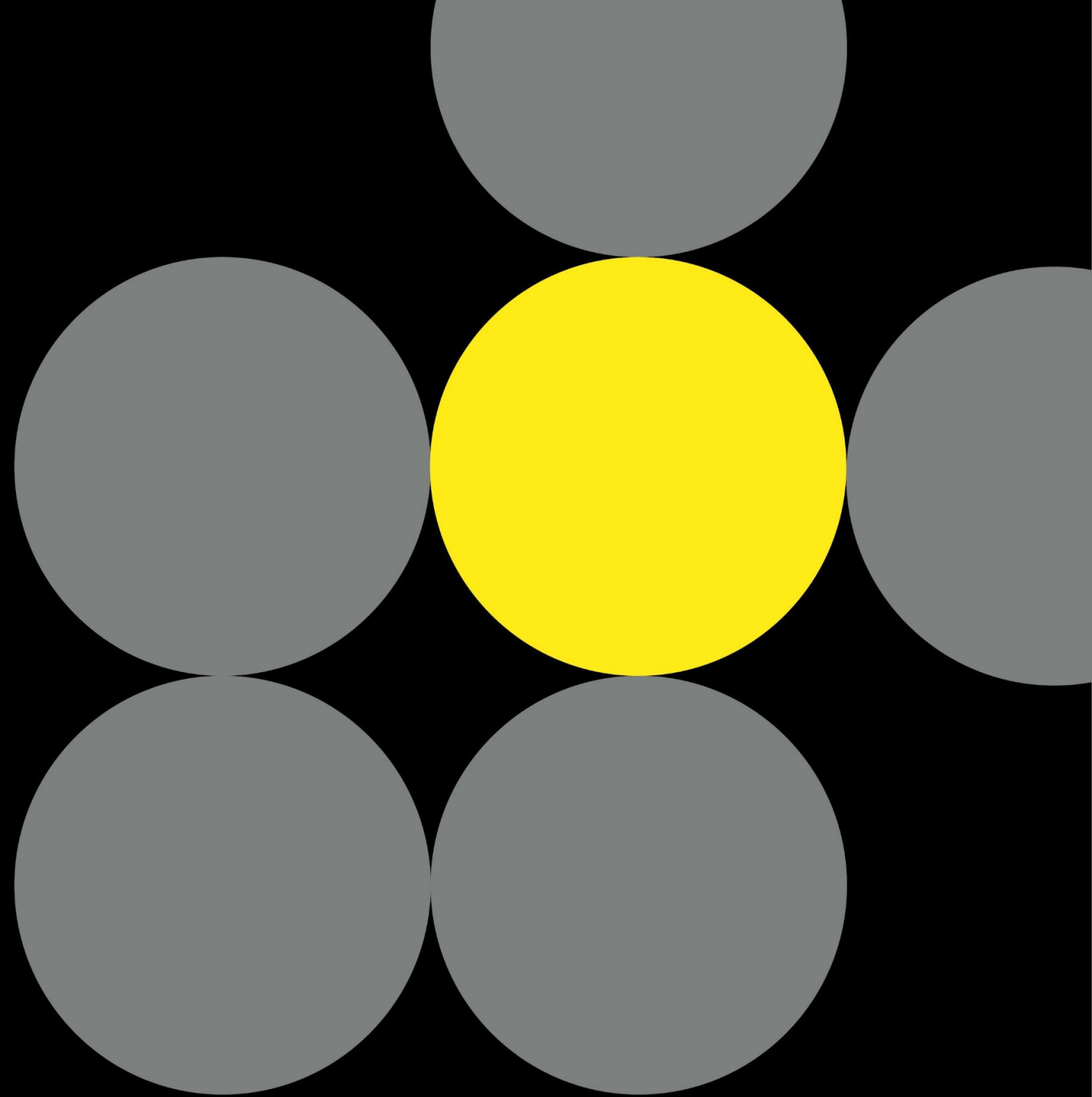




Kings Meadow View

Modern Methods of Construction (MMC) Strategy

May 2023



QUALITY INFORMATION

Prepared by	Checked by
Rob Littlewood	Jamie Hillier

REVISION HISTORY

Revision	Revision date	Details	Authorized	Name	Details
00	23/05/23	Draft Issue (WIP)	RL	Rob Littlewood	Partner
01	30/05/23	Final Issue 1	RL	Rob Littlewood	Partner
02	1/06/23	Final Issue 2	RL	Rob Littlewood	Partner
03	24/07/23	Final Issue 3	RL	Rob Littlewood	Partner

TABLE OF CONTENTS

Executive summary

Background

- Introduction

- What is MMC

- MMC categories

- Benefits

- Purpose of the MMC strategy for Kings Meadow View

Value drivers for Kings Meadow View

Digital

Design review

- Spatial analysis, repeatable areas and NIA

- MMC Evaluation: structures, shell and core (MMC categories 1-4)

- MMC Evaluation: sub-assemblies, fit-out and MEP (MMC categories 5-6)

- Summary

Procurement

- Early supply chain engagement

- Timeframes for decision making

Manufacture and assembly

- Programme

- Logistics and pre-assembly

- PMV assessment

Next steps and actions

APPENDIX A – PROGRAMME

APPENDIX B – SPATIAL ANALYSIS



EXECUTIVE SUMMARY

Having considered the market dynamics of homebuilding in the UK in 2023 and taking due account of the value drivers for the client, council and stakeholders, Akerlof has assembled an initial Modern Methods of Construction (MMC) strategy for the delivery of King’s Meadow View.

We have evaluated key value drivers against the Government’s *‘The Social Value Model’* to lead the strategic direction of the strategy, with a summary of these drivers being:

- Tackling economic inequality
- Provision of equal opportunities and
- Wellbeing of residents.

The strategy concludes that there remain a number of potential options for successful deployment of MMC across what could be a 3 phased development, each with its own drivers and key performance indicators, on which to assess success. These include (but are not limited to):

For the buildings’ superstructure:

- MMC Category 1 (whole building modules)
- MMC Category 2 (light gauge steel frame)
- MMC Category 2 (precast concrete sandwich panels and crosswalls)
- MMC Category 3 (precast columns, slabs and delta beams)
- MMC Category 5 (unitised cladding)
- MMC Category 6 (large format brick slips)

For the buildings’ fit out:

MMC Category 5 - Volumetric podded assemblies

- a) Whole bathroom assemblies (including enclosing structure)
- b) Kitchen assemblies (including enclosing / supporting structure
- c) Bathroom / kitchen combined assemblies (including enclosing / supporting structure)
- d) In unit M&E central equipment assemblies (utility cupboards etc)

MMC Category 5 - Panelised / linear assemblies

- a) In unit M&E distribution assemblies
- b) Infrastructure M&E assemblies – vertical risers / main distribution
- c) Infrastructure M&E assemblies – central plant and equipment
- d) Partition cassettes
- e) Pre-hung door sets

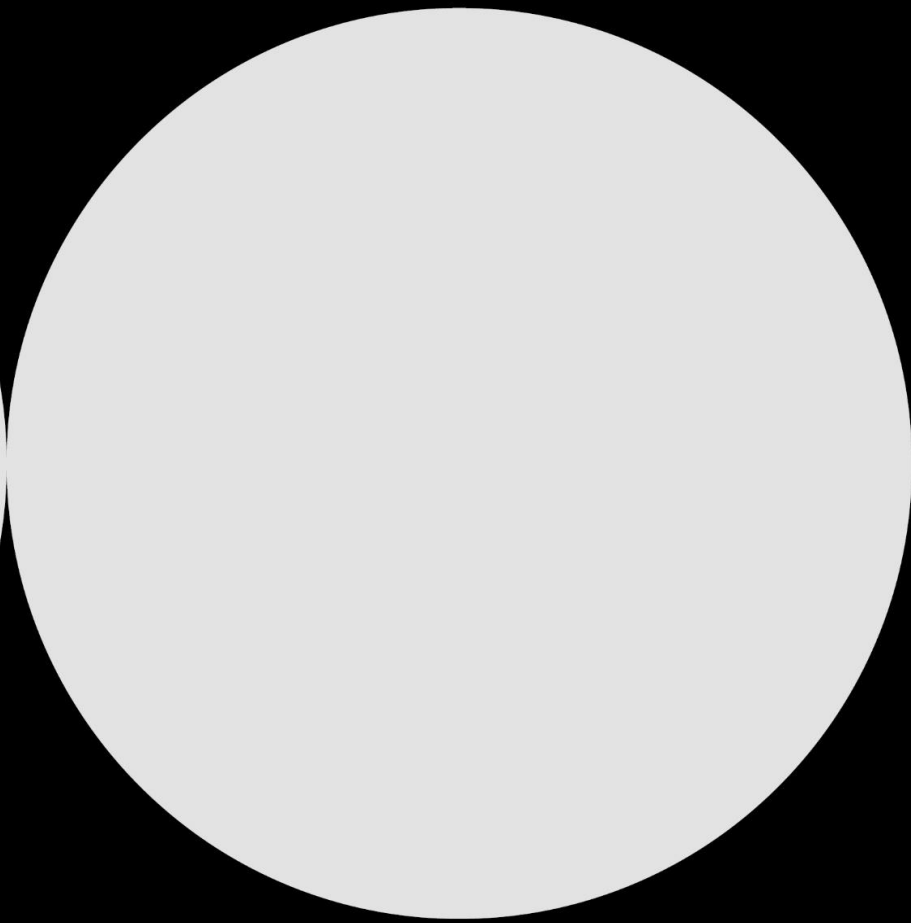
These options are not all mutually exclusive. As such there may be a combination of options for deployment once further work is carried out in future design stages (which would emerge at the reserved matters stage) around value, cost, risk, profile and other key metrics.

We would thus anticipate that Pre-Manufactured Value (PMV) of the proposed development is likely to be in the order of 55% - 70%. This can be determined in future stages once the strategy has been further developed against the specifics of the design

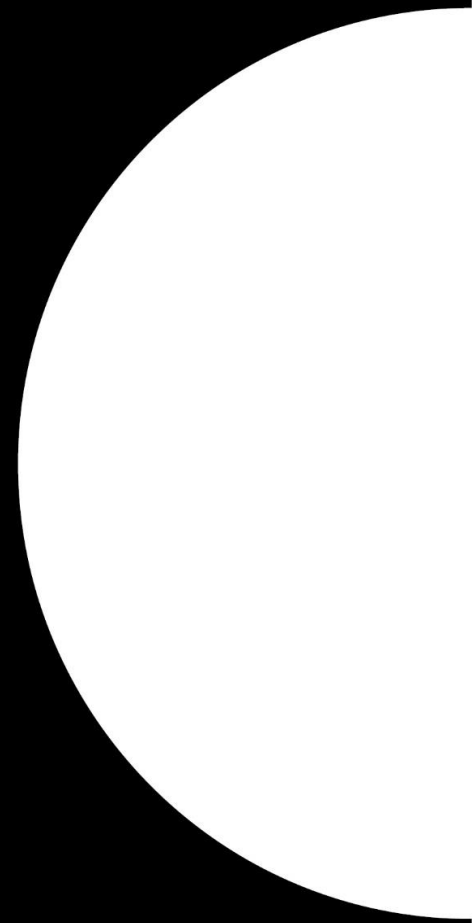
It is anticipated that the scheme is delivered in 3 phases, with each phase being constructed in approximately 2 years. The specifics of this relative to the construction of the basement remains subject to further work, with procurement likely to require early engagement with a number of parts of the supply chain to secure design, programme and buildability advice against each category of MMC.

A series of MMC-focused workshops will be held during subsequent design stages to address actions to ensure that the principles described here are taken forward and developed to deliver best value.

Going forward, the client, team and stakeholders are committed to embracing MMC as a means to deliver a highly productive, resource efficient, sustainable development in Reading.



BACKGROUND



BACKGROUND

Introduction

Viability of housebuilding in the UK is now increasingly complex, driven by a period of rapid price inflation, resource scarcity, a consumer and investor criteria ‘arms race’ (in response to assets becoming increasingly measured and rated) and regulatory reform. These all contribute to increasing development costs and outcome volatility.

These factors mean that the housebuilding sector is now being set against some challenging economic headwinds and increasing regulatory burdens.

As a result, housebuilding costs through 2022 were on the up, in some cases substantially so. Most industry commentators concluded that 2021 and 2022 saw tender price increases of around 15%, creating future difficulty for businesses who either cannot raise prices or are locked into fixed price arrangements where input costs are rising rapidly. This is affecting the ability to deliver affordable housing.

Internationally, Governments have finally recognised the importance of construction in achieving its political ambitions and the move towards manufacture and digitisation is crucial in addressing the headwinds in the industry.



Acknowledging the role of the construction sector as a significant contributor to the UK economy, independent studies have also identified that the sector is held back by low productivity growth and poor predictability. To combat this, there has been a shift to prioritise the use of offsite manufacturing and other modern methods of construction in order to deliver better outcomes.

The Construction Playbook: The mandatory policy within the public sector, builds on a Government presumption in favor of offsite construction and outlines a commitment to develop approaches that support the use of effective new technologies, noting that:

“Greater use of offsite manufacturing can deliver efficiencies and higher quality and safer solutions with lower GHG emissions quicker than traditional construction methods.”

Trust and Productivity: The private sector Construction Playbook, builds on the work of the public sector. It narrows the focus in some areas and introduces the notion that there are new measures of success, including maximising economic, environmental, and social value outcomes.

It notes that:

“Modern methods of construction (MMC) have the potential to transform the construction industry into a highly productive, resource efficient, sustainable sector of the economy.”

The guidance set out within the playbook is to adopt practices and processes that:

- Establish a collaborative team at the outset
- Encourage early supply chain engagement
- Drive standardisation and modern methods of construction
- Create mutually beneficial contracting arrangements
- Ensure a strong and capable supply chain

With this context, this report outlines the strategy for application of Modern Methods of Construction in delivering the desired outcomes for Kings Meadow View (herein KMV).

The report includes an overview of the options available for integration of MMC into the design, procurement, manufacturing and assembly methodology of the programme, with defined action plan for future stages.

BACKGROUND

Kings Meadow View (KMV)

Kings Meadow View is a mixed use, residential-led redevelopment, including:

- Demolition of existing structures
- The construction of up to 820 residential apartment units (Class C3)
- Up to 5,500 sqm (GEA) of commercial uses (Class E).

The development also provides for ancillary and associated development including:

- New and enhanced pedestrian routes and vehicle access routes
- Open spaces
- Hard and soft landscaping
- Basement, and basement car parking providing up to 200 car parking spaces
- Up to 53 car parking spaces serving the commercial uses
- Up to 860 cycle parking spaces and servicing facilities
- Sewer diversion and associated works.

The details of layout, scale, external appearance and landscaping will be finalised at the reserved matter stage.



Illustrative axonometric view

Site location

Located on the site of the existing Forbury Retail Park site in Reading, the site is located to the north of Forbury Road at the exit for Kenavon Drive, next to major rail infrastructure, adjacent to Reading Railway Station



Existing aerial view

The site is located within Reading Town Centre. It is bounded by Forbury Road and Kenavon Drive, as well as Huntley Wharf, Reading Prison and St James’s Church to the south.

The northern edge of the site runs parallel with the main train line. The western edges of the site adjoin the offices at Forbury Place and the eastern edge adjoins the western edge of the neighbouring retail park. The site ownership boundary currently comprises the existing Forbury Retail Park which hosts a variety of shops, as well as a smaller food outlet building and a large car park. The KMV OPA application boundary covers the part occupied by the Forbury Retail Park and associated access road.

Forbury Road is a busy thoroughfare, accommodating both vehicular traffic and pedestrians. It provides a vital link between key areas of Reading, connecting the town's historic and cultural sites with its commercial and retail hubs.



Illustrative aerial view with Huntley Wharf

The KMV OPA site is located within Reading town centre, which falls within the ‘Central’ constituency of Reading Borough Council. In the wider regional context Reading sits between Newbury (to the west), Basingstoke (to the south), and Windsor, Heathrow Airport (and Greater London) to the east.

BACKGROUND

What is MMC?

Modern Methods of Construction (MMC) is an umbrella term used broadly to describe contemporary **innovations** in construction, including **new technologies** (such as digital tools and techniques), **offsite manufacture** and use of **efficient processes** to deliver **better project outcomes**.

MMC is multi-faceted and needs be tailored to the context to be successfully applied, We have therefore sought to develop a considered approach throughout this strategy, measured against these focus areas,

Consistent vocabulary

With a broad range of terminology often used interchangeably with MMC, it's key that a consistent vocabulary is adopted.

This report will therefore adopt the numerical categories developed by the Ministry for Housing, Communities and Local Government (the MMC Definition Framework) to define and communicate the type of manufactured solutions which could be applied at Kings Meadow View.

The document is a 7-category definition framework that enables a full and future-proofed range of MMC used in homebuilding to be better understood with regularised terminology. It spans all types of pre-manufacturing, site-based materials and process innovation.

However, in addition to the 7 categories identified by the framework, we have expanded this to capture innovations in design and briefing phases, specifically under what Akerlof refers as 'Category 0'.



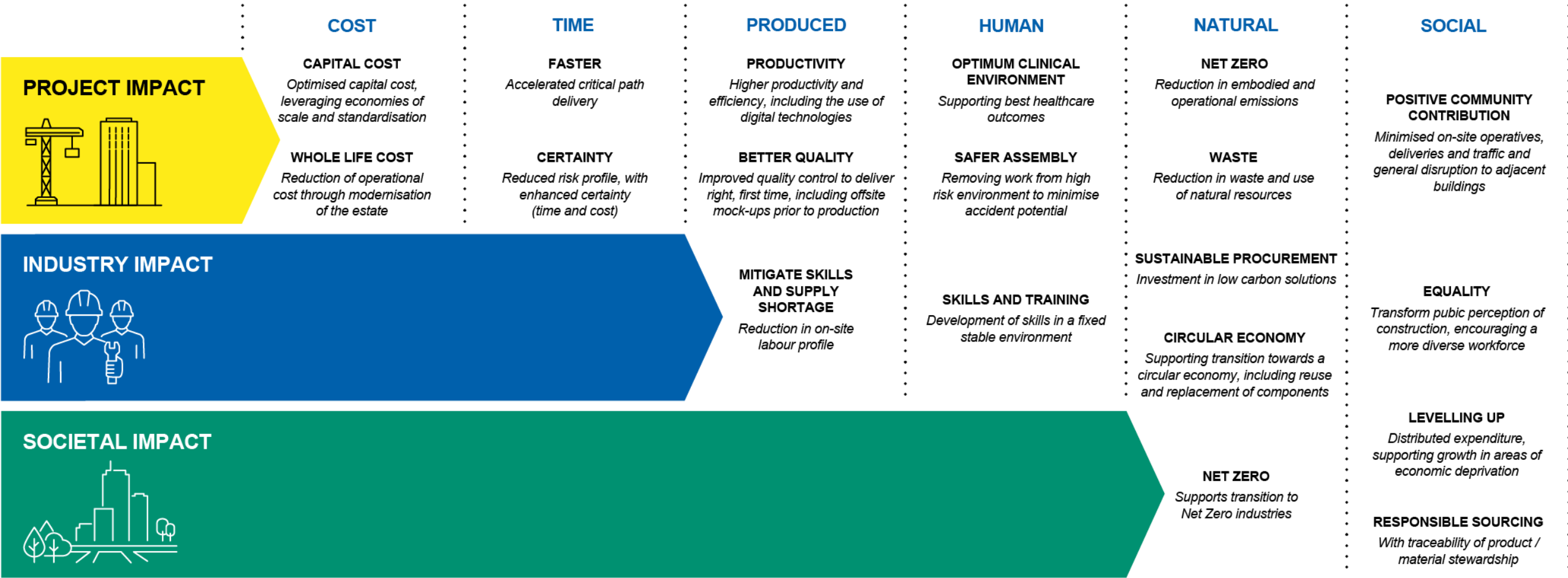
7 + 1 Categories of MMC (Adapted from MHCLG Definition Framework)

BACKGROUND

Benefits of MMC

By adopting Modern Methods of Construction, there are a multitude of potential benefits that can be realised at a project, industry and societal level, examples of which are listed below.

Through this MMC strategy, the project team will look to link the project value definition, as defined through both existing Reading Council Policy and combined with the sustainable investment strategies of Abdrn, with the application of MMC to deliver targeted benefits and better outcomes.



Benefits of MMC (Akerlof)

BACKGROUND

Purpose of this MMC strategy

The purpose of this MMC strategy is to provide visible and defined structure behind any future adoption of MMC, capable of communication to the project team and stakeholders.

We propose developing the MMC strategy in two stages.

The first stage (which reflects the objective of this report and is commensurate with the outline planning stage), is to explore the various MMC options available in the UK market and assess at high level which would be suitable for KMV. In doing so, the report will also cover other factors for consideration to make decisions around the use of MMC going forward, and at which specific stages of the project.

The second stage (aligned to future design changes which would emerge at the reserved matters stage) will be to explore in more detail those identified suitable categories of MMC, and systems / manufacturers which are detailed within this report. This will include specifics around their suitability for the project, and how they work to achieve any value drivers for the development, considering the specific brief and design constraints.

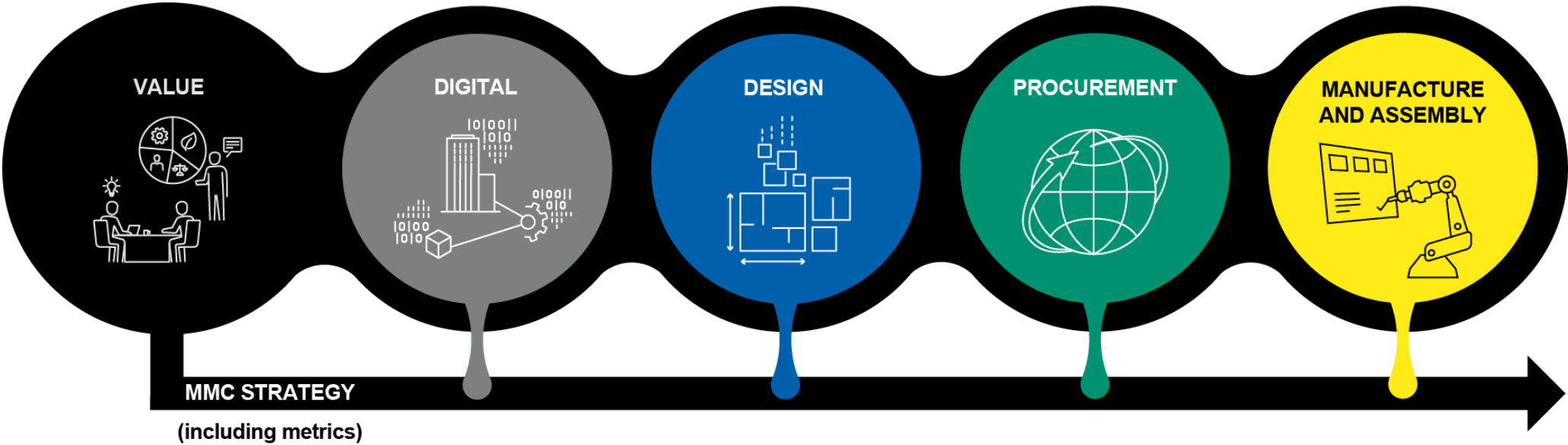
Quantification of key metrics, at a project, industry and societal level, will also be evaluated and Akerlof will seek to analyse these benefits to support the decision-making process.

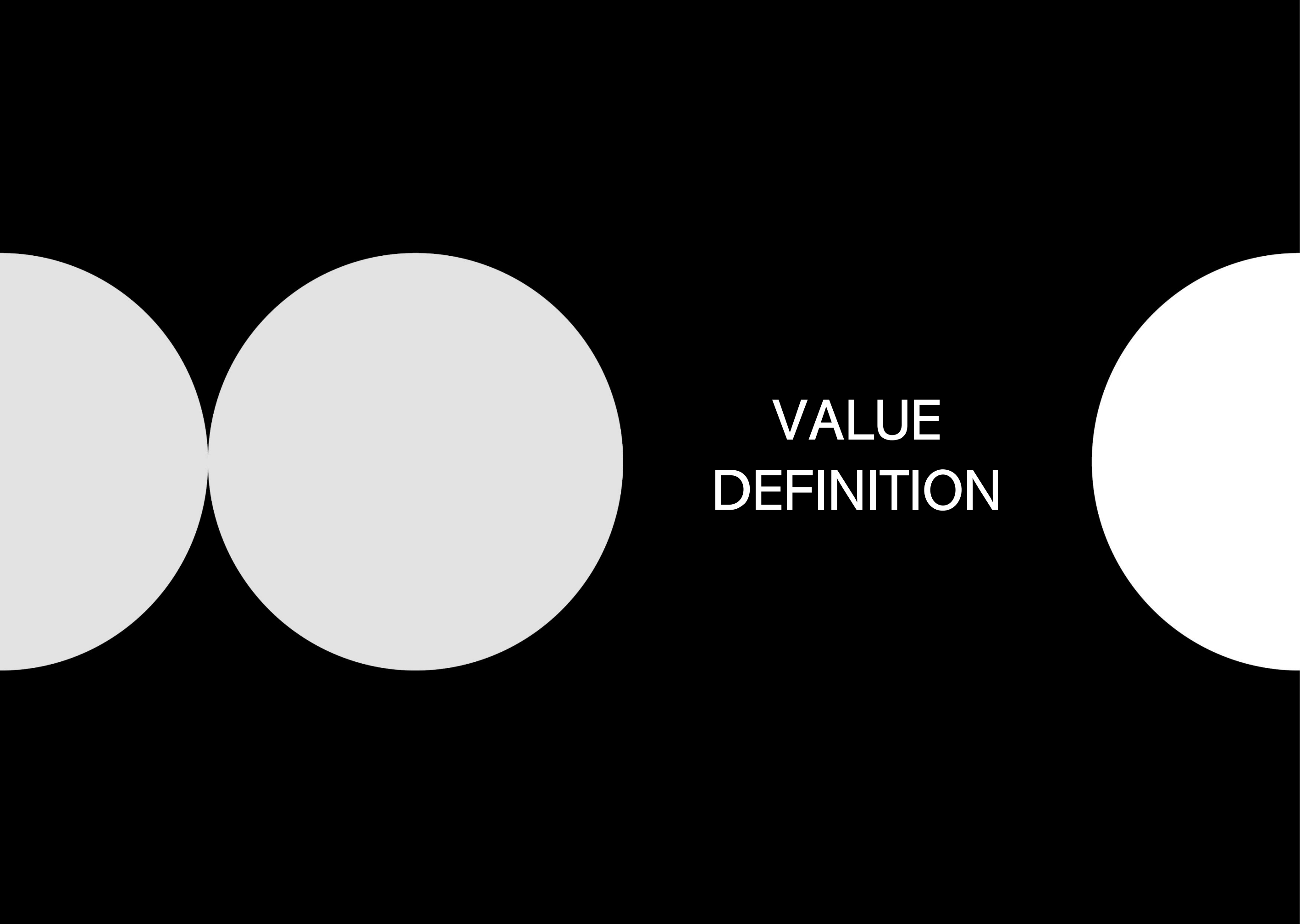
Future metrics could include:

- Compliance with value drivers
- Impact on the critical path (overall development timeline)
- Quality of finished product
- Cost and certainty
- Risk reduction
- Health and safety
- Societal - including reduced noise and waste
- Cashflow and funding
- Supply chain certainty
- Procurement process

We have consciously structured the report into the following 5 sections, representing the project delivery timeline (as illustrated below), with our interpretation of both Abrdn's and Reading Borough Council's key value drivers leading the strategic direction of the MMC strategy.

As part of our conclusions to the report, we have outlined the future steps required to take the strategy forward.





VALUE
DEFINITION

VALUE

“A shared focus on outcomes, rather than scope, will unlock innovation and drive continuous improvement.” Construction Playbook

The application of MMC at KMV is focused to deliver value for Abrdn, Reading Borough Council, stakeholders and future occupiers of the completed buildings. In order to identify and prioritise the competing value priorities and ensure they underpin this MMC Strategy, Akerlof has conducted a high level ‘value assessment’, to identify wider project social drivers and outcomes

As part of the process, we carried out a policy review incorporating local (5nr) and organisational (10nr) policy documents. We subsequently extracted strategic objectives associated with each policy – overall this identified 223 objectives across all policies.

In order to create a value profile, the strategic themes were mapped to Government’s ‘The Social Value Model’ (Covid19 Recovery, Tackling Economic Inequality, Equal Opportunities, Fighting Climate Change, Wellbeing) which identified how each of the policies relates to each of the social value themes. As a result, we have been able to produce a value profile associated with Abrdn’s investment strategy and RBC’s local objectives.

We have generated 3 separate value profiles:

- Assessment of the Abrdn policies (shows what is important through the eyes of organisational policy)
- Assessment of the local policy (shows what is important through the eyes of local policy)
- A combined policy profile (provides holistic view of all policy and value from the social value themes in relation to a given project).

Local policy states the two greatest priority areas are:

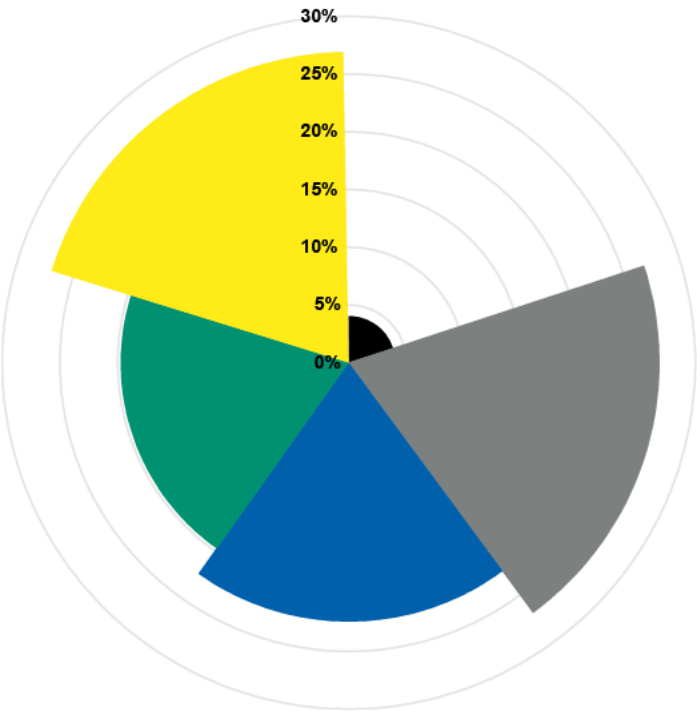
- Tackling economic inequality and
- Wellbeing of residents.

Organisational policy shows greatest priority areas are:

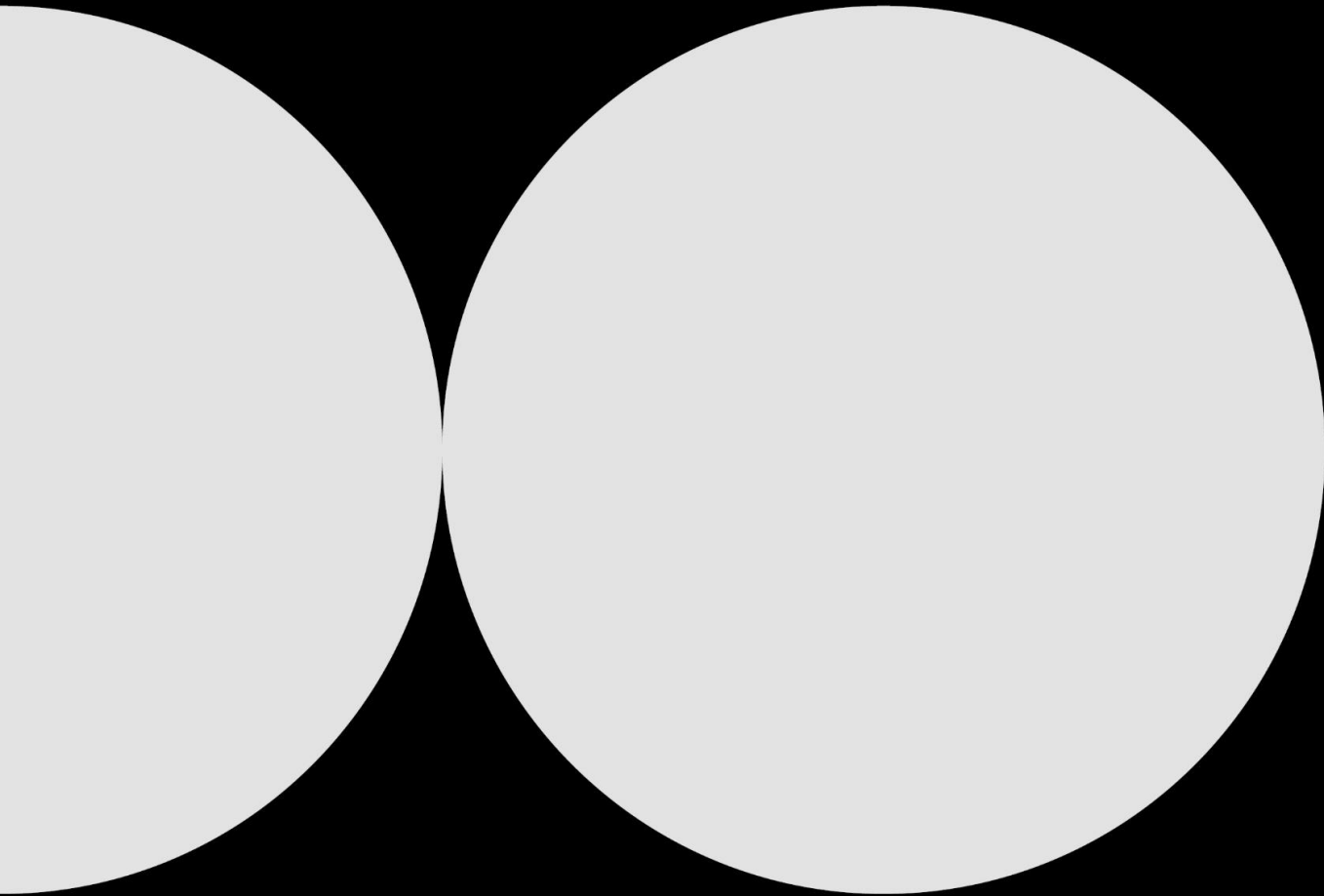
- Tackling economic inequalities and
- Provision of equal opportunities.

The MMC strategy, aligned with the design and delivery plan, is intended to be underpinned by delivering these objectives. As such, the key policy objectives have been informed to guide the options evaluation criteria (all illustrated by the category assessment, which is a principle to be maintained going forwards, in the second stage of the MMC strategy).

KEY	POLICY PROFILE WEIGHTINGS		
	CAPITAL	DOCUMENT OBJECTIVES	%
	COVID-19 Recovery	9	4
	Tackling Economic Inequality	60	27
	Equal Opportunities	50	22
	Fighting Climate Change	44	20
	Resident Wellbeing	60	27
	Overall	223	100
Number of Strategic Driver Documents		15	



Combined policy profile by strategic objectives



DIGITAL



Digital strategy

Deployment of MMC at KMV will rely on the adoption and use of digital tools and data analytics to drive rationalisation, and to capture learnings for continuous improvement and quality management through the three phases of development.

As a general rule, successful implementation of MMC relies upon a data-rich library, which combines the standardised requirements including:

- Standard space types, critical adjacencies and spatial clusters for common configurations (for example, apartment layouts in delivery of residential projects)
- Groupings of items to perform a function (for example, systems and asset types that mitigate risks like spread of smoke or fire)
- Sets of rules regarding interfaces, technical requirements, and standards (for example, thermal performance and energy efficiency).

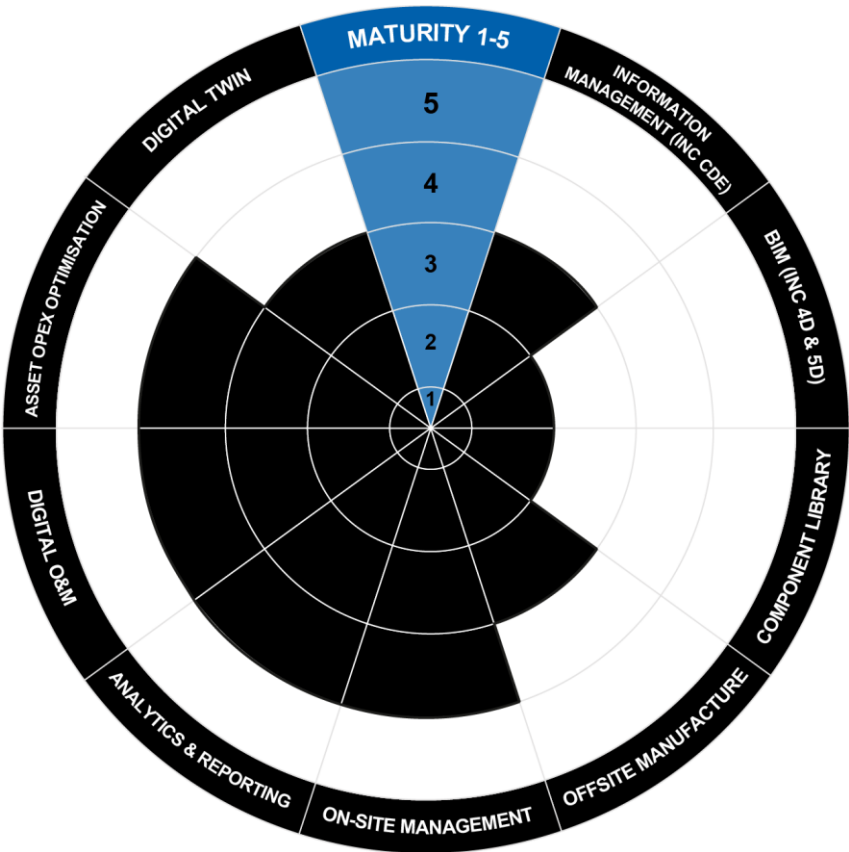
Under the heading of Modern Methods of Construction, the Construction Playbook actively encourages the integration of digital tech, including the UK BIM Framework and digital twins:

“to improve the performance, sustainability and value for money of projects and programmes allowing for the effective retention and management of the ‘golden thread’ of building information to be passed on from the design team to the facility operator via the contractor”.

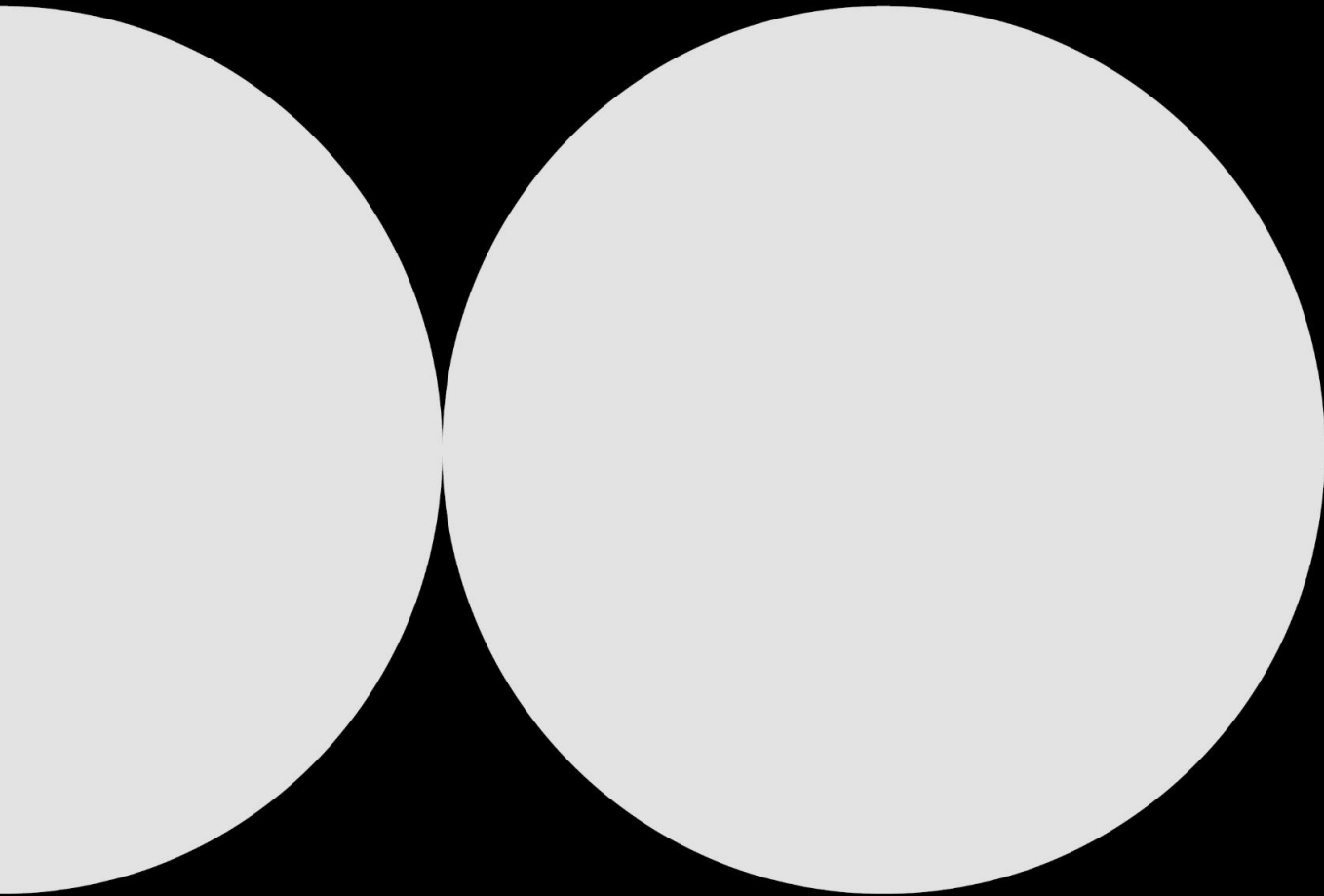
To drive this focus, this MMC strategy (specifically the second stage as outlined in the purpose of this report) will be developed in conjunction with the project’s digital strategy in future design stages: the two intended to be aligned and complimentary.

Given the stage of design, the project’s digital strategy is under development. The high-level maturity assessment (illustrated to the right and assessed at RIBA Stage 2) has been included to provide focussed encouragement towards digital adoption that supports MMC. This includes:

- Application of UK BIM Framework
- BIM to inform design co-ordination, logistical planning / programme validation and quantitative take-offs
- Immersive technologies to support stakeholder engagement
- Use of standard component libraries to inform and enable repeatable design
- Application of digital technologies to support on-site / field management
- Analytics and live reporting against key metrics to drive improvement performance in real time



Adapted from Building SMART BIM Maturity Assessment



DESIGN



PLATFORM AND DfMA OVERVIEW

Overview

There are many interesting debates about the design of residential homes. Talk of ‘inside -out’ and outside-in’ approaches to building massing and internal layout development proliferate but architectural input to the process is still dominated by bespoke design with little standardisation opportunities harnessed.

In a high intensity construction workflow, residential is known to be one of the most difficult sectors for contractors to work in. The design and layout of a floorplan tends to be configured within the building shape rather than structuring the building shape around a floorplan that has been developed using standard typologies. This is ultimately driven by mass variability, meaning limited opportunity for learning curves for on-site activities, often with gangs delivering different dimensional or configuration constraints from one home to another.

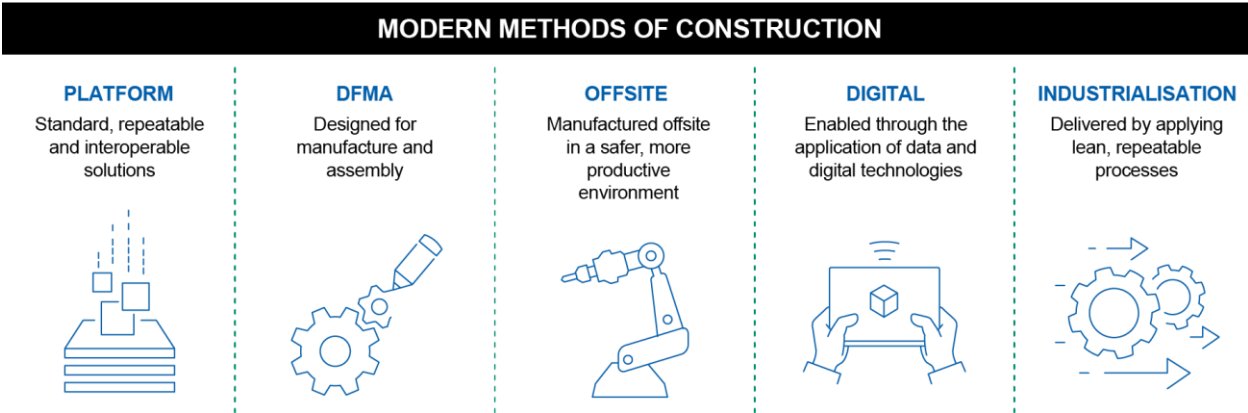
As such there is a great opportunity for manufacturing philosophies to transform the design and production process, harnessing standardisation at building, sub assembly or component level, combined with high quality architecture that can be delivered at a consistently high quality, not subject to the vagaries of individual installation teams and local skills capacity.

Platform design

As set out in the private sector’s ‘Construction Playbook’, the application of successful MMC strategies in residential development is typically aligned to leveraging the use of platforms.

In construction, platforms are a set of common (low variety) core assets (such as apartment types, but could also be structural components, design processes, knowledge, people or relationships), which are then complimented by a set of peripheral components (such as finishes) to create high variety.

Platforms are a key part of MMC in residential delivery, and an enabler to greater use of manufactured solutions



Design for Manufacture and Assembly (DfMA)

DfMA in residential delivery emphasises two practical design considerations - how a component is manufactured, and how it will be assembled as part of the building solution.

It seeks to find ways to rationalise the design process, improve the selection of materials, and optimise the planning and logistics of building. In particular, it exploits opportunities to design efficiently using a limited variety of repeated, preferably standardised, components, sub-assemblies or assemblies that can beneficially be manufactured offsite, transported to site viably, and assembled safely, quickly and straightforwardly.

Within this ‘Design’ section we provide an overview of the current design status and reflect upon the principles as outlined above.

SPATIAL ANALYSIS

Analysis of spaces

As the design develops, the standardisation of components and interfaces will become more of a focal point, however, given the stage of design, our immediate focus has been towards the analysis of spaces.

Akerlof has therefore conducted an analysis of the Kings Meadow View apartments, (based upon the illustrative scheme by Squire and Partners, one of the schemes that could be delivered out of the parameters set by this application) to evaluate the extent of repeatability by apartment type, size and number of variants.

DESCRIPTION	NUMBER OF SIZE VARIANTS	NUMBER OF APARTMENTS
1 Bed / 2 Person	14	443
2 Bed / 3 Person	9	147
2 Bed / 4 Person	9	58
3 Bed / 4 Person	8	122
3 Bed / 5 Person	2	4
3 Bed / 6 Person	2	11
Totals	84	785

Number of different types of apartments



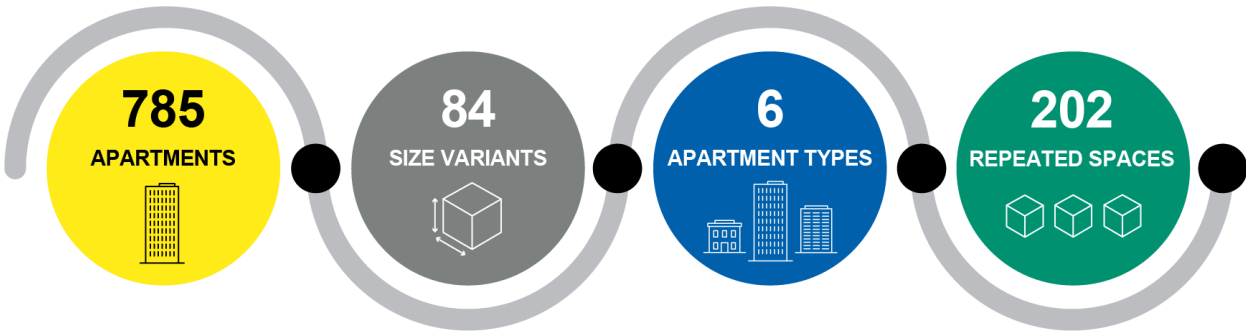
As with many other residential developments, Squire and Partners have applied unit types to each space to categorise the spatial typology.

We have therefore been able to demonstrate and analyse the extent of repeatability (by size and frequency), to inform and identify opportunities and actions to be taken forward.

For example, we have identified that the most repeatable rooms per unit type (excluding circulation space) are:

- 1 bed 2 person apartments at a size of 52m² (73 Nr, occupying 3,796m²),
- 2 bed 3 person apartments at a size of 62m² (42 Nr, occupying 2,604m²),
- 2 bed 4 person apartments at a size of 70m² (17 Nr, occupying 1,190m²),
- 3 bed 4 person apartments at a size of 75m² (60 Nr, occupying 4,500m²),
- 3 bed 5 person apartments at a size of 89m² (3 Nr, occupying 267m²),
- 3 bed 6 person apartments at a size of 106m² (7 Nr, occupying 742m²),

Overall, 202 spaces or c. 13,100m² NIA are configured from standardized, repeated apartment types. This reflects approximately 27% of the overall residential NIA against what will be an ultimate standardisation target of 80%.



When assessed by apartment type alone, the illustrative Schedule of Accommodation implies that there is significant diversity and limited repeatability across the project currently - this will need to be addressed in future stages of design.

Further details can be seen in Appendix A.

SPATIAL ANALYSIS

Floor plate repetition

The illustrative scheme maintains efficient stacking and repeatability (as highlighted by those references in italics below) - this means a standard, repeatable grid can be adopted, enabling the deployment of a number of structural MMC solutions, particularly those present within MMC categories 1-3.

In addition, at an individual room layout, there is future opportunity to implement a sub-grid to assist with the placement of rooms and furniture, to further encourage repeatability in key rooms.

Floor	Development Zone 1				Development Zone 2				Development Zone 3				Total
	East Block 1	East Block 2	East Block 3	East Block 4	Central Block 1	Central Block 2	Central Block 3	Central Block 4	West Block 1	West Block 2	West Block 3	West Block 4	
GF	372	251	300	238	303	241	368	358					2,431
Level 1	434	383	363	284	311	299	440	445				0	2,959
Level 2	434	383	363	420	311	299	577	673				0	3,460
Level 3	434	383	363	420	311	299	577	673	473	521	399	381	5,234
Level 4	434	383	363	420	311	299	577	673	473	521	399	381	5,234
Level 5	434	383	363	420	311	299	577	673	473	521	413	384	5,251
Level 6	434	383	363	420	311	299	577	673	480	526	413	384	5,263
Level 7	434	383	363	420	312	299	577	673	480	526	413	386	5,266
Level 8	434	383	363	420	311	299	577	673	480	526	239	386	5,091
Level 9	434	383	357	420	311	299	576	430	441	430	238	331	4,650
Level 10	434	336	0	420	311	299	413	0	0	0	0	0	2,213
Level 11	377	0	0	375	272	255	0	0	0	0	0	0	1,279
NIA	5,089	4,034	3,561	4,677	3,686	3,486	5,836	5,944	3,300	3,571	2,514	2,633	48,331
N:G	73%	70%	71%	72%	73%	68%	76%	75%	73%	71%	70%	68%	72%
GIA	6,971	5,763	5,015	6,496	5,049	5,126	7,679	7,925	4,521	5,030	3,591	3,872	67,039
Resi GIA	24,245				25,780				17,014				67,039

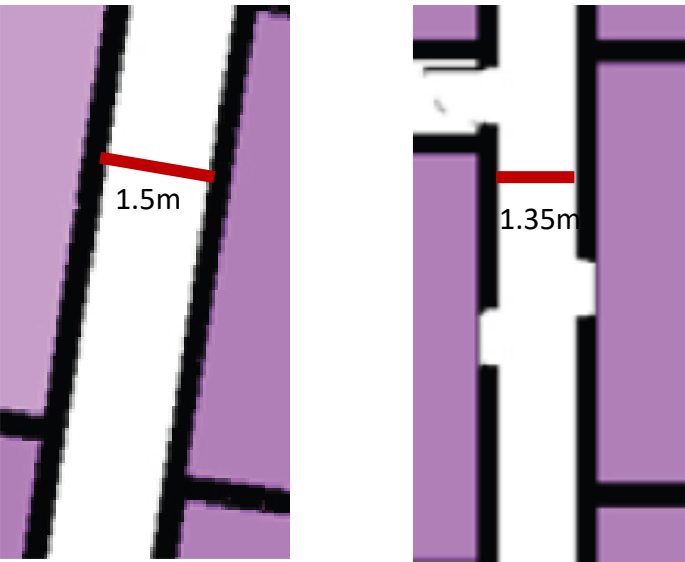
As eluded in our earlier text, typically, the introduction of a second staircase is resulting in a loss in net area of circa 2-3% which will impact scheme viability. Those residential NIA:GIA ratios seen here are perhaps lower than historical benchmarks and one of the reasons for this can be explained by additional escape stairs in each apartment block.

SPATIAL ANALYSIS

Corridors

In addition to apartments and Net Internal Area (NIA), the design team have worked to standardise the spacing of corridors.

Akerlof has checked the current spacing and would note that the illustrative scheme indicates corridor widths of 1350mm - 1500mm, with those narrower corridors only on shorter travel distances. The majority of development blocks (10nr) show 1500mm.



Extract from proposed scheme, typical floor plan, showing both corridor widths identified

Staircases

Given the number of apartment blocks and the requirement for secondary escape staircases, there is opportunity to standardise components and interfaces across the majority of building cores (enabling the deployment of Category 3 MMC) - we would expect target floor to floor heights be consistent at 3.15m on a typical floor. However, going forward, equally critical is to enable consistent parameters to be set amongst both ceiling heights and floor levels through every floor, such that standardisation principles around core structure and applied finishes can be developed as the design progresses.

BLOCK	FLIGHTS / FLOOR	NR STOREYS	TOTAL STAIR FLIGHTS PER BUILDING
West Block 1	4	10	40
West Block 2	4	10	40
West Block 3 – Tall	2	8	16
West Block – Short	2	6	12
West Block 4	4	7	28
Central Block 1	4	11	44
Central Block 2	4	11	44
Central Block 3 – Tall	2	10	20
Central Block 3 – Short	2	9	18
Central Block 4 – Tall	2	9	18
Central Block 4 – Short	2	8	16
East Block 1	4	11	44
East Block 2	4	11	44
East Block 3	4	11	44
East Block 4	4	11	44
Total flights			472

Lifts

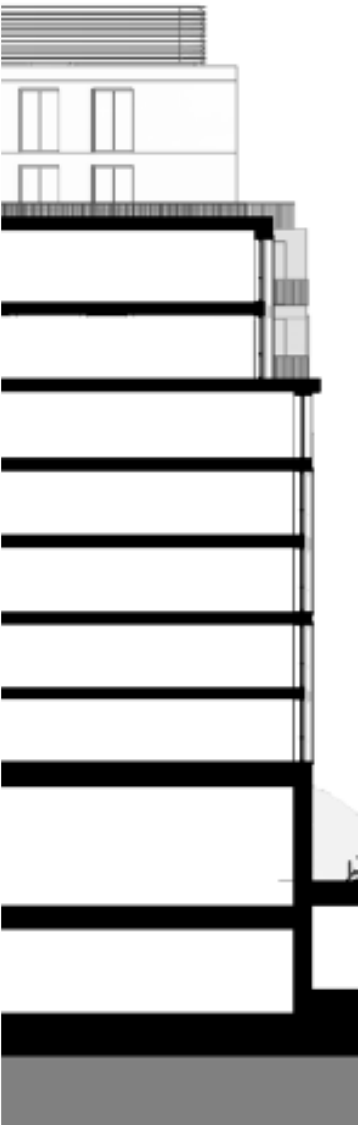
We would again anticipate the standardisation of components and interfaces where appropriate to enable modular frame and shaft installation (enabling the deployment of Category 5 MMC) . Typical lift ratios should target around 1 lift per 35 apartments (around 23 lifts for a 785-unit scheme), subject to appropriate waiting times, in accordance with best practice and at the high end of CIBSE requirements for normal occupation.

BLOCK	LIFTS	NR STOPS	TOTAL STOPS PER BUILDING
West Block 1	2	11	22
West Block 2	2	11	22
West Block 3	2	9	18
West Block 4	2	8	16
Central Block 1	2	12	24
Central Block 2	2	12	24
Central Block 3	2	11	22
Central Block 4	2	10	20
East Block 1	2	12	24
East Block 2	2	12	24
East Block 3	2	12	24
East Block 4	2	12	24
Total	24	132	264

SHELL & CORE ANALYSIS

Floor to floor standardisation

The design team have standardised the floor heights, with consistency upwards of level 1, and variation only in the L1 (basement), and top floor ‘pavilion’ apartments.



Extract from proposed scheme, sections

Wall:Floor ratios

Wall to floor ratio is one of the best indicators to understand whether a building’s envelope is economically designed or not, through examining the ratio of enclosing walls to gross floor area.

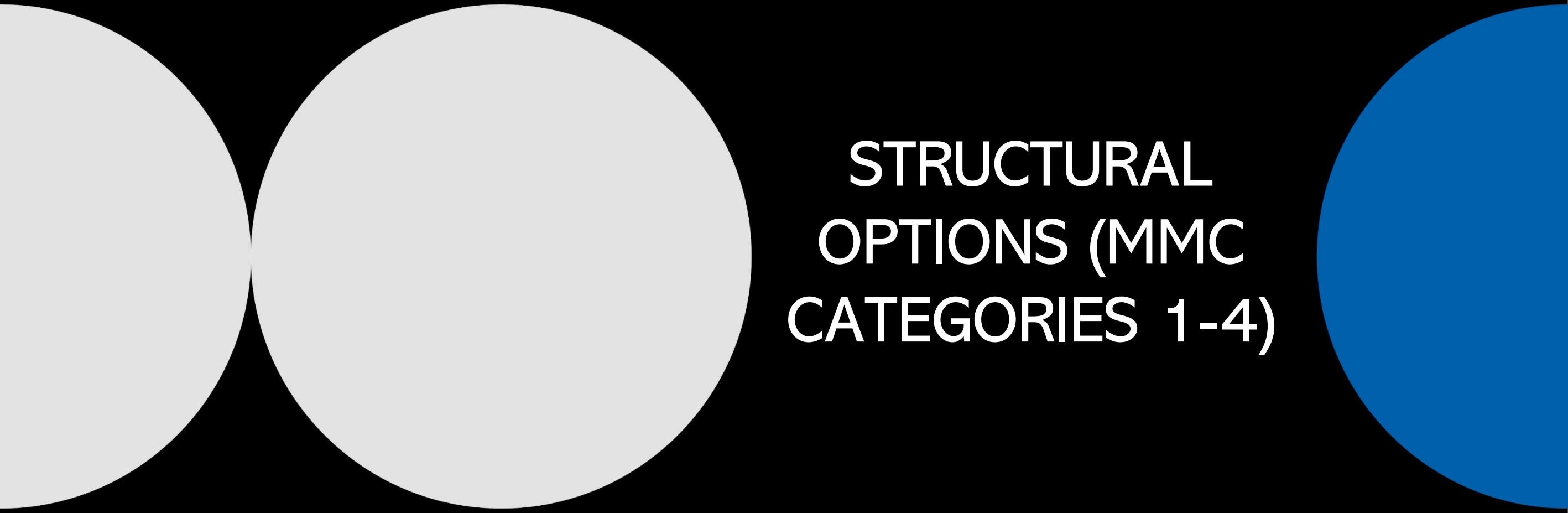
In these instances, we would suggest that W:F ratios at KMV sit within a benchmark range of similar projects, albeit there is some way to go before those ratios are at the lowest end of the scale.

Benchmark ranges would typically be 55-60% as a design target.

BLOCK	W:F RATIO (TYPICAL FLOOR)
West Block 1	63%
West Block 2	66%
West Block 3	60%
West Block 4	65%
Central Block 1	71%
Central Block 2	58%
Central Block 3	70%
Central Block 4	62%
East Block 1	63%
East Block 2	67%
East Block 3	66%
East Block 4	64%



MMC EVALUATION



STRUCTURAL OPTIONS (MMC CATEGORIES 1-4)

OVERVIEW

The structural design (particularly superstructure) has significant influence upon other elements of the building not least in terms of deflection, thermal performance, embodied carbon and tolerances.

It is therefore central to the DfMA design strategy.

Accordingly, we have carried out a more detailed evaluation against a series of potential structural MMC options, initially within MMC Categories 1 through 4. All of these would be deemed suitable at the heights, scale and complexity of the individual blocks at KMV, though each would need to be assessed against merits of value, cost, risk and programme at later design stages and once the details of the design are further developed.

To carry out our initial assessment, we have applied the following evaluation principles, which we would advocate are carried forward into the technical design phase.

- **Value criteria:** alignment of the system to the value profile defined by the policy mapping exercise carried out by Akerlof.
- **Repeatability and standardisation (platform design):** the potential of the system to achieve standardisation at a spatial and component level.
- **Design:** How do the specific design characteristics of the system align to the current proposals and are there any considerations in respect of coordination, weight or regulation which would require change to the current design.
- **Sustainability:** The likely embodied carbon of the system relative to industry best practice.
- **Procurement:** consideration towards the need for early specialist input.
- **Manufacture and assembly:** considerations to the programme, plus any site-specific constraints, particularly access and transportation limitations.
- **System maturity and suitability:** the suitability and technology readiness of solution relative to its context.

MMC Categories 5 and 6 are captured separately and cover non-structural assemblies. At this stage, Category 7 is not covered in detail and will be reviewed in more detail with the supply chain once procurement is underway.

WHOLE BUILDING MODULES (MMC CATEGORY 1)

Summary

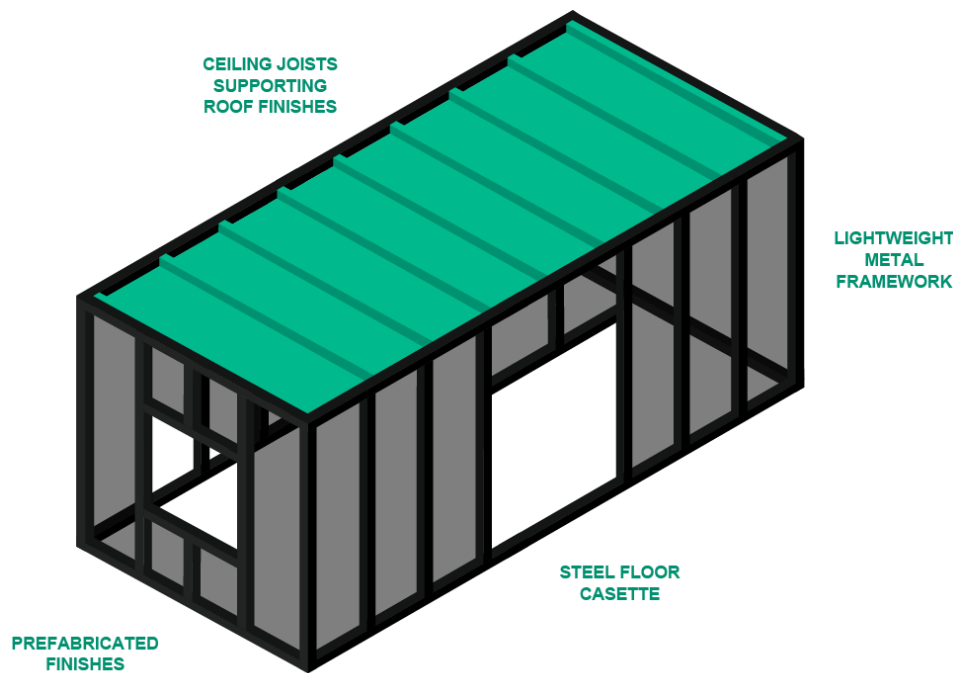
These are what is most commonly associated with the term ‘modular construction’. Prefabricated, finished building units consisting of various components, are produced in a factory and transported to site as whole volumetric components or as large building elements which can then be joined or stacked on site to form larger structures. These are generally self-supporting but may require independent framework when used on more high-rise schemes.

Product options include:

- a. Structural chassis only - not fitted out
- b. Structural chassis and internal fit out
- c. Structural chassis, fit out and external cladding / roofing complete
- d .Structural chassis and internal fit out - ‘podded’ room assemblies - bathrooms / kitchens etc

Any of the above variants can be used in the following 3 configurations:

- i. Whole building systemised
- ii. Hybrid construction - part systemised; part traditional (i.e. traditional core / ground floor podium)
- iii. Hybrid construction - secondary structure to enhance system performance (i.e. build at height)



Examples of suppliers in the market: Elements Europe, Vision Modular, JRL Modular, TopHat

Key feature: Fast completion of high-quality finished product on site.

Suitability analysis			
1	Alignment to Value Criteria	◆	70%+ PMV with High quality finish due to high level of factory quality control
2	Potential to adopt a platform approach	◆	Requires the most standardisation but easily adaptable for future building extensions and can even be dismantled and moved
3	Design	◆	Potentially viable but duplication of structure may result in negative impact on NIA/ GIA. However, this will result in excellent acoustic properties, lighter weight foundations and it is also possible to achieve very high levels of air tightness and thermal performance.
4	Sustainability	◆	Good low embodied carbon solution which maximises offsite construction, minimising waste and site activities. Use of timber studwork and structure where possible will maximise sustainability
5	Procurement	◆	Likely to require earliest engagement of all MMC solutions, requiring early engagement from the supply chain in Stage 1-2
6	Manufacture and assembly	◆	Likely to be shortest overall build programme but longest overall design and manufacture lead in. Fewest vehicle movements relative to other systems
7	System maturity and suitability	◆	The supply chain capacity to deliver at the scale of KMV is limited and requires further investigation

Where has this been done before?



Greystar Croydon - Category 1b delivered by Tide/Vision. 40-storey tower delivered in 18 months



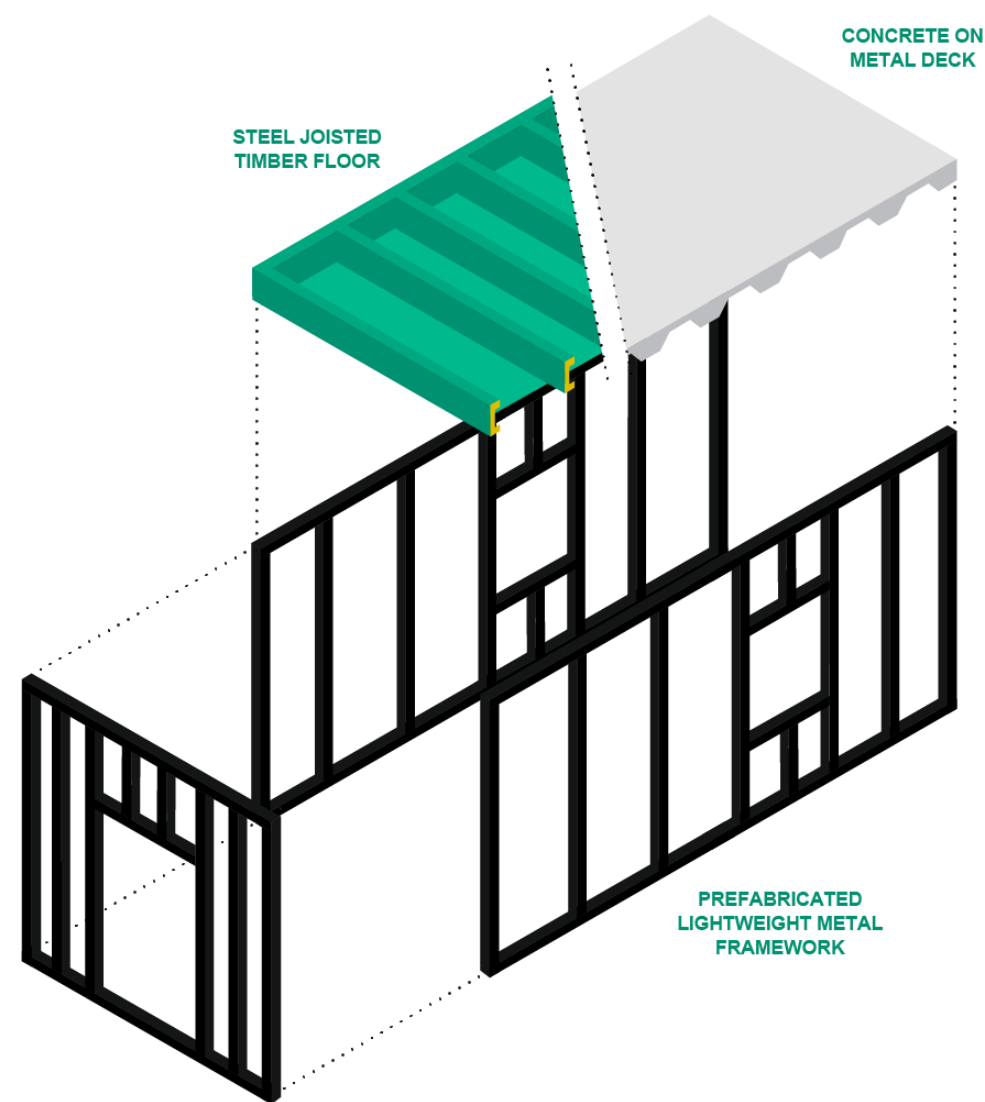
Kitchener Barracks, Chatham - Category 1c delivered by TopHat ,308 houses and apartments delivered in two years

LIGHT GAUGE STEEL FRAME (MMC CATEGORY 2)

Summary

Pre-panelised lightweight metal studwork system designed to provide the main vertical load bearing structure. Floor slabs are typically concrete on profiled metal deck or steel joisted timber floors. Elements of hot rolled structural steelwork may be included to facilitate large openings or transfer structures. The solution may often be combined with a low-level transfer structure or podium, to provide more flexible mixed-use ground floor spaces.

Product options tend to include basic framing only, including walls, floors, stairs and roof structure. Residual scope is then constructed in situ, on site, but can easily be combined with Cat 5-7 MMC.



Examples of suppliers in the market : Hadley, Metek, Frameclad, Fusion

Key feature: Fast, and lightweight construction solution which is likely to result in economic foundations and reduced transfer structure sizes.

Suitability analysis			
1	Alignment to Value Criteria	◆	
2	Potential to adopt a platform approach	◆	May easily be adapted with additional floors or extensions relatively simple to construct, however, room layouts are not easily adjusted due to load bearing wall construction which restricts the potential for future change of use
3	Design	◆	High level of coordination is likely to be required at the design stages. Lightweight solution is likely to result in economic foundations and reduced transfer structure sizes. Studwork can be used to form residential separating walls with high acoustic properties. Possible to achieve very high levels of airtightness and very low u-values. Likely to need to combine with traditional reinforced concrete podium to deal with transfers and alternative uses at Ground Floor.
4	Sustainability	◆	Good low embodied carbon solution which maximises offsite construction, minimising waste and site activities. Use of a joisted timber floor will maximise sustainability though more common to utilise composite slab.
5	Procurement	◆	Reasonably flexible with a number of suppliers offering similar systems. Lead in time vary but likely to dovetail nicely with constriction of podium and basement,
6	Manufacture and assembly	◆	Likely to be quick programme given the structure and floors will come up simultaneously perf floor. Requires coordination with brick envelope.
7	System maturity and suitability	◆	Mature supply chain with a number of players. Delivering at this scale requires further work

Where has this been done before?



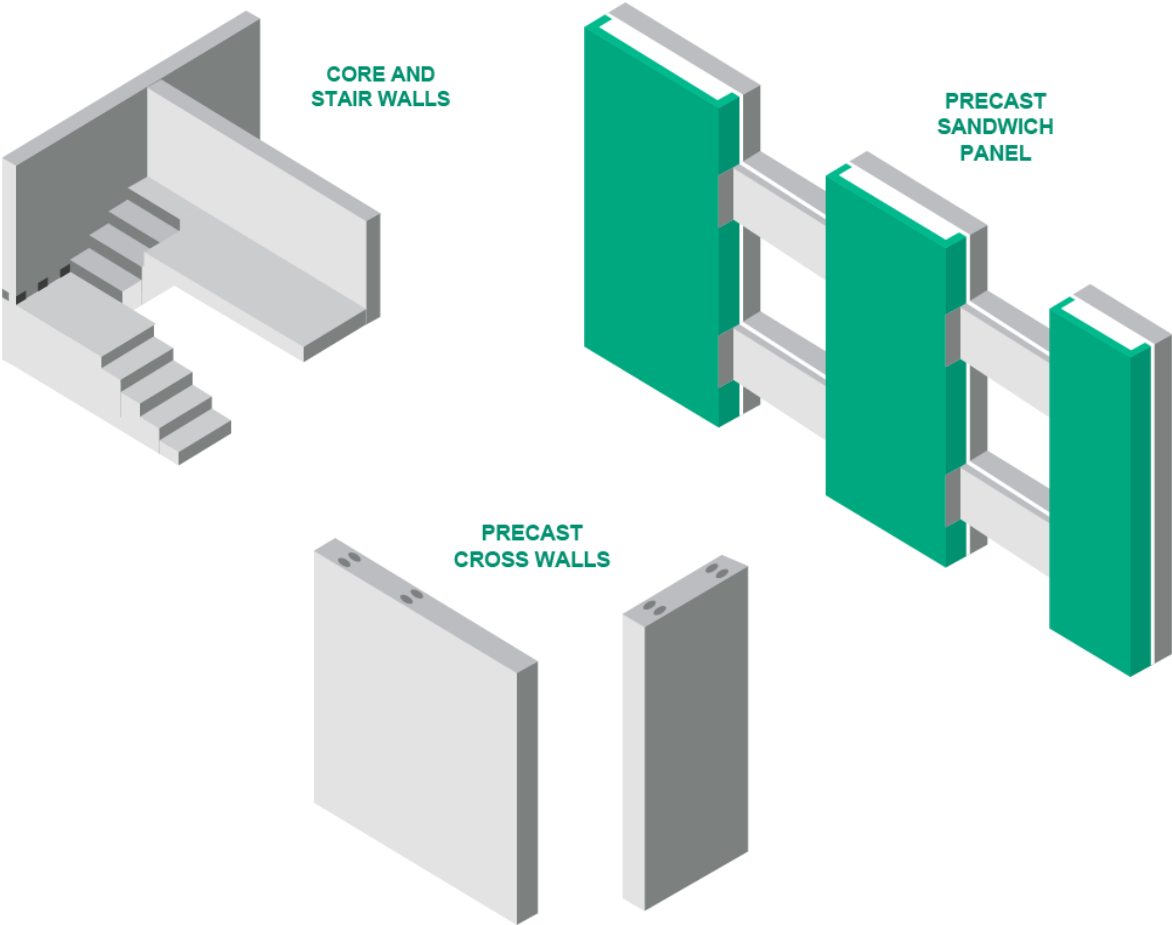
Waverley Park, Shawlands, with LGSF delivered by Hadley in 15 weeks

LOAD BEARING PRECAST SANDWICH PANEL FACADE AND PRECAST CROSS WALLS (MMC CATEGORY 2)

Summary

In load bearing precast, a combination of ‘sandwich panels’ and internal cross walls form the main vertical load bearing structure. The sandwich panels have inner structural leaf that does the work of the columns usually found on the outside of traditional insitu frames. Slab elements span between the walls and sandwich panels to form the floors. A corridor is generally formed between bays and may be used to distribute main services. To work more effectively the grids must generally align through the height of the structure. Transfer structures or podiums are often required at a lower level to accommodate mixed use layouts at ground floor.

Product options include enhanced consolidation against the Cat 2 system, including insulation, linings, external cladding, roofing, doors, windows.



Examples of suppliers in the market : Byldis, PCE, Creagh,

Key features: Fast construction to repeatable layouts and extremely robust design solution for thermal, acoustic and fire performance.

Suitability analysis			
1	Alignment to Value Criteria	◆	
2	Potential to adopt a platform approach	◆	Load bearing cross walls are not easily changed or adapted. Limited scope for change of use of structure. Limited scope for future hole formation without significant structural intervention.
3	Design	◆	Generally a flat soffit with a relatively shallow slab, however, solid cross walls prevent simple service distribution. Precast solution is generally a heavy solution and may require significant foundations and transfer structures. However, Good integral fire resistance to precast concrete solution and exposed concrete could be use for thermal mass
4	Sustainability	◆	Use of prefabricated elements reduce waste on site. Opportunity to incorporate sustainable mix options in concrete.
5	Procurement	◆	Reasonably flexible with a number of suppliers offering similar systems. Lead in time vary but likely to dovetail nicely with construction of podium and basement,
6	Manufacture and assembly	◆	Likely to be quick programme given the structure and floors will come up simultaneously per floor.
7	System maturity and suitability	◆	Mature supply chain with a number of players, some of which have deliver 5000 units plus in the UK

Where has this been done before?



London City Island, Canning Town, where Byldis has delivered over 4,000 residential units using crosswall construction

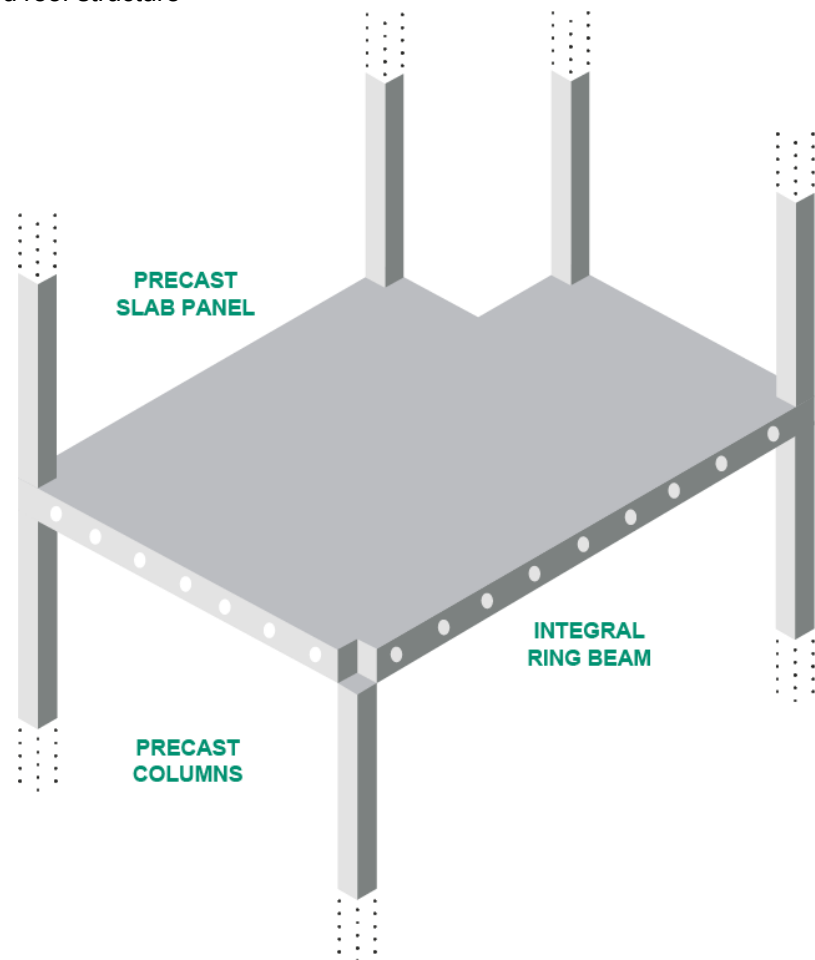
PRECAST FRAME – STEEL ‘DELTABEAM’ AND PRECAST COLUMNS (MMC CATEGORY 3)

Summary

This system is used extensively by Laing O'Rourke with the aim of significantly reducing the amount of 'wet trade' on site. With this system, each precast floor panel with integral deltabeam is intended to form a single area supported on precast columns. These are all interconnected through use of dowels with grouted joints which can achieve floor continuity. Services may be integrated within the ring beam.

Products and components will include

- Floor slabs
- Integrated columns, shear walls, beams and floor slabs
- Staircases
- Pre-assembled roof structure



Examples of suppliers in the market : Laing O'Rourke (Expanded), PCE, Bison,

Key feature: Fast construction suited to repeatable layouts.

Suitability analysis			
1	Alignment to Value Criteria	◆	
2	Potential to adopt a platform approach	◆	Floor panels are designed to suit a particular room space or layout so critical to adopt repeatable spaces in respect of the apartment layouts
3	Design	◆	More lightweight than a traditional solid RC solution but heavier than a steel solution. Inherent fire resistance through concrete design. Good opportunity to utilise thermal mass of concrete
4	Sustainability	◆	Use of prefabricated elements reduce waste on site. Opportunity to incorporate sustainable mix options in concrete as curing times on site do not inhibit use. Good opportunity for reuse at end of life through specialist dowel connections
5	Procurement	◆	Long lead in time with a significant design period but fast erection on site by a highly skilled workforce. Size of precast components are limited by the transportation available but this minimises logistical and assembly issues,
6	Manufacture and assembly	◆	Likely to be quick programme given the structure and floors will come up simultaneously per floor.
7	System maturity and suitability	◆	More limited supply chain with Laing O'Rourke the most known of the UK suppliers.

Where has this been done before?



Cadence S5 at Kings Cross by Laing O'Rourke for Argent

**NON-STRUCTURAL
ASSEMBLIES AND
COMPONENTS
(MMC CATEGORIES
5-7)**

MMC CATEGORY 5 (NON-STRUCTURAL ASSEMBLIES AND SUB-ASSEMBLIES) – FIT OUT

Summary

A considered MMC strategy to the building fit-out offers a number of benefits for the construction phase.

Typically, a labour intense phase of construction, Cat 5 MMC applied to fit-out offers the potential to minimise site congestion and concurrent working thereby affording benefits to programme, certainty of delivery and quality.

Given the stage of design, many of these assemblies for fit out have not yet been considered, however, potential options could include:

Volumetric podded assemblies

- a) Whole bathroom assemblies (including enclosing structure)
- b) Kitchen assemblies (including enclosing / supporting structure)
- c) Bathroom / kitchen combined assemblies (including enclosing / supporting structure)
- d) In unit M&E central equipment assemblies (utility cupboards etc)

Panelised / linear assemblies (fit out items only)

- a) In unit M&E distribution assemblies
- b) Infrastructure M&E assemblies – vertical risers / main distribution
- c) Infrastructure M&E assemblies – central plant and equipment
- d) Partition cassettes – with horizontal and vertical services / finishes added
- e) Door sets (pre-hung, finished with ironmongery)

During future design stages we will seek to evaluate and embed these opportunities where they align with the project's value profile.



Examples of suppliers in the market (volumetric podded assemblies):

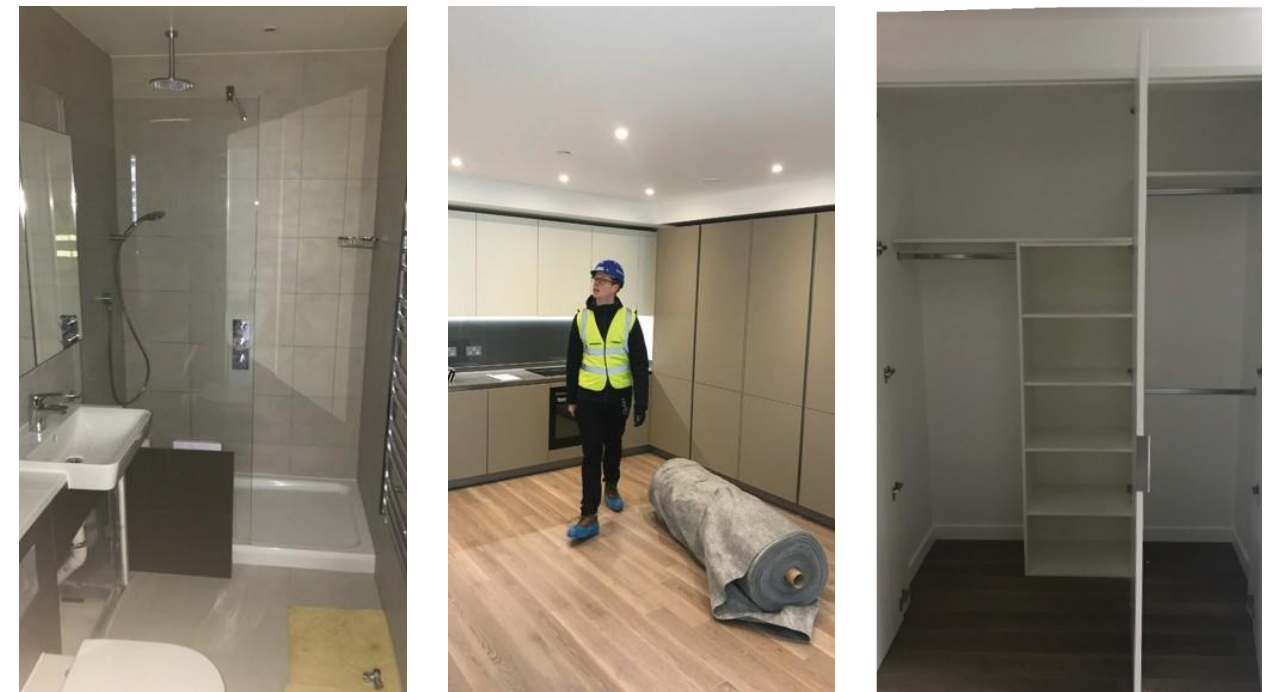
- **Bathroom pods:** Deba, Elements Europe, Forta, Off Site Solutions, Walker Modular
- **Utility pods:** Borough Engineering Services, Modular Engineering, Alternative Heating, Duty Point
- **Kitchen pods:** Elements Europa, B&B Italia

Examples of suppliers in the market (panelised / linear assemblies):

- **Door sets:** UK Door Sets, Shadbolts, Door Concept
- **Risers:** Pipetech, Modular Engineering, Balfour Beatty, DST Group
- **Wall cassettes:** Eekowall

Key features: In all instances, podded and panelised assemblies offer the potential for fast construction and the de-risking of the high intensity workflow that comes with residential fit out. However, in order to be effective, there is a need to minimise variants amongst types and maintain standard sizes.

Where has this been done before?



Plot N08, East Village – Category 5 delivered by Mace, 482 units delivered in 136 weeks

MMC CATEGORY 5 (NON-STRUCTURAL ASSEMBLIES AND SUB-ASSEMBLIES) - ENVELOPE

MMC CATEGORY 6 (TRADITIONAL BUILDING PRODUCT LED IMPROVEMENTS) - ENVELOPE

For Kings Meadow View, the regular grid and recta-linear building shapes offer great opportunity to employ a manufactured façade solution. This may form part of the systemised structure (Category 2 MMC) but other options existing in the form of Panelised / linear assemblies (for example 'single skin' precast concrete façade panels, such as those below).



Programme data from other residential projects utilising pre-fabricated envelope assemblies have demonstrated the potential for accelerated critical path (and early watertightness) through a considered approach to the façade; similar opportunities exist at KMV regardless of whether these are adopted as part of a systemised (Cat 2 MMC) Structure, or indeed a combination of Category 3 and 5 set of assemblies.

Whilst the materiality of the solutions are under review, the façade is likely to be brick faced in the majority of instances, so can be prefabricated and panellised. The appropriate treatment of the facades is set out in the design codes. The following options are the most suitable:

- **Precast (factory glazed and insulated)**
Precast concrete units, either stack-loaded or spanning floor to

floor (height) and column to column (width). These provide a range of design options which could suit KMV well. The precast outer layer of the panels could be composed of a cut brick adhered to a concrete backing, providing a great choice of finishes, with a range of architectural themes.

Factory glazing windows and factory installing insulation and membranes will improve interface quality, airtightness and thermal performance.



Illustrative elevation, showing regular external wall arrangement suitable for precast, brick faced panels

- **Unitised cladding system**
Where large scale precast units (which need crane access) are not suitable or do not suite the envisaged design and façade articulation, the alternative is to apply unitised façade systems,

usually spanning floor to floor, and designed to be installed from inside the building, with floor-based lifting devices.

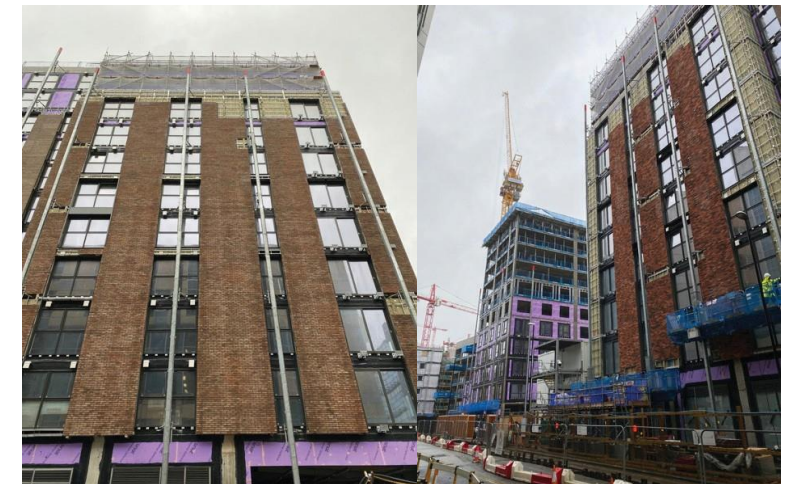
As with precast façade elements, these units arrive on site fully glazed and insulated, improving quality and performance, and reducing on site issues with installation.

Other options

Subject to a formal assessment at later design stages, there may also be an opportunity to deploy traditional building product led improvements, such as large format brick slips or roofing finishes.

These systems, which tend to have the perception as an area of little client influence, may be more compatible with lighter weight frames (such as those associated with LGSF as a Cat 1 or 2 MMC). As such these require further research in future design stages

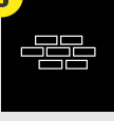
Where has this been done before?

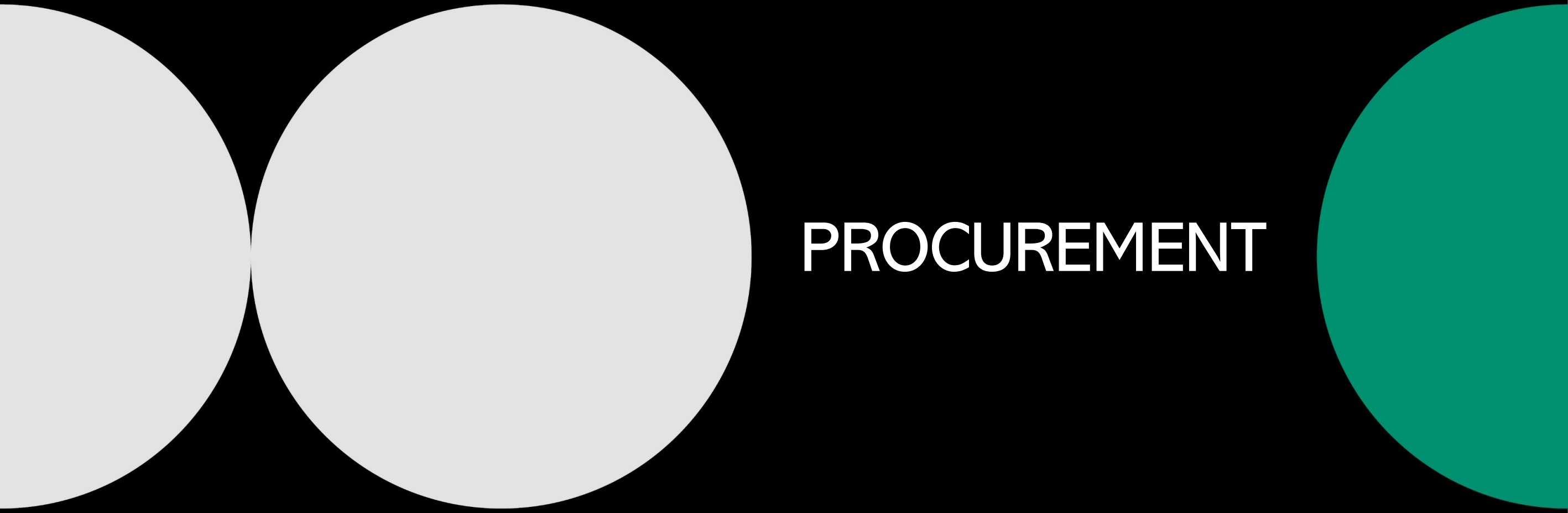


Temple Quarter, Bristol, Category 6 delivered by Vistry

SUMMARY OF MMC FOCUS AREAS

In accordance with our second stage of the MMC strategy, the summary of options, including areas we wish to continue to analyse against key metrics, and further develop during future design stages, are summarised below.

		SPACES	FRAME	ENVELOPE	MEP	FIT OUT
0 	BRIEFING, SCOPING & DESIGN	Repeatable apartments and spaces within apartments	- Standard grid - Repeatable floor to floor heights and slab thickness - Aligned columns	Consistent, repeatable panel sizes (with minimised types)	- Standard service zones - Standard room arrangements	Standard repeatable assemblies for spaces (e.g. bathroom pods, utility cupboards) and components.
1 	3D PRIMARY STRUCTURAL SYSTEMS		Light Gauge or Hot Rolled Steel cages	Potential for cladding to be completed on site, subject to supplier / manufacturer	Fully fitted out modules, subject to nuances of particular system and manufacturer	
2 	2D PRIMARY STRUCTURAL COMPONENTS		- Precast cross walls - Precast core walls	Precast sandwich panels		
3 	NON-SYSTEMISED PRIMARY STRUCTURE		- Precast stairs - Precast columns - Precast planks - Lift shafts - Precast basement liner walls	Precast, brick faced panels (with preinstalled windows)		
4 	ADDITIVE MANUFACTURE		UNLIKELY TO BE SUITABLE FOR KING'S MEADOW VIEW			
5 	NON-STRUCTURAL ASSEMBLIES				- MEP corridor distribution modules - Vertical riser modules - Packaged plantrooms - Pre-fabricated utility cupboard - Modular integrated plumbing systems - Generators - HV / LV switchgear skids - Distribution boards - Offsite photovoltaic panels	- Partition systems - Fire stopping / penetration details - Bathroom pods - Kitchen assemblies - FFE assemblies
6 	SITE-LED IMPROVEMENTS			Large format brick slip		



PROCUREMENT

PROCUREMENT - EARLY SUPPLY CHAIN INVOLVEMENT

“Early engagement with manufacturers and specialist contractors improves the efficiency of the design and the design process through a better understanding of manufacturing capabilities, logistics constraints and on-site buildability.” Private Sector Construction Playbook

Given the stage of design, the procurement strategy for KMV has not yet been established and is subject to further dialogue between Abrdn and their team of professional advisors.

However, there is a great opportunity for manufacturing philosophies to transform the design and production process, harnessing standardisation at building, sub assembly or component level, combined with high quality architecture that can be delivered at consistently high quality, not subject to the limitations of individual installation teams and local skills capacity.

A project of this size and scale being delivered over a long programme is exposed to significant volatility of the market around price and capacity to deliver the vision established at the outset of the project. Therefore, whichever the route forward, it should facilitate the ability for Abrdn to invest in long term relationships with the supply chain, which demonstrate value for money and ‘continued improvement’, block by block, zone by zone, to allow them to continue.

To realise the benefits of MMC and drive maximum value into the development, there may be a requirement to engage tier 1 contractors, alongside tier 2 and 3 sub-contractors and suppliers in the pre-construction phase to input into:

- Design (including the use of standards for products and interfaces),
- Costing,
- Risk management and
- Development of the programme.

With the procurement vehicle to facilitate this pathway under review, we have considered in the interim:

- **The who:** the sub-assemblies / packages which hold a project sensitivity, whereby early specialist input is likely to add value in the pre-construction phase of the project
- **The when:** the timing of input required relative to the design process, to afford collaboration and value add in developing the design detail, mitigating rework later in the process.

The selection of which parties to engage with will be informed by an MMC competency and capacity assessment, to be developed during at the outset of the next design phase.

Initial reviews of developing design against the market does not currently raise any red flags. Notwithstanding, the scheme elements have been mapped against input required to identify the key areas for early engagement. This of course subject to which MMC categories are taken forward.

Overleaf the timing for engagement has been plotted against the RIBA stages. Engagement with specialists (particularly Superstructure, MEP and Façade packages) will be critical at the early stages of RIBA 3, with other MMC related trades also flagged as providing valuable input at this same time period.

TRADE	POTENTIAL MMC CATEGORY	EARLY DESIGN INPUT REQUIRED	EARLY BUILDABILITY INPUT REQUIRED	PROGRAMME INPUT REQUIRED (CRITICAL PATH)	RISK IF NOT UNDERTAKEN		
					LOW	MEDIUM	HIGH
FRAME AND UPPER FLOORS	1 2 3	✓	✓	✓			✓
ROOF	2	✓	✓				
STAIRS	3	✓	✓				
EXTERNAL WALLS, WINDOWS AND DOORS	1 2 3 5 6	✓	✓	✓		✓	
INTERNAL WALLS, AND DOORS	5 6	✓	✓	✓		✓	
FINISHES	6						
FFE	5	✓	✓				
SANITARYWARE (BATHROOM PODS)	5	✓	✓	✓		✓	
MECHANICAL AND ELECTRICAL SERVICES	5	✓	✓	✓			✓
LIFT INSTALLATIONS	5	✓	✓		✓		
LOGISTICS AND INSTALLATION	7				✓		

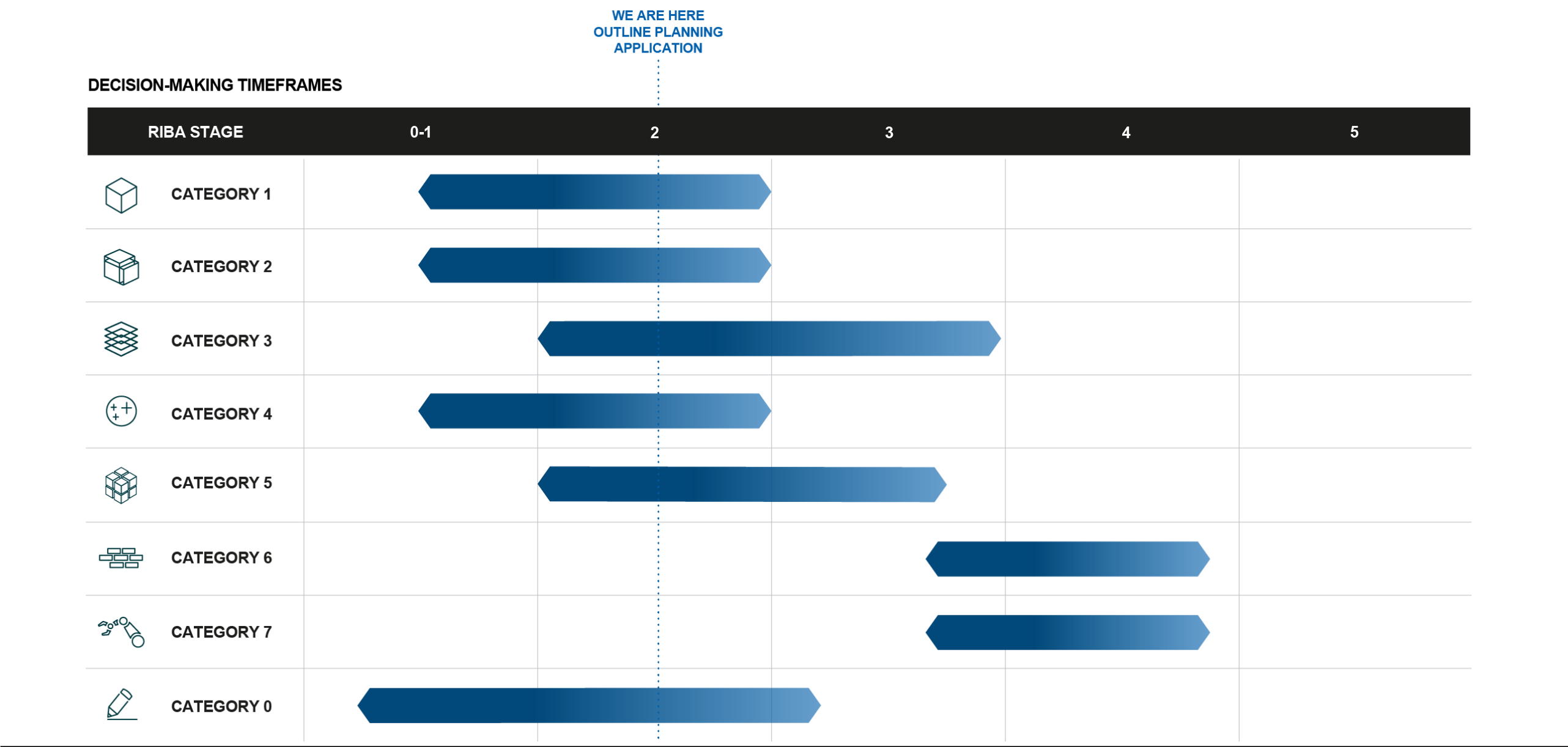
Project elements against input required, relative to the risk of not doing so

TIMEFRAMES FOR DECISION MAKING

The use of MMC should be considered early in a project lifecycle. It should also be revisited at each RIBA stage as part of the gateway approval process, sign off for which can then be used to inform the brief for the next design stage.

The rationale for this is that as the design and procurement processes progress, it becomes less viable to implement certain MMC solutions without avoiding abortive work or redesign. There is a ‘point of no return’ for each MMC system, after which point the technology cannot be implemented without consequence (usually cost and time).

The following graphics illustrate the optimum stage each category of MMC should be considered and during which RIBA stage a decision on whether it will be adopted should be made in order to realise the greatest benefit. It shows that, whilst there is still time in the design programme to afford choice of MMC Category, the decision points around Category 1 and 2 MMC should be made prior to the end of formal RIBA stage 2.



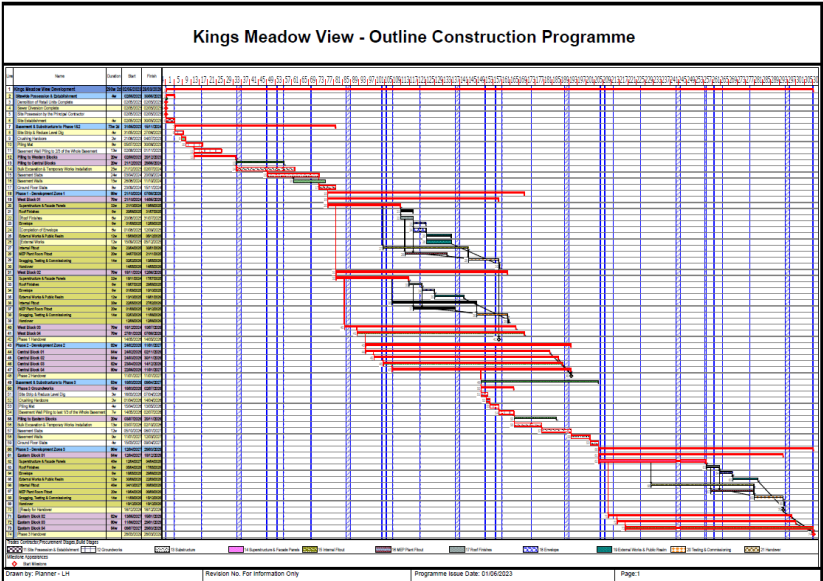


MANUFACTURE AND ASSEMBLY

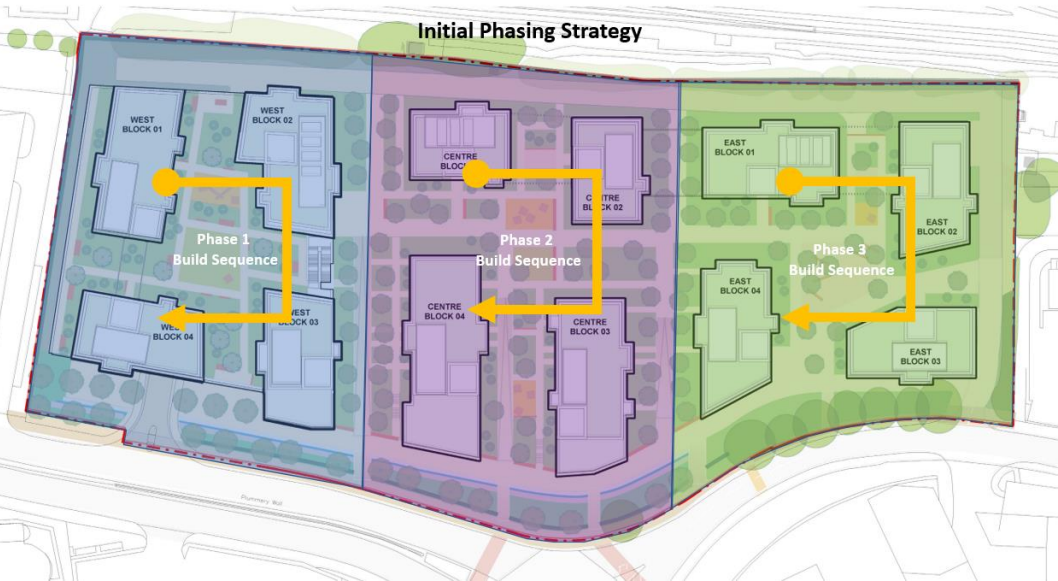
PROGRAMME

Outline construction programme and phasing strategy

Akerlof has developed an initial ‘control’ programme against the illustrative scheme, from which to develop options analyses going forward – it is split into the enablement works, basement construction and 3 separate phases in line with the ‘zoned’ development intention outlined in the design codes and DAS.



The programme for each phase has been built ‘bottom up’ and follows a very similar construction sequence. It is described at high level herein, with a full and detailed programme contained at Appendix A.



Phased development strategy

The working assumption is that the commencement of the programme is based upon the possession of a cleared site ready for possession by the Principal Contractor. All existing retail units are demolished, the major Thames sewer diverted, and any land remediation completed as a part of the enabling works completed in advance of the commencement of the main works.

Site start and establishment

We would envisage the Contractor will establish a secure hoarding around the whole of the site and set up a compound to accommodate site operatives and materials. The presence of the existing Network Rail railway lines to the north may require improved security fencing and enhanced protection from future construction work. In order to work away from Network Rail assets, it is likely that blocks in each development zone will progress from North to South. The early engagement of specialist rail advisors and are recommended at the next stages, establishing the implications of the existing railway lines and any risk mitigation strategies.

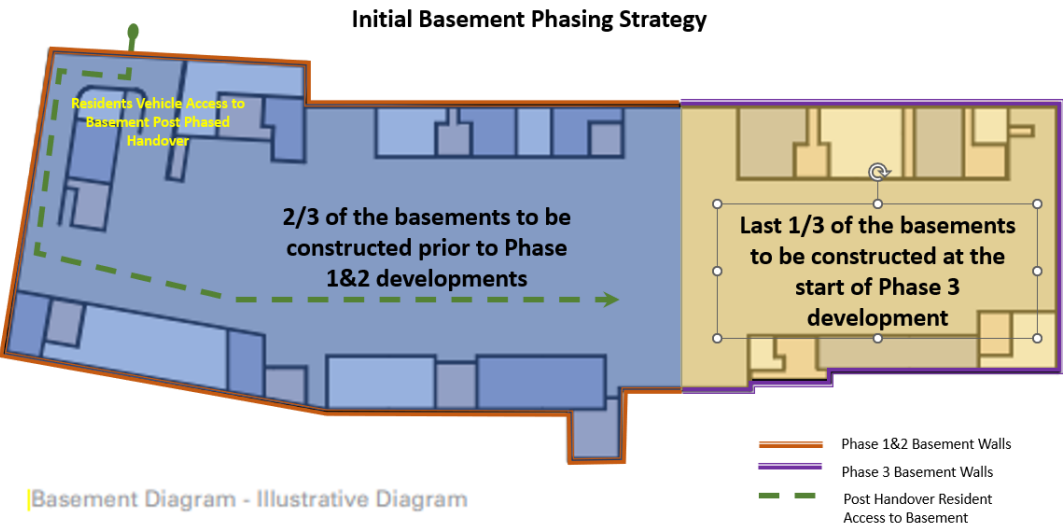
Basement construction

The first stage of the development will begin with a general site strip, reduce level excavation, crushing of onsite hardcore materials and the formation of a piling mat across Phase 1&2 sites in preparation for the construction of the basement. The basement will require the construction of a retaining structure, different options for which need to be explored during future design stages. It is envisaged for Phase 1 and 2 that any piling to form the basement retaining walls, and loadbearing piles to the building, take place simultaneously. However, during Phase 3, the piling to Eastern Blocks will follow once the basement retaining wall piling is complete due to tighter site footprint available to the Contractor. After the piling is complete, bulk excavation and basement construction to form the slabs, concrete columns, walls and shafts can commence in earnest.

The construction of the basement could be formed in a number of ways. The first option is to construct and complete the basement in its entirety, which will take a considerable amount of time and early drawdown of funds.

The second (and perhaps more practical) option, could consist of the construction of two thirds of the basement initially, with final completion part of future development phases. Access routes to the permanent basement would need to be considered to facilitate a phased approach to the construction of the basement and to provide access for future residents to the underground car parking facilities. Other solutions also exist, and all options should be explored and evaluated during the next RIBA design stages.

PROGRAMME



Basement Diagram - Illustrative Diagram

Basement phasing strategy

The location of the energy centre and other major items of plant will need to be considered as part of the build out strategy for the basement. If a phased approach is selected, this may inform the proposed location for major plant, which would need to form part of the first phase of the construction sequence.

Residential blocks

As described in earlier sections of this report, options for the construction of the superstructure, including envelope solution, underpinned by this MMC strategy, will be subject to further evaluation in later design stages. This may include the option of a traditional RC Frame for the podium construction at ground floor, which will provide flexibility for any commercial uses, and any transfer structures which are required to move between grid layouts.

Subject to MMC options and PMV metrics for the superstructure, the internal fit-out sequence will commence once the superstructure is advanced to its uppermost levels. It is shown to commence at level 01 and progress to the upper floors of the structure.

Localised plant rooms for each residential block, or a hybrid of central plant located in the basement and combined with satellite plant rooms in each residential development blocks may be considered. Our programme assumes centralised plant in the basement, combined with a plant room for local services in the residential blocks. These plant areas will be formed from a combination of Cat 5 MMC and traditional installation on site. The roofs are also assumed to contain an element of plant including photovoltaic panels.

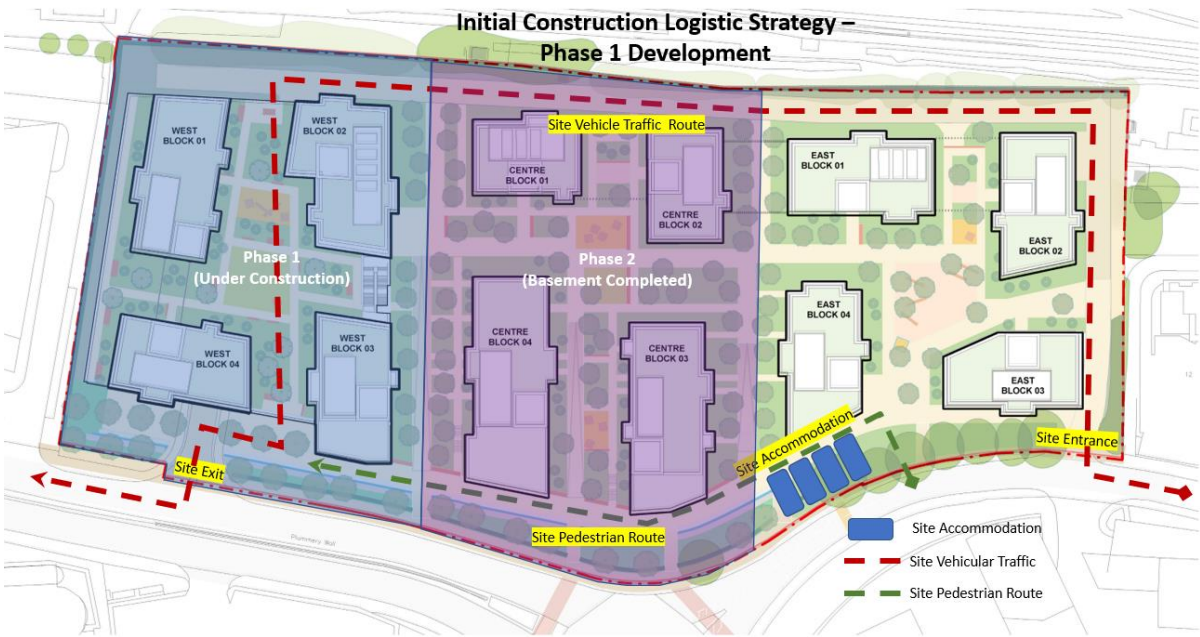
Public realm

A phased approach could be considered for the public realm works, with likely minimum requirements being localised finishes to the perimeter of the residential blocks (and any specific podium gardens) complete with the relevant access to the basement areas for residents and plan maintenance and access purposes. A phased approach to the public realm would provide a progressive spend profile for these works as well.

Phased handover and site logistics

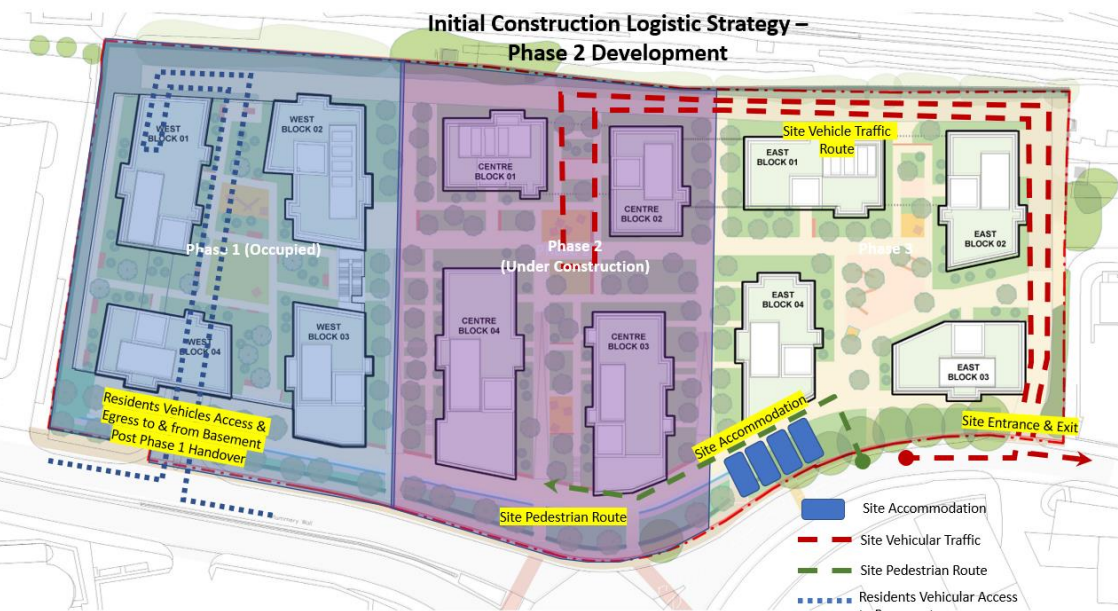
Our control programme assumes that the overall development is built out as a three phased approach, building out four blocks at a time. This approach allows for progressive construction progressive spend profile and a progressive sale (or rental) of the residential units.

Considerations have also been given to interfaces between resident's access to basement after each phase of the handover and the construction site traffic. The following diagrams illustrate that this phased approach is compatible with the construction of all three phases of the development.

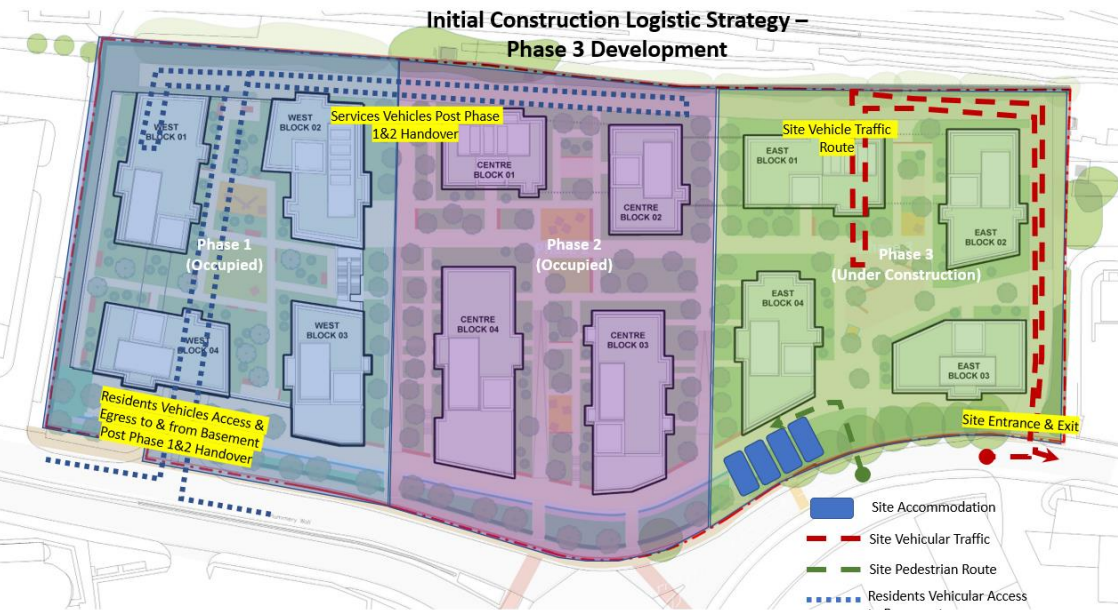


Indicative logistics plan during Phase 1

PROGRAMME



Indicative logistics plan during Phase 2



Indicative logistics plan during Phase 3

Overall

There are many variable factors in determining the overall programme durations, which include build methodology, funding and levels of absorption of the residential units.

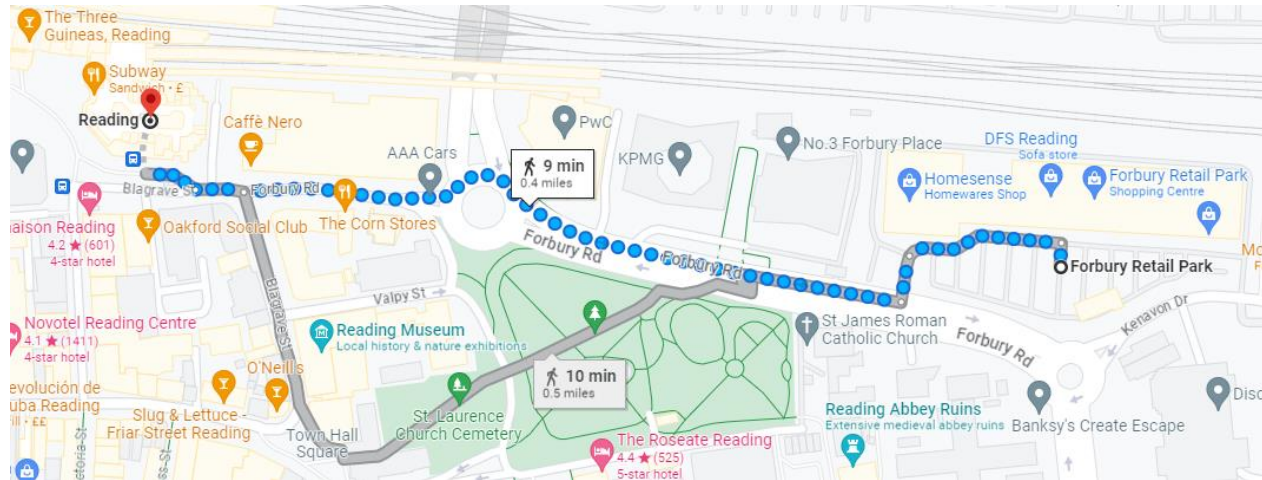
It is anticipated that each development phase could be constructed in approximately 2 years – a seamless ‘start to finish’ programme would thus be 7 years including the basement.

However, this requires further assessment in future design phases which will be part of the reserved matters stage. Our detailed programme can be seen at Appendix A.

LOGISTICS & PRE-ASSEMBLY

Labour movement (Offsite)

With an estimated peak of circa 250 persons per phase, the development of offsite solutions to reduce the reliance upon on-site labour remains a primary strategy for the project.



Map from Reading Station to site (walking – 9 minutes)

Site access (materials)

- **Last mile approach:** a review of the potential to use a near site consolidation / distribution centre - enabling deliveries to be coordinated to the project site but also providing the opportunity to combine individual prefabricated components together, delivered in larger scale over the last mile. This will be particularly prevalent during latter phases of the development when lay down areas and disruption are more sensitive.

This approach would enable a buffer of components to be stored, mitigating transport, BREXIT, COVID and weather-related risks.

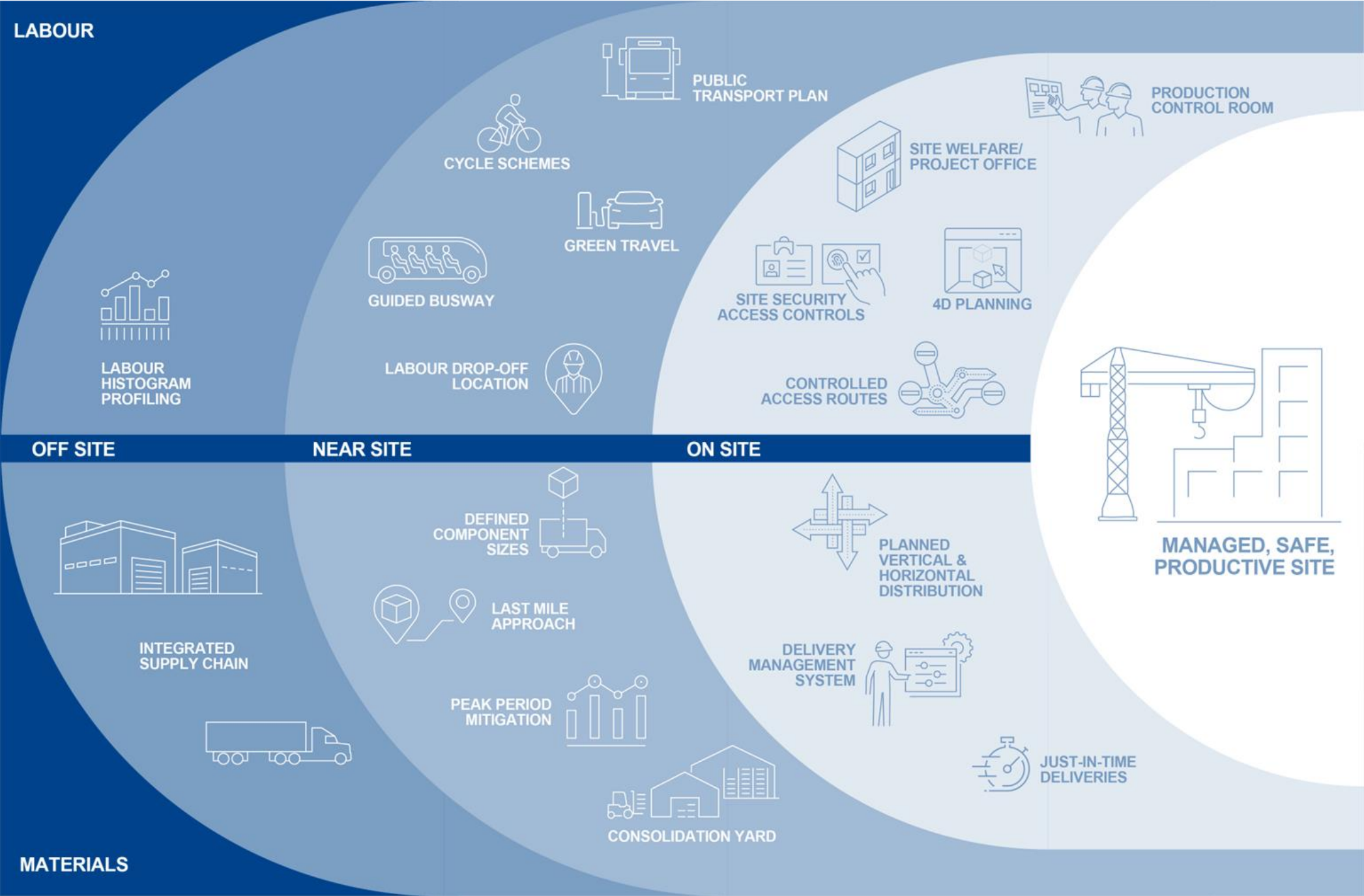
- **Component size analysis:** Review of the size of components, which can be delivered to site. As part of the procurement model, it is recommended that a logistics specialist complete a review of the access roads and any restrictions, with similar principles to be fed into the craneage strategy.
- **Out of hours deliveries:** with materials ready for next day operations
- **Electrical vehicle options:** either directly or for near site deliveries (to and from the consolidation centre)

- **Planning and / or partnerships with dedicated plant and equipment providers:** coordinating the delivery of all equipment and reduce site congestion (subject to procurement route)
- **Co-ordination of delivery schedules with adjacent projects:** Alongside review of the materials distribution, the site logistics and traffic management strategy should be developed during future design stages. Typically, this would include optioneering around:

- Location of material loading bays and craneage (inc hook time analysis)
- Labour drop-off location (from station) and access
- On-site and near site material storage
- Site office and welfare locations
- Enabling works
- Adjacent developments

LOGISTICS & PRE-ASSEMBLY

In establishing an industrialised approach, the supply chain will be challenged to consider safe, repeatable and productive ways working, offsite, near site and on-site.

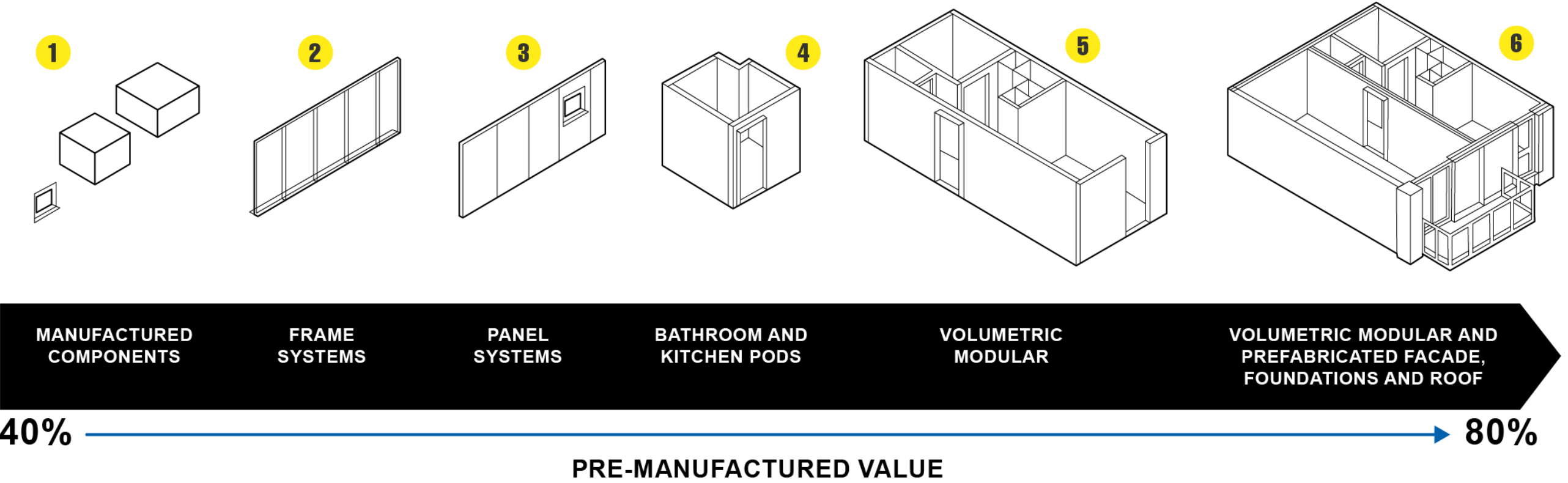


PRE-MANUFACTURED VALUE

One of the key focus areas of the MMC strategy is the presumption in favour of offsite, where it affords best value.

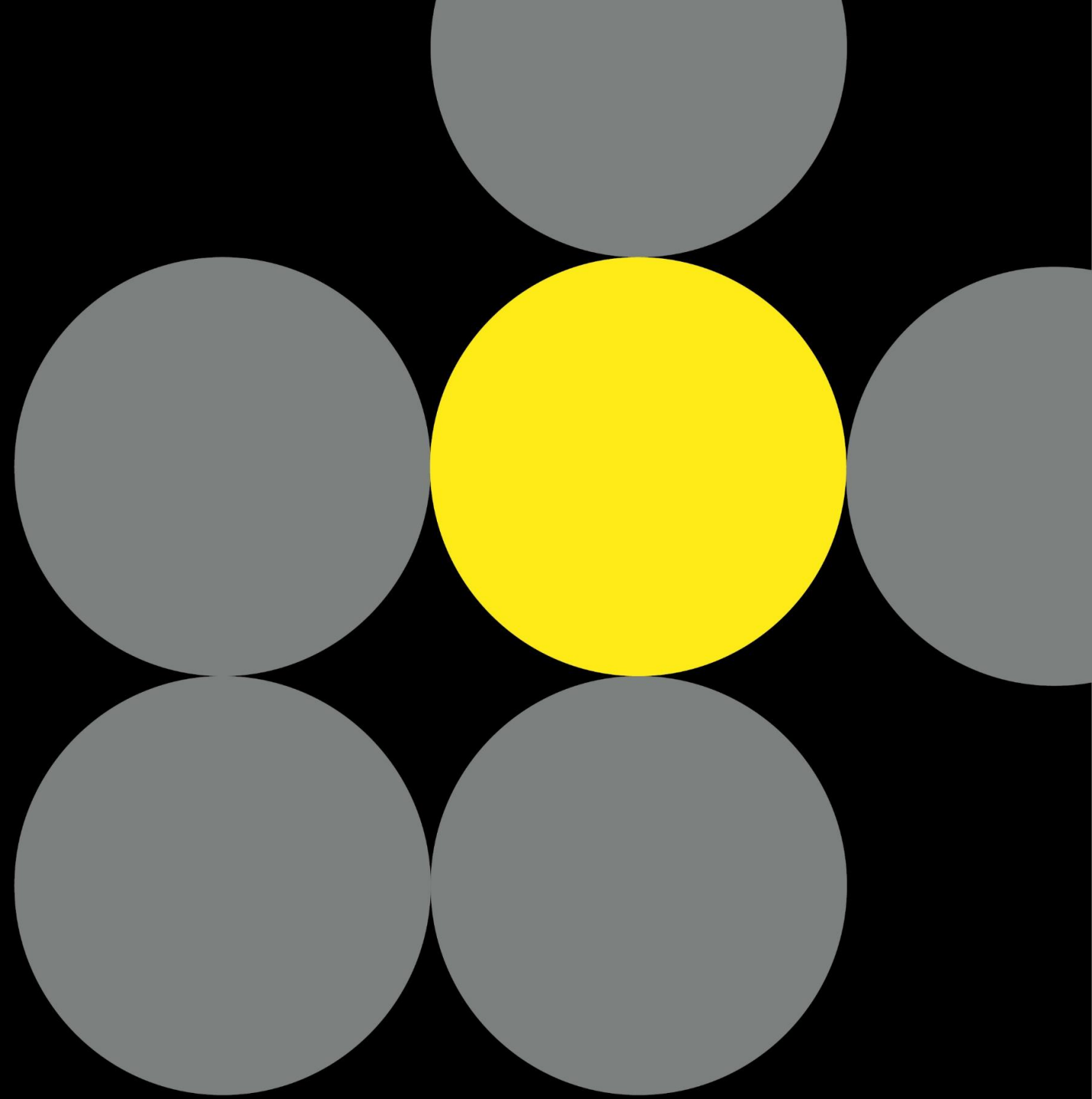
To assess the proportion of works planned to be manufactured offsite, the project will measure the Pre-Manufactured Value of the measured works.

Pre-Manufactured Value, known as PMV, was first set out in The Farmer Review. The metric, expressed as a percentage, is intended to identify to what extent projects are implementing innovative construction techniques that result in reduced site labour intensity. A higher PMV percentage, signifies a greater proportion of offsite activity has been undertaken on a project, programme or portfolio.



Indicatively we would expect the scheme to achieve a PMV of between 55% and 70% subject to the options deployed – this will be concluded during future design stages

ACTION PLANNING



FORWARD ACTIONS

Akerlof has considered the opportunities for integrating MMC into the architecture, structural engineering and building services design for KMV and the team are committed to embracing MMC:

As highlighted in the background and purpose to this report, our next stage of this MMC strategy will be to explore in more detail those identified suitable categories of MMC, and systems / manufacturers which could be engaged.

This would emerge at the reserved matters stag and will include specifics around their suitability for the project, such as cost and programme and how they work to achieve the value drivers for the development, considering the specific brief and design constraints.

The key actions moving forward to embed this strategy include:

Training

MMC awareness training and induction of strategy for new project team members (not least future supply chain involvement)

Metrics

Measurement and reporting of the following metrics during the design development period:

- **Platform** - Analysis of repeatability across spaces and components
- **Manufactured** - measurement of PMV
- **Digital** - application of the digital maturity assessment (pending finalisation of the digital strategy)

Analysis of spaces

- Review of varying arrangements and layouts within apartment types during development of the design, to standardise where possible
- Continued analysis and reporting of component standardisation (as noted above) - to maintain repeatability through the design, where appropriate

Subsequently there is a need to carry out a series of cost, programme, risk and procurement analyses

against MMC Categories 1-7, which include the following specific considerations:

Frame

Continued development of a structural arrangement that is efficient, regular and repeats floor to floor

- Adoption of low carbon materials
- Development of construction methodology that incorporates standard prefabricated elements

Envelope

Develop design to embody the use of standardised, factory-produced façade components

MEP

Evaluation of the available with specific emphasis and focus upon:

- Standard Arrangements (inc prefabricated assemblies)
- Modules for building services in risers and corridor ceiling voids.
 - Prefabricated utility cupboards

Fit-out

Review the potential for:

- Bathroom Pods
- Customised modular demountable partition systems, with localised building services systems (e.g. power, data, water etc.) integrated within the prefabricated partitions

Procurement

Conclude the procurement strategy, enabling Early Supply Chain involvement during the next design phase for those MMC categories that are appropriate.

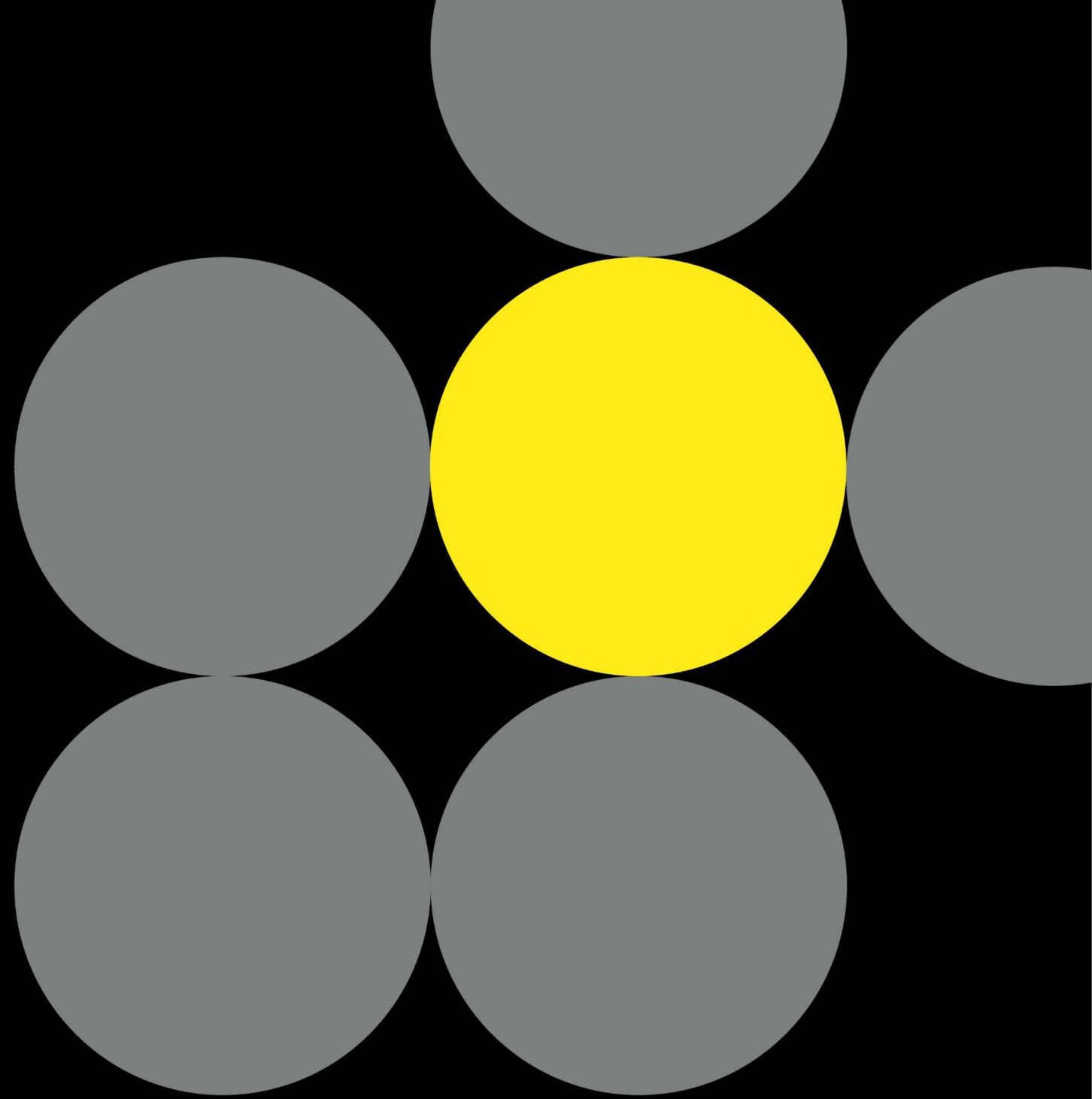
Logistics, pre-assembly and buildability

Programme Analysis against options (inc Critical Path review and sequence visualisations)

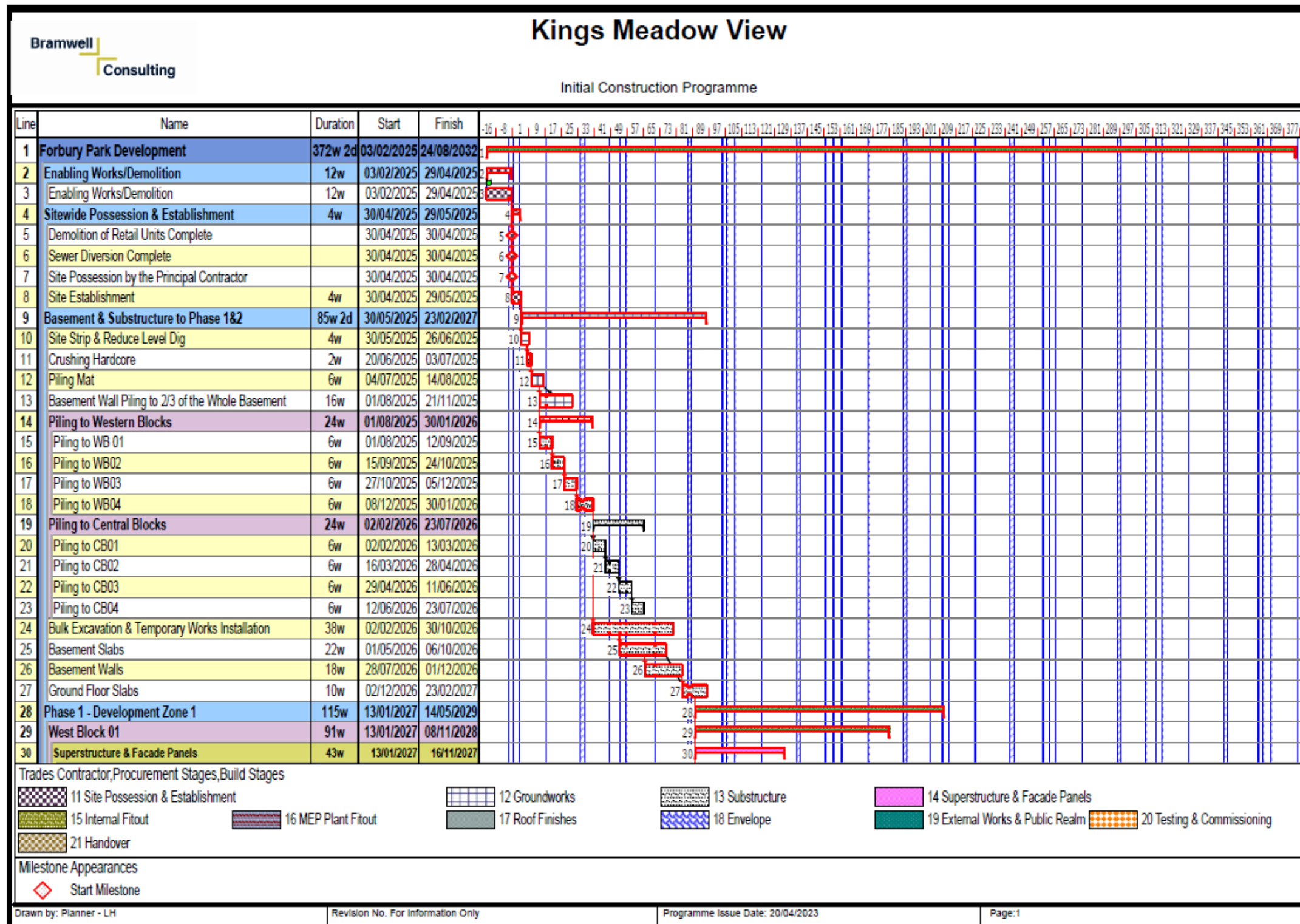
A series of MMC-focused workshops will be held during subsequent design stages to address actions to ensure that the principles described here are taken forward and developed to deliver best value.

APPENDIX A

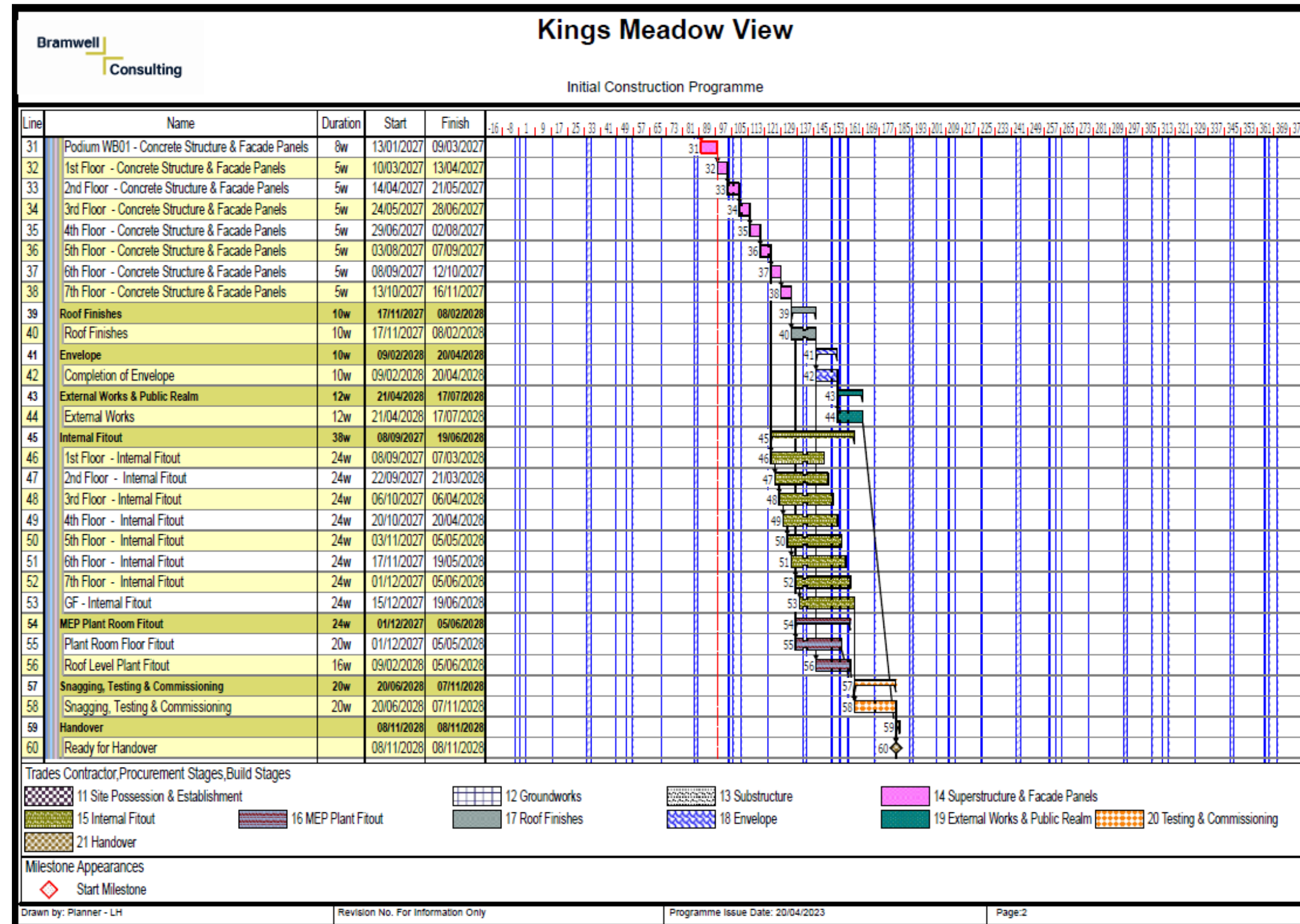
Programme



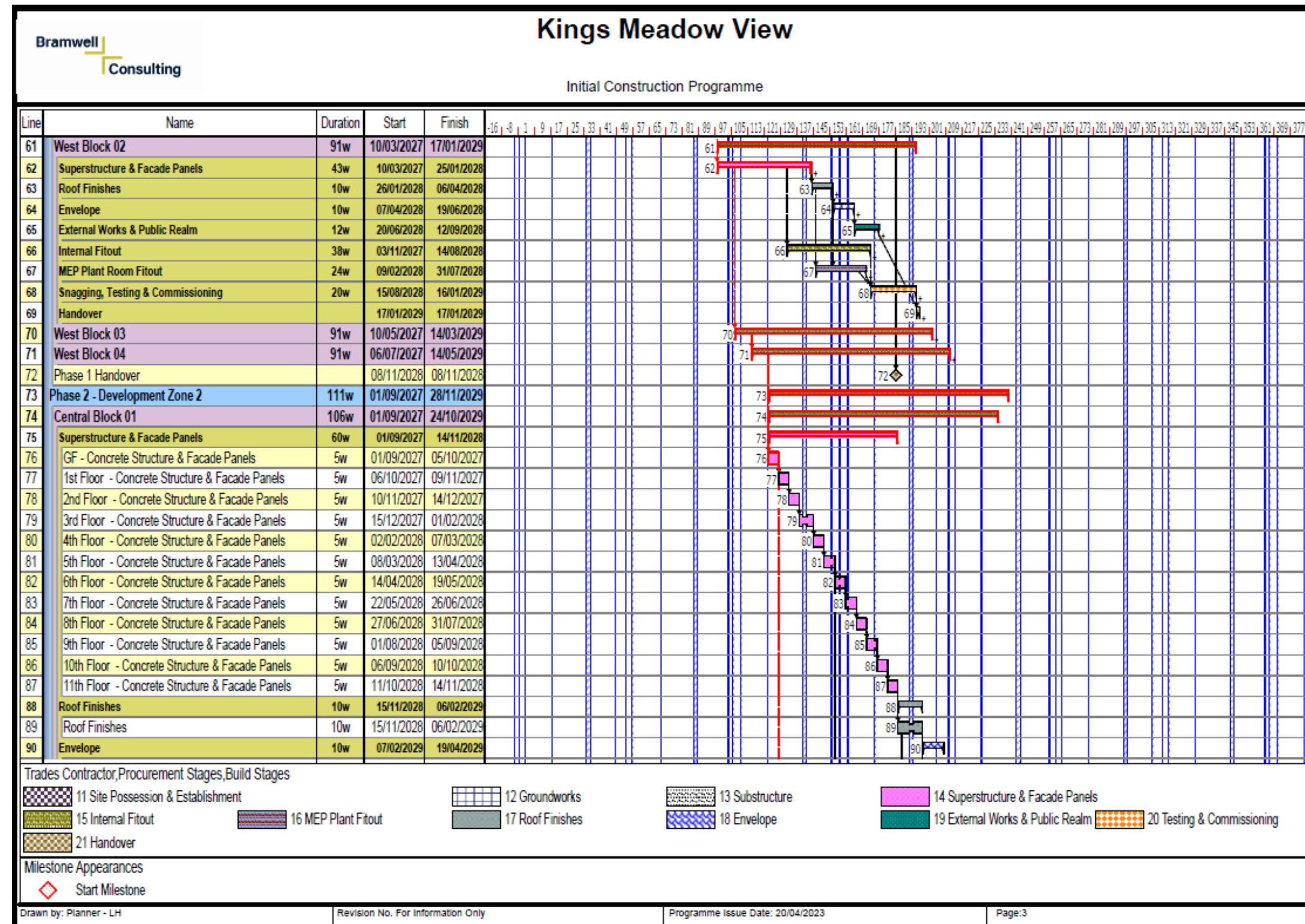
APPENDIX A



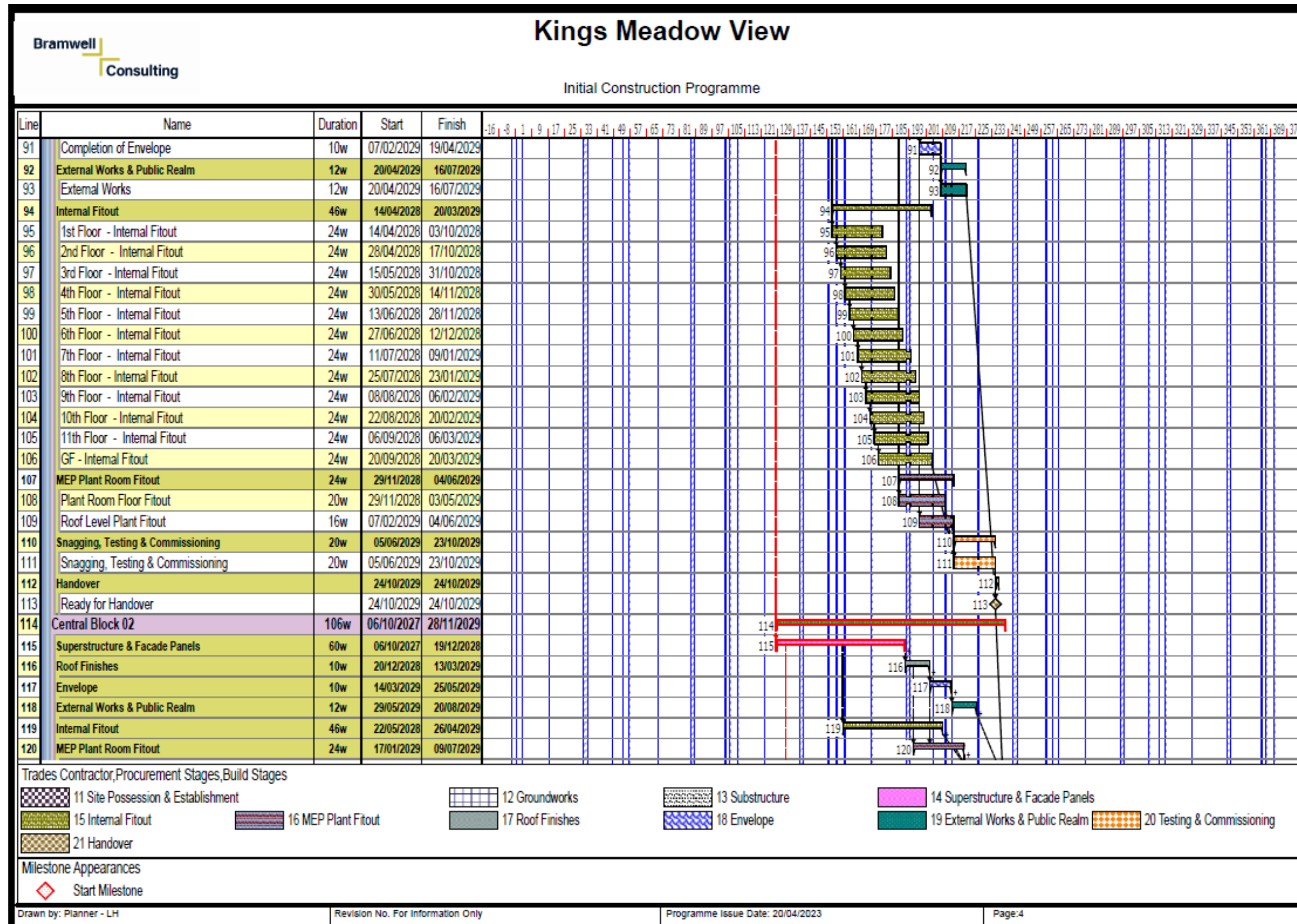
APPENDIX A



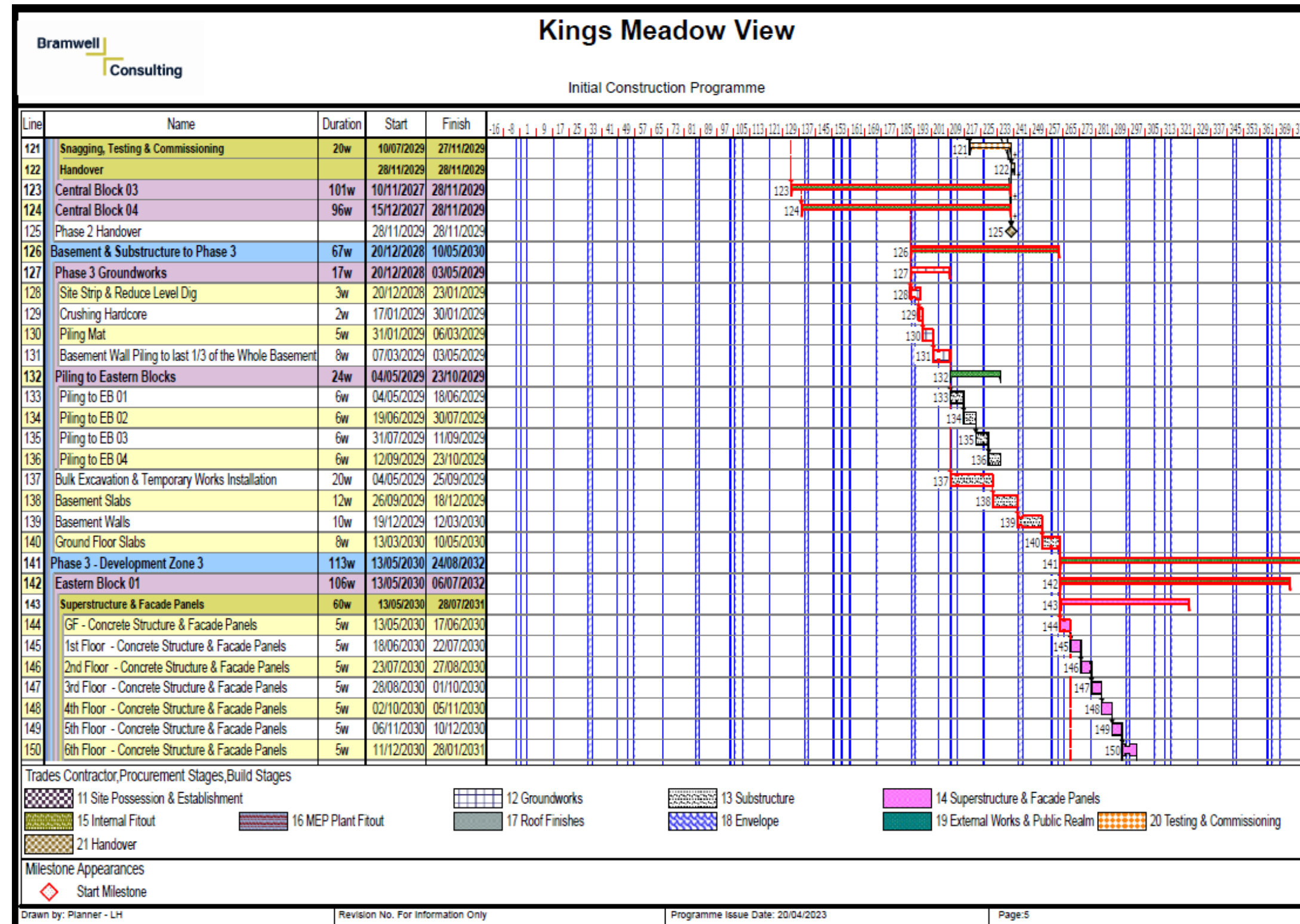
APPENDIX A



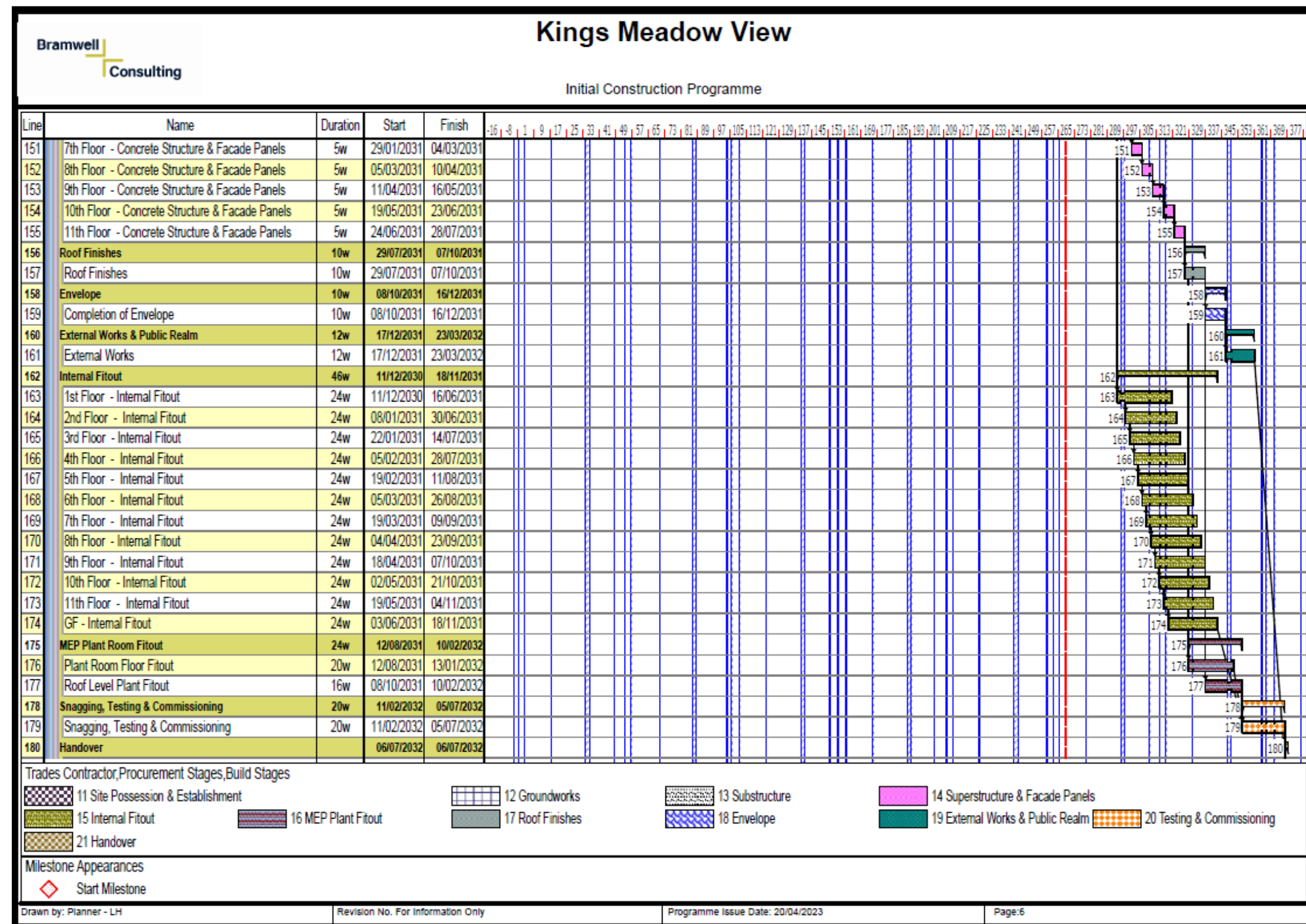
APPENDIX A



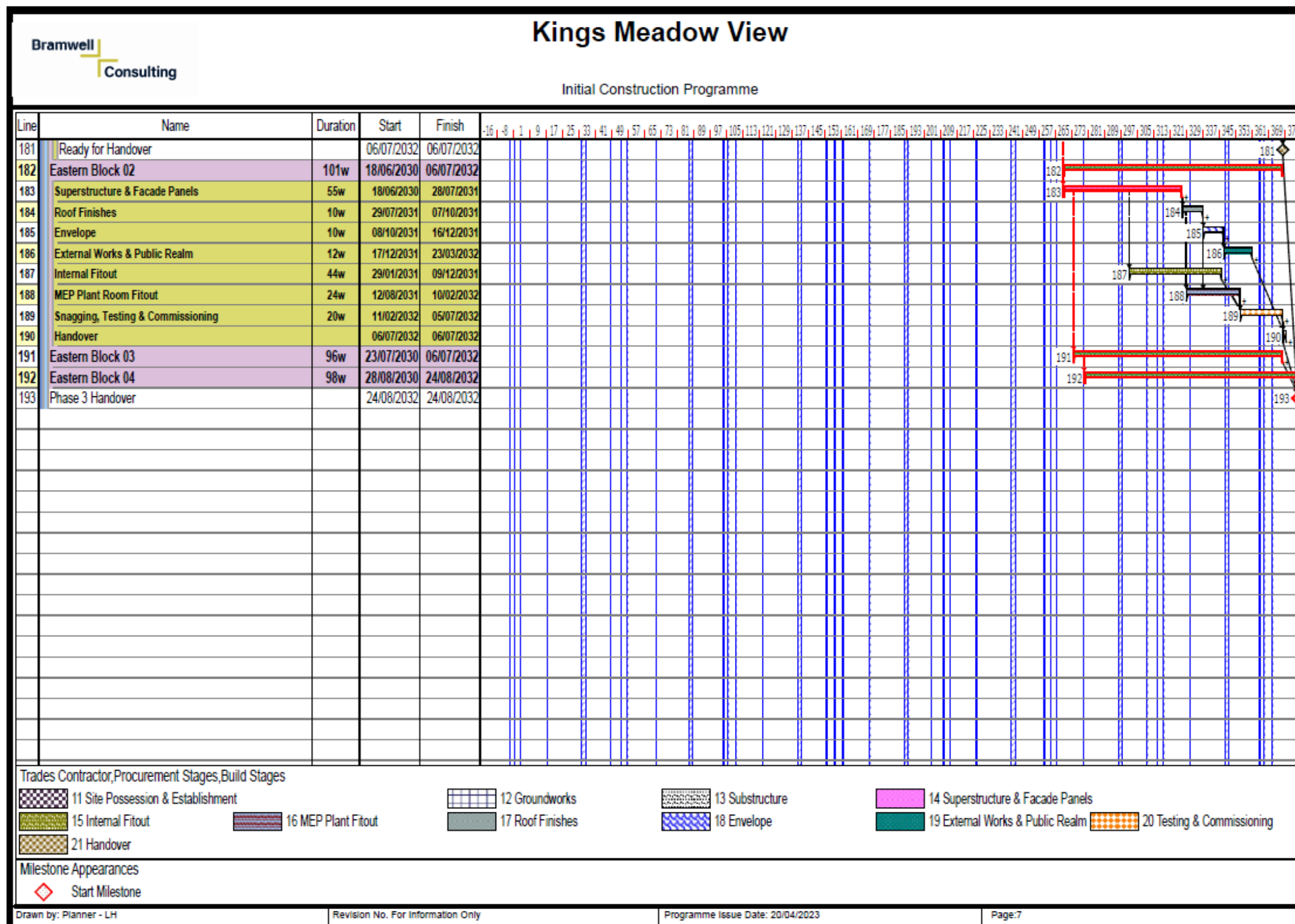
APPENDIX A



APPENDIX A

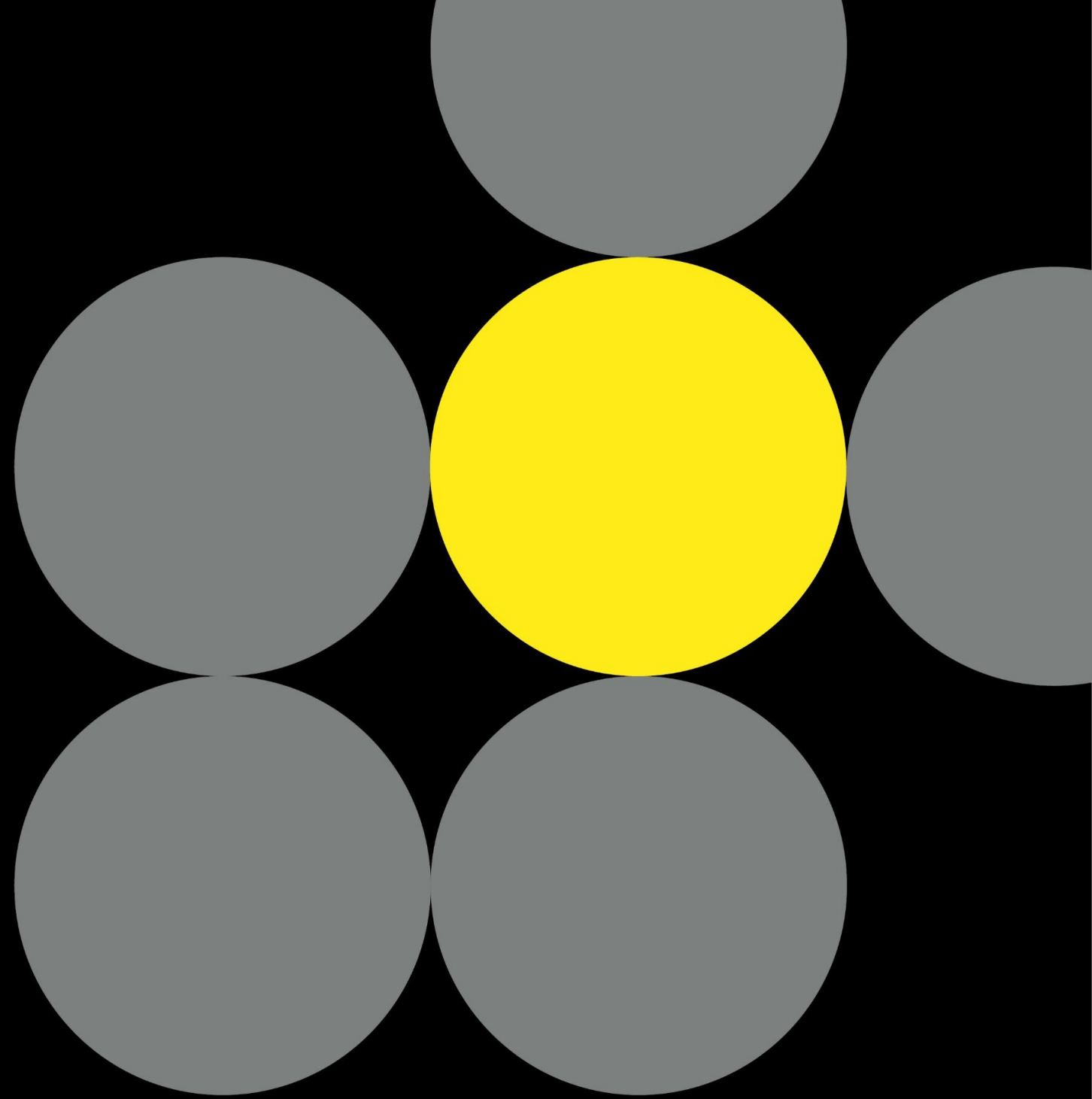


APPENDIX A



APPENDIX B

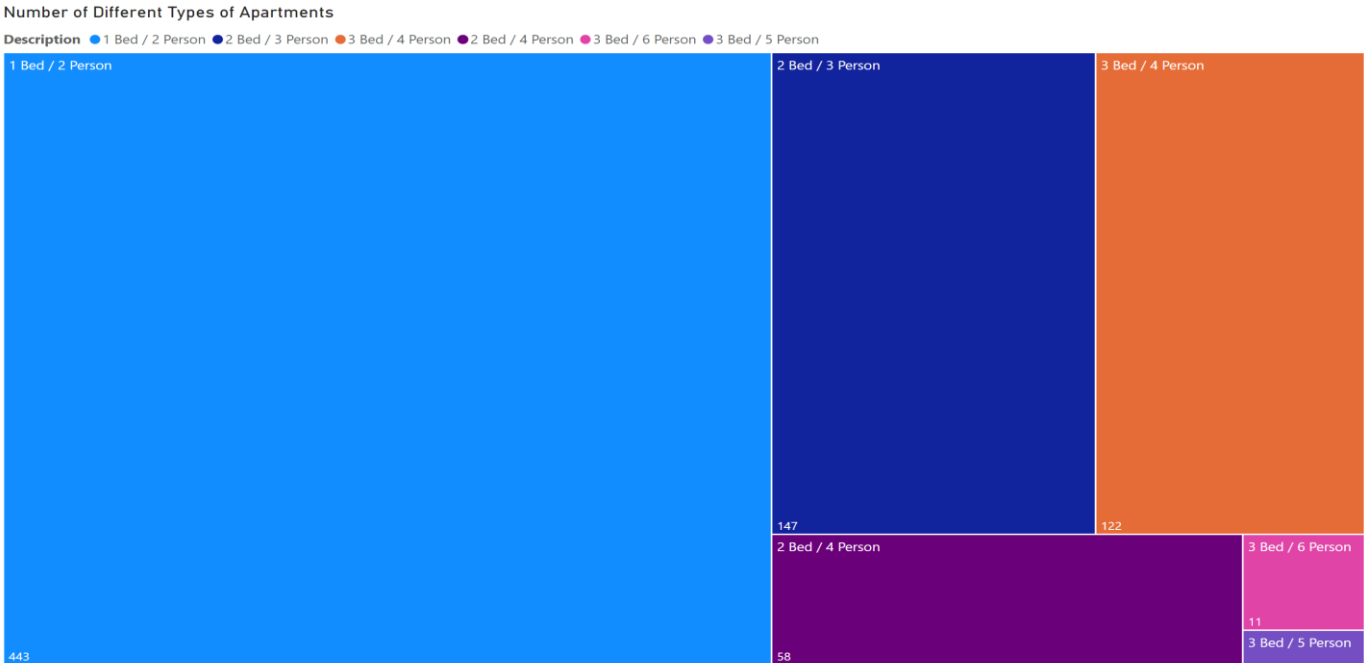
Spatial Analysis



APPENDIX B

DESCRIPTION	NUMBER OF SIZE VARIANTS	NUMBER OF APARTMENTS
1 Bed / 2 Person	14	443
2 Bed / 3 Person	9	147
2 Bed / 4 Person	9	58
3 Bed / 4 Person	8	122
3 Bed / 5 Person	2	4
3 Bed / 6 Person	2	11
Totals	84	785

Summary of apartment permutations in the illustrative scheme



APARTMENT AREA	NUMBER OF APARTMENTS
50	53
51	61
52	73
53	47
54	57
55	33
56	40
57	25
58	17
59	24
60	1
62	10
65	1
68	1
Total	443

1 Bedroom / 2 Person Permutations

APARTMENT AREA (m²)	NUMBER OF APARTMENTS
61	27
62	42
63	6
64	7
65	17
66	17
67	20
68	4
69	7
Total	147

2 Bedroom / 3 Person Permutations

APARTMENT AREA (m²)	NUMBER OF APARTMENTS
69	2
70	17
71	6
72	16
73	2
74	3
75	7
78	2
80	3
Total	58

2 Bedroom / 4 Person Permutations

APARTMENT AREA (m²)	NUMBER OF APARTMENTS
74	3
75	60
76	16
78	8
80	16
82	9
84	9
85	1
Total	122

3 Bedroom / 4 Person Permutations

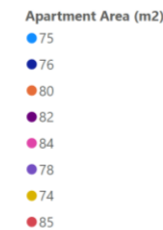
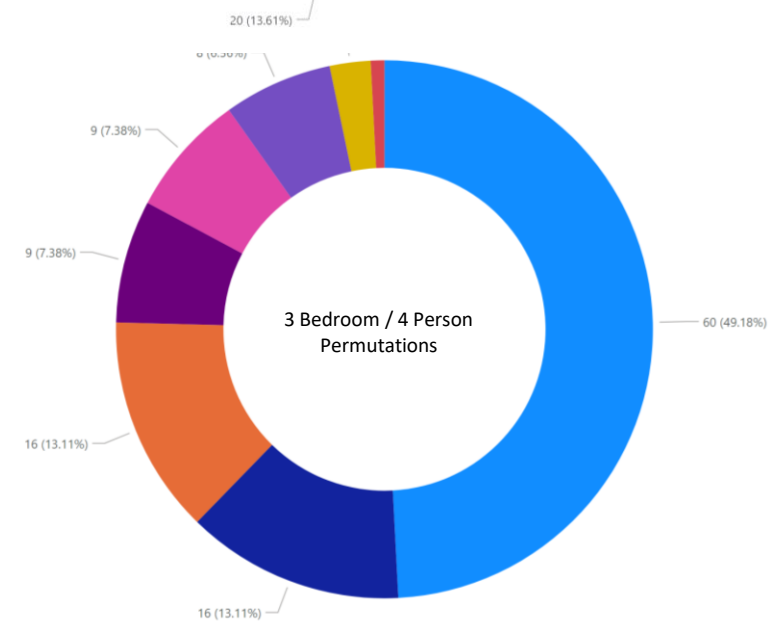
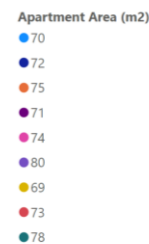
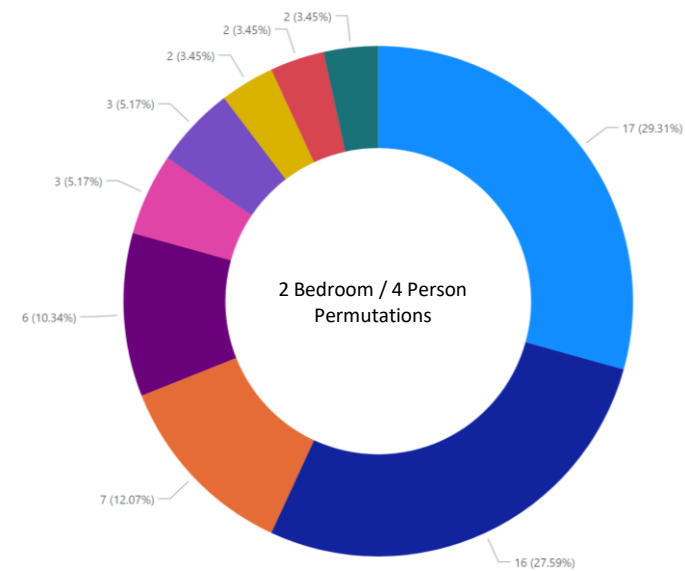
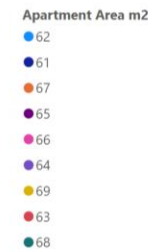
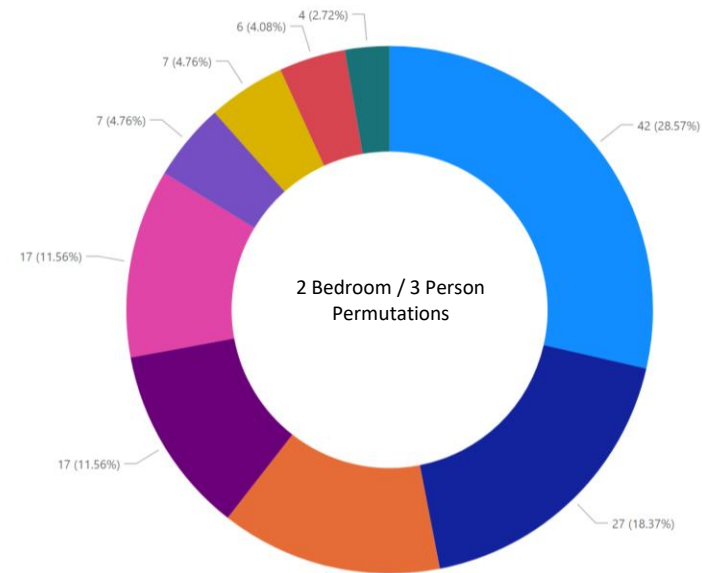
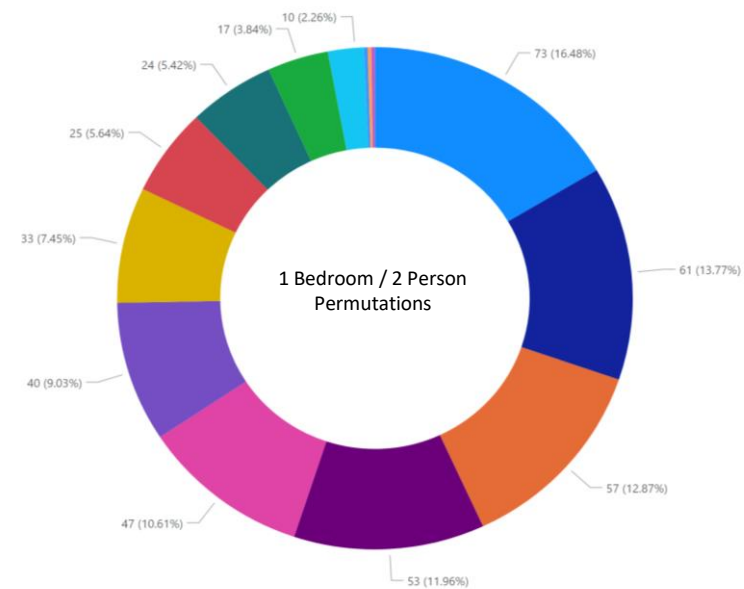
APARTMENT AREA (m²)	NUMBER OF APARTMENTS
89	3
90	1
Total	4

3 Bedroom / 5 Person Permutations

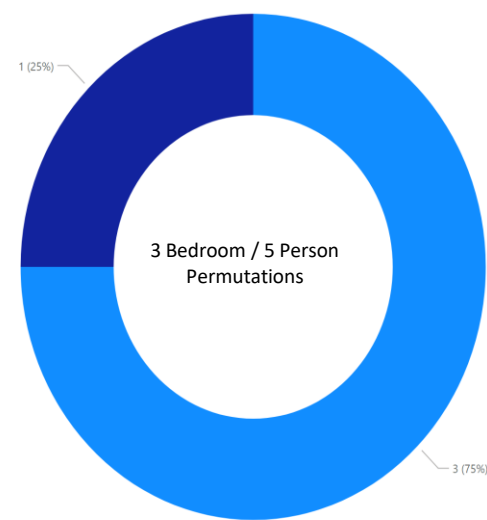
APARTMENT AREA (m²)	NUMBER OF APARTMENTS
106	7
107	4
Total	11

3 Bedroom / 6 Person Permutations

APPENDIX B



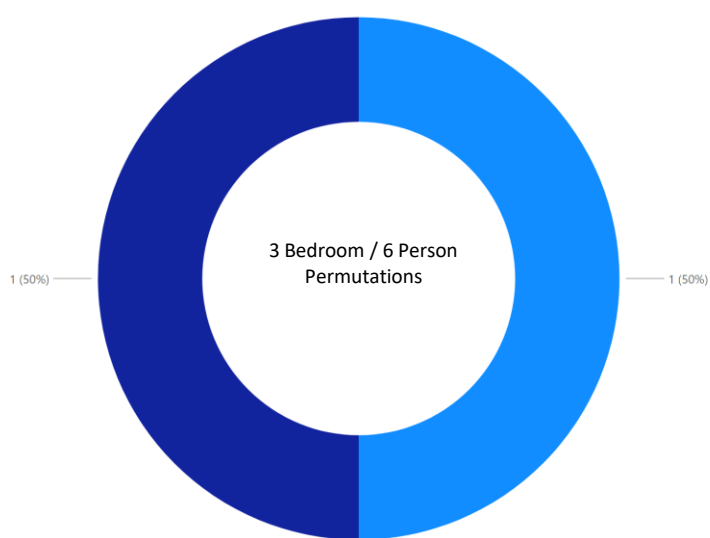
3 Bedroom 5 Person Apartment Sizes



Apartment Area (m2)

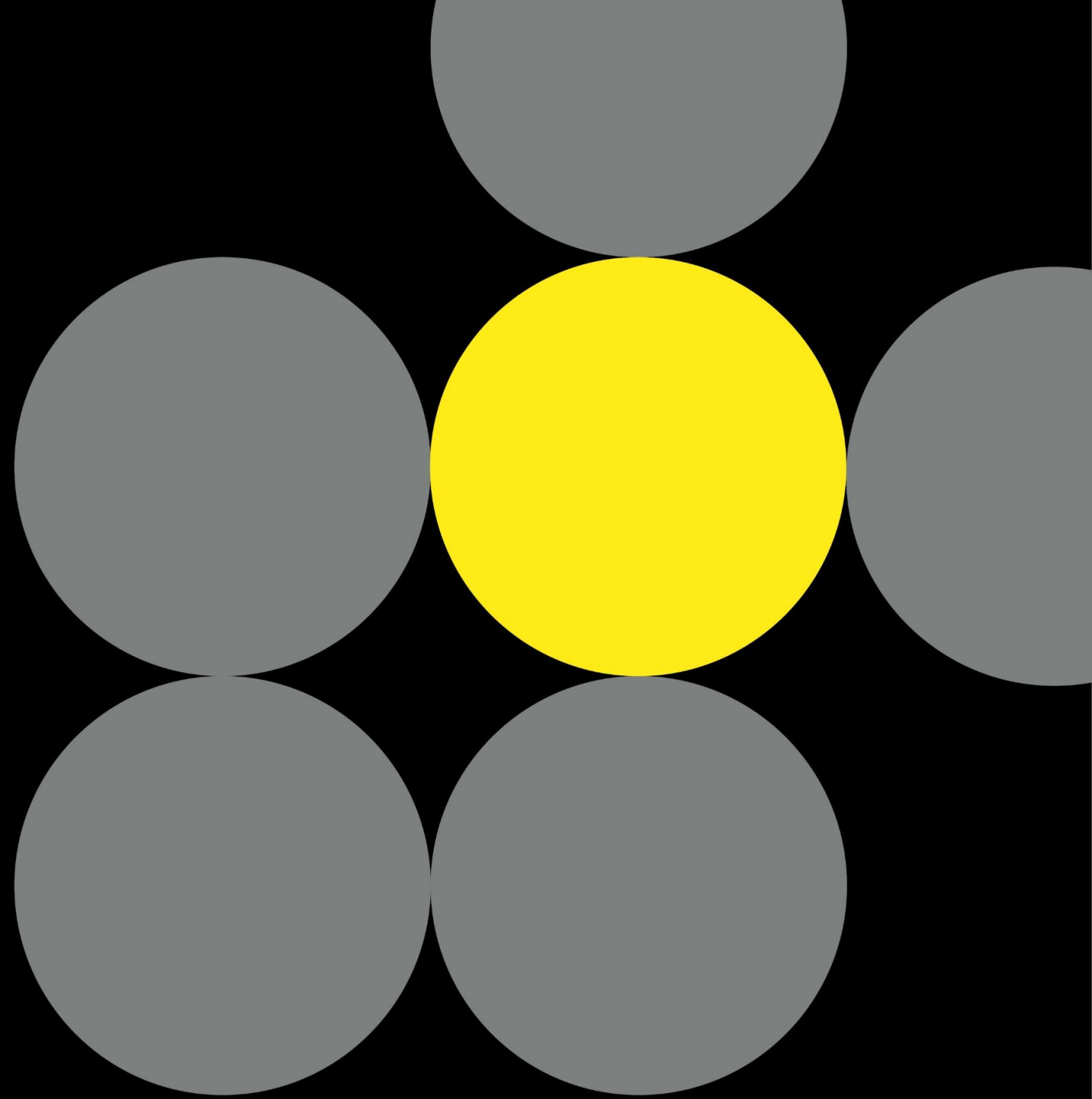
- 89
- 90

3 Bedroom 6 Person Apartment Sizes



Apartment Area (m2)

- 106
- 107



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