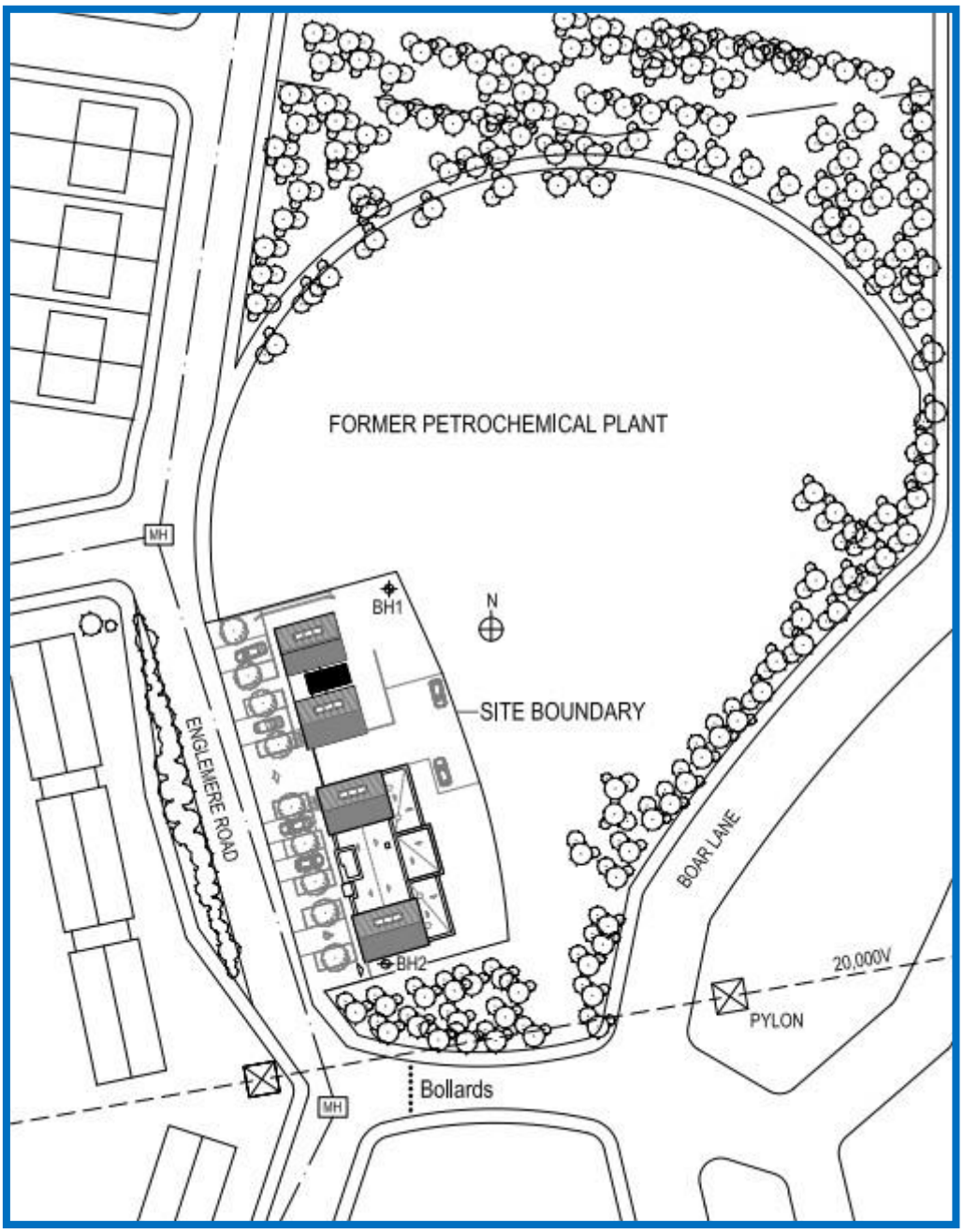
MJB Design Ltd.



1. Introduction

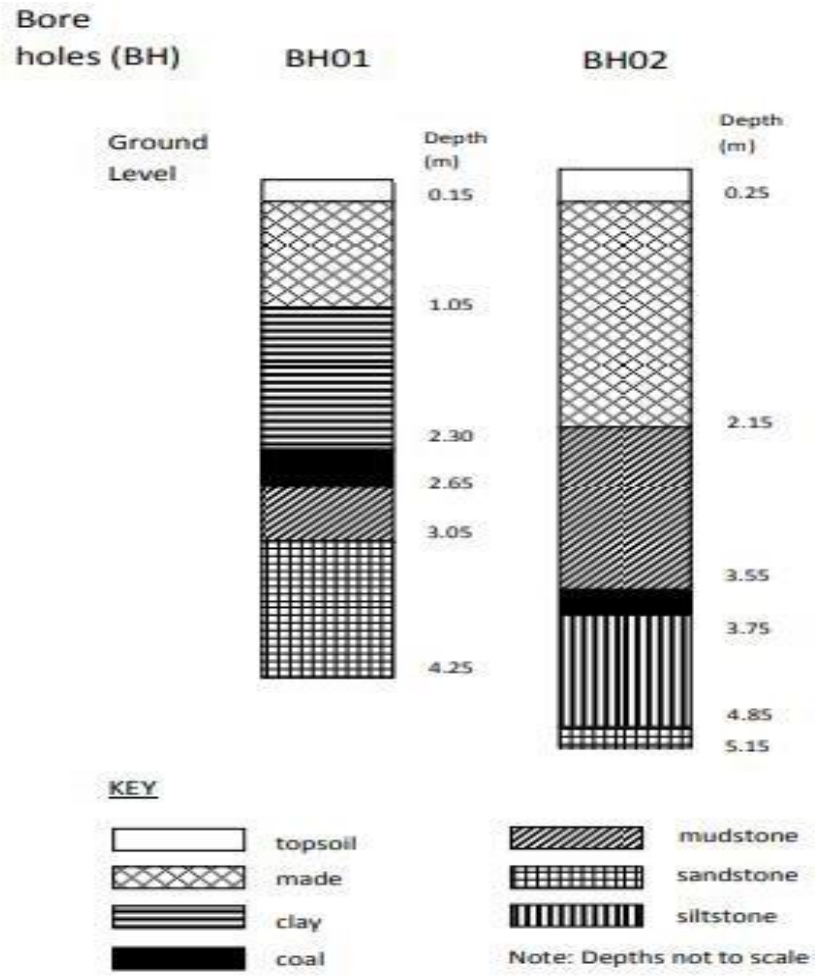
MJB Design Ltd are undertaking the role of Design Manager for the Construction phase of the Core House at the Englemere Rehabilitation Centre (ERC). This report, together with an illustrated technical drawing will give consideration to the viable options of construction methods for the superstructure of the Core House and a suitable foundation system. MJB Design will determine which is our preferred method, and the reasoning behind our decision.

Part A of this report will provide detail on the viable options, with the advantages and disadvantages for each construction method whilst taking into account fire retardant properties, wind resistance performance, cost, design and sustainability of the materials for each method. In Part B of this report, MJB Design have made provision for an active and passive fire engineering solution for the development, and Part C will discuss the opportunities for the incorporation of prefabrication and off site manufacture for the Move on flats which are located adjacent to the Core house on the Englemere Rehabilitation Centre development.

2. Preamble

The proposed development of the ERC is to be constructed on a brownfield site that has been previously used for mining, then later as a petro chemical plant. The ground was found to be contaminated with high levels of petro chemicals, and due to the site previously being neglected and left insecure, there have been incidents of illegal dumping of industrial and domestic waste. Two invasive bore holes tests were carried out, one to the north east of the site, and another to the south of the site. The southern located borehole (BH2) is in very close proximity to the external envelope

of the Core House and confirms solid ground is at a depth of 5.15m



It has been established there is an unusually high water table at a depth of 0.5m. All ground works have now been completed, the contaminated land has been excavated, remediated, and backfilled ready to receive a suitable foundation to carry the superstructure.

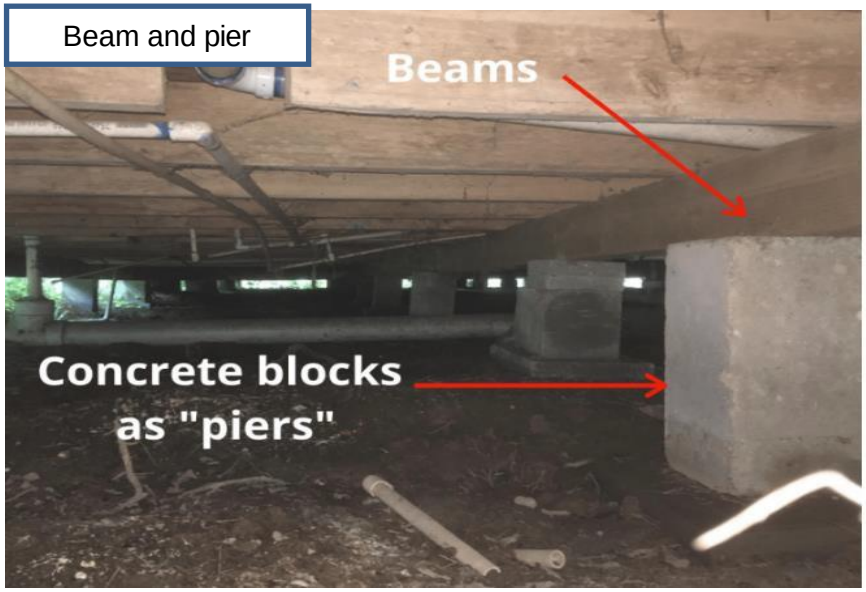
3. Part A

The structural engineer has calculated the imposed dead and live loads of the Core house considering the dead load of the RC Frame, sheer walls, floor and floor screed, windows, doors and internal finishes and the live load of people, fixtures and fittings and wind loads all transmit down to a suitable foundation system which complies with Part A of the Building Regulations, Section 2E – Foundations of Plain Concrete. To compare and review the most efficient, cost-effective construction method, MJB Design have drawn up a table that allows us to easily identify the advantages and disadvantages to each type of foundation system and frame that could be used for the construction of the main Core House. Consideration has also been given to the fire retardant properties of the frame materials, imposed load capacity, as well as the performance of the building framework.

Foundation	Advantages	Disadvantages
Pile and slab	• Suitable for deep installations • can be pre ordered • Durable • Suitable for wetlands – High water table	• Can be damaged if driven into stone • Can be corroded by marine borers in salt water • tricky to calculate required length of pile • High cost • Noisy to install • Vibrations when installing can cause disturbance to buildings close by
Beam and pier	• Elevate the core house to defend from flooding and moisture • Creates crawl space under the Core house to house services and access for maintenance	• High cost • potential for creaking and sagging floor • rain accumulation in crawl space bugs and rodents can nest in crawl space
Strip Foundations	• Low cost • Technically simple to install	• Time consuming • The soil could be disturbed when installing
Raft Foundations	• Provides a good foundation where soil is variable • Can be used as the sub base for the ground floor	• High cost • Needs form work • can crack if not installed correctly

Pile and slab

Beam and pier



Strip foundations

Raft foundations

Superstructure Frame	Advantages	Disadvantages
Steel - Skelton and Braced Frame	• Provides strength, stiffness and durability • Reduced lateral sway so reduces movement • excellent fire protection properties • Can be pre ordered and pre fabricated • Low cost • Easy to construct • Maximises internal floor space • Sustainable material as can be endlessly recycled • Prefabricated • Water resistant	• Heavy lifting equipment required to install • Low thermal properties • Difficult for future alterations • Must be treated with intumescent paint to achieve minimum of 30 minutes fire protection
In situ Concrete Frame	• Most economical type of material • High thermal properties • good noise acoustic performance • Excellent fire resistance	• High Labour costs to fabricate • Difficult to alter • Uses more internal floor space than steel frame

Pre cast concrete	• Strong and durable • Resistant to lateral flow pressures – wind • Versatile • Can be fabricated on site if space is not limited. • Fast construction method • Quality assurance - Uniformly manufactured • Prefabricated off site • Can be used on site with limited space as prefab off site • Strong and durable • Good noise acoustic properties • Resistant to lateral sway	• Fabricated on site not suitable for limited space sites. • Slow construction method as concrete has to set and cure • Specialist transportation to site – damaged in transit • Large plant machinery required to install • Unable to modify once cast • Sensitive connection works

Timber frame	• Fire resistant • Good thermal properties • Good thermal performance • Fast construction method • Low labour costs as can be pre fab off site • Sustainable material	• Poor acoustic qualities • Regular Maintenance required • Poor fire retardant properties • High material cost

Steel

In situ concrete frame

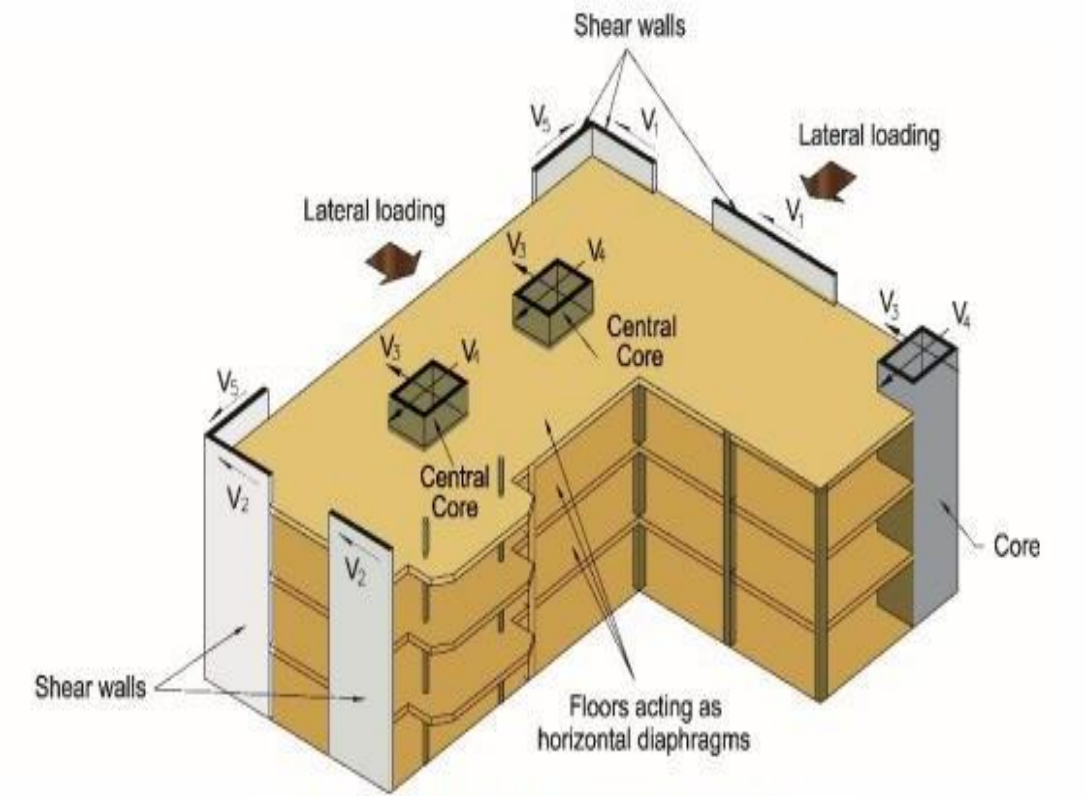
Pre cast concrete frame

Timber frame

MJB Design would immediately discount considering a timber frame for this development due to the poor fire retardant properties of timber, also we acknowledge the future maintenance requirements of a timber frame. Timber can be compromised by adverse weather conditions should the exterior envelope fail.

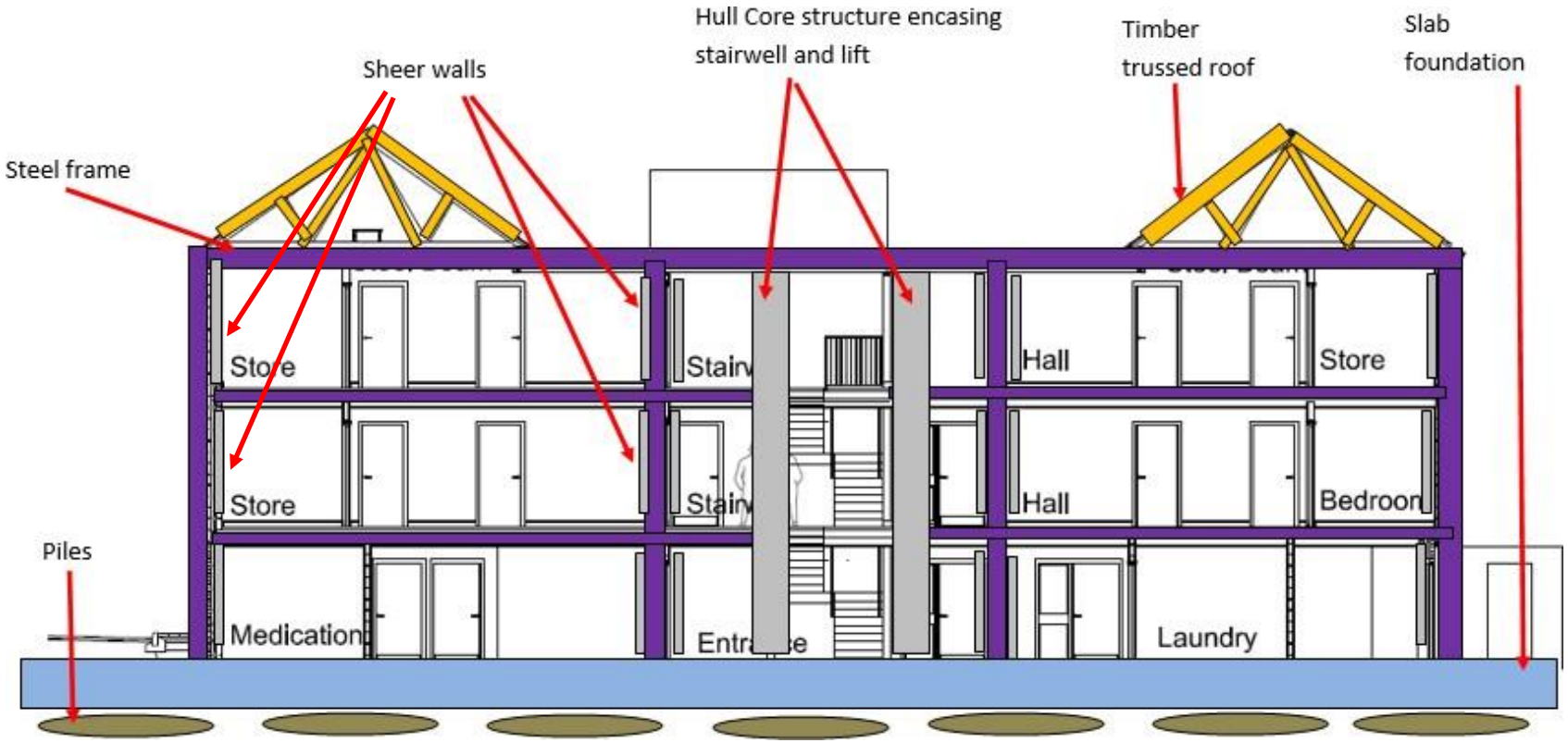
A pre cast concrete frame would have to be specially transported to site, with added risk of damage during transit. For this reason, MJB Design would discount using this type of frame for the ERC, as damaged materials will delay works as per the master project plan.

The ERC site has limited space, so we are not able to accommodate in situ concrete as a frame, also this is very labour intensive and curing could delay the construction phase. Based on the information in the table above, a rigid steel frame would be our preferred method of construction with a core hull structure, tied into a pile and slab foundation system. The steel frame will be tied into the foundation concrete slab, transitioning the load to the slab which distributes the imposed load evenly to the piles below. The steel frame must comply with BS EN 1993 and can be pre ordered and prefabricated off site to be ready for installation as the groundwork package is completed.. All steel is to be coated in a thin film of intumescent product to achieve minimum 30 minutes fire protection to comply with Approved Document B. The design of the Core house design allows for the provision of a core hull structure. The Core hull method will provide two shafts, one for the stairwell leading off of the entrance lobby and another for the lift. These walls must form a fire proof protective shell as the staircase is the main escape route from the upper floors of the Core House.



MJB Design have made provision for the pre-fabricated trussed timber roof in the illustrated technical drawing **(Figure 1)** also depicting the pile and slab foundation, steel frame with Core hull construction method.

Figure 1.


Hull Core structure encasing
stairwell and lift
Timber
trussed roof
Slab
foundation
Sheer walls
Steel frame
Store
Hall
Store
Store
Hall
Bedroom
Piles
Medication
Laundry

4. Part B.

MJB Design have made provisions for both Active Fire Protection (AFP) and Passive Fire Protection (PFP) to the Core House and the Move on Flats at the ERC Development. There is a “stay put” policy in place, which relies on the Active and Passive Fire Protection measures being fit for purpose and fully compliant with the Building Regulations Approved Document B. All AFP and PFP measures at the Englemere Rehabilitation Centre are to be installed by a specialist suitable qualified person and the relevant certification provided.

Active Fire Protection – Detecting, stopping, and escaping fire.

Electronically operated fire detection system

This system must be L1 rated to comply with Approved Document B. The system will cover all of the internal areas of the Core House and the Move on flats. This will be backed up by an audio and visual warning for any end users who have a hearing impairment. This system will be tested weekly by trained fire marshals, and any faults recorded in the fire safety manual kept behind the reception area of the Core House.

Sprinkler systems

A sprinkler system is to be installed and must comply with Approved Document B, with a trigger point of 18m and is designed and installed in line with BS 9251 to both the Core House and the Move on Flats at the ERC.

Communal areas

Communal areas are to be kept free of any belongings or hazards that would impede escape in the event of a fire that required evacuation from either the Core House or the Move on Flats. Refuge areas on the staircase to the Core House to remain free of hazards and will also be checked as part of the weekly fire checks.

Fire Extinguishers

Fire extinguishers for both the Move on flats and the Core House are to be located close to areas of high risk, such as the boiler room and kitchen in the Core house, and the kitchens in the Move on Flats. Fire Extinguishers are only to be used by trained competent persons.

Passive Fire Protection – Containing fire and preventing fire and smoke spread

Fire stopping and Fire Collars

Steel used to construct the Core House and the move on Flats is coated with an intumescent paint that will give 60 minutes of fire protection, and fire collars are installed to the soil vent pipes at both floor and ceiling level to ensure compartmentation between floors. Compartmentation to the Core House to be achieved by ensuring the walls and floor to the hull core structure around the stairwell and lift shaft to be an enclosed area with adequate Fire Protection on all sides. The “core” will accommodate electrical services which will benefit from having fire protection on all sides. The stairwell will be the main escape route from the upper floors of the Core House, as well as the external metal staircases. Internal floors and walls to both the Core House and the Move in Flats are to be constructed of concrete

to keep different areas separate to reduce the chance of flames and smoke spreading throughout the building. There must also be sufficient layers of plasterboard to achieve a minimum of 30 minutes fire protection.

Doorsets

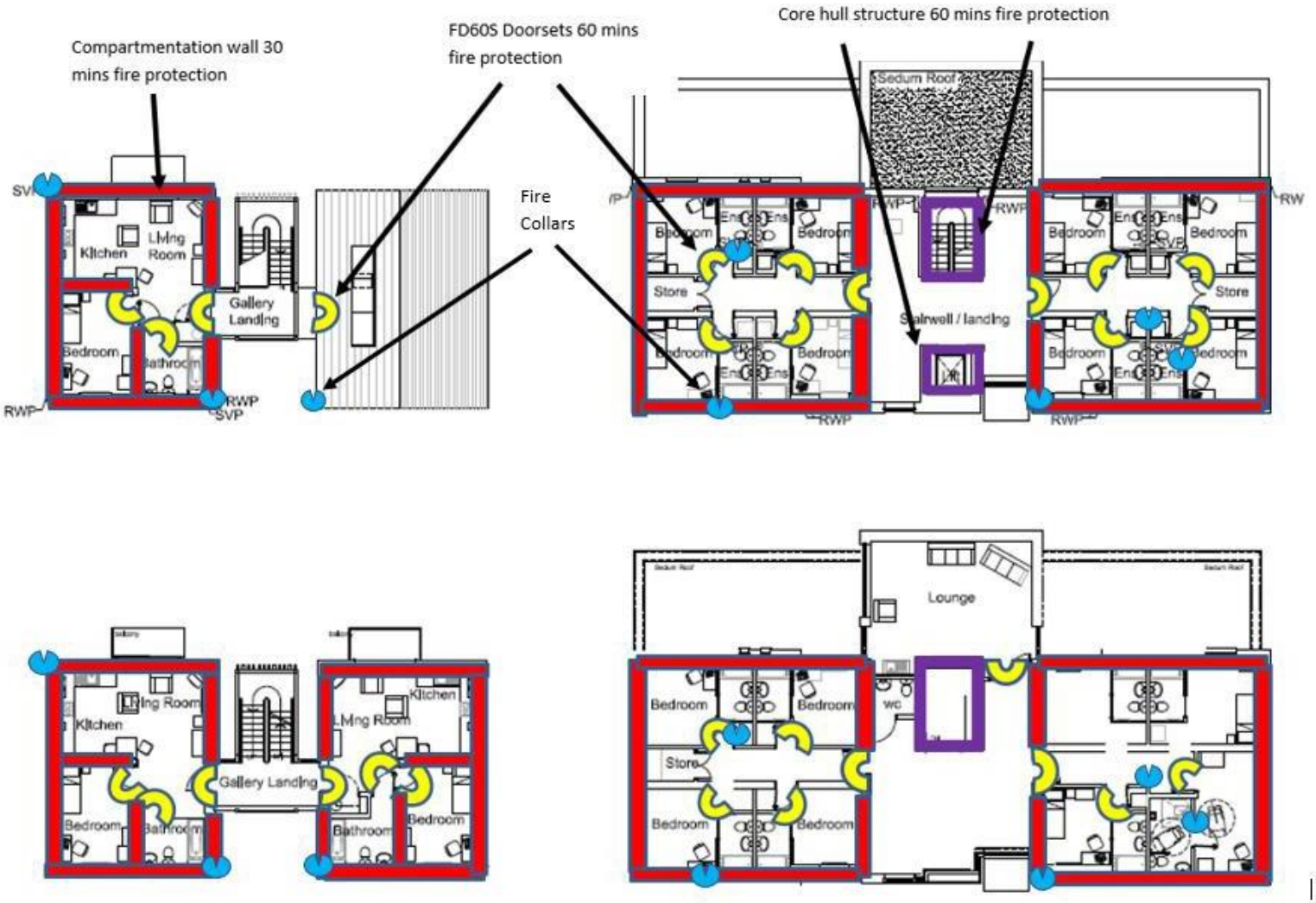
All internal doors to both the Core House and the Move in flats are to be FD60S Fire door sets, achieving 60 minutes of fire protection. Doorsets will be Q marked by the manufacturer and installer and must be BM Trada certified. All internal doors are to be fitted with a self-closing device. These must be checked as part of the weekly fire checks.

Fire Checks

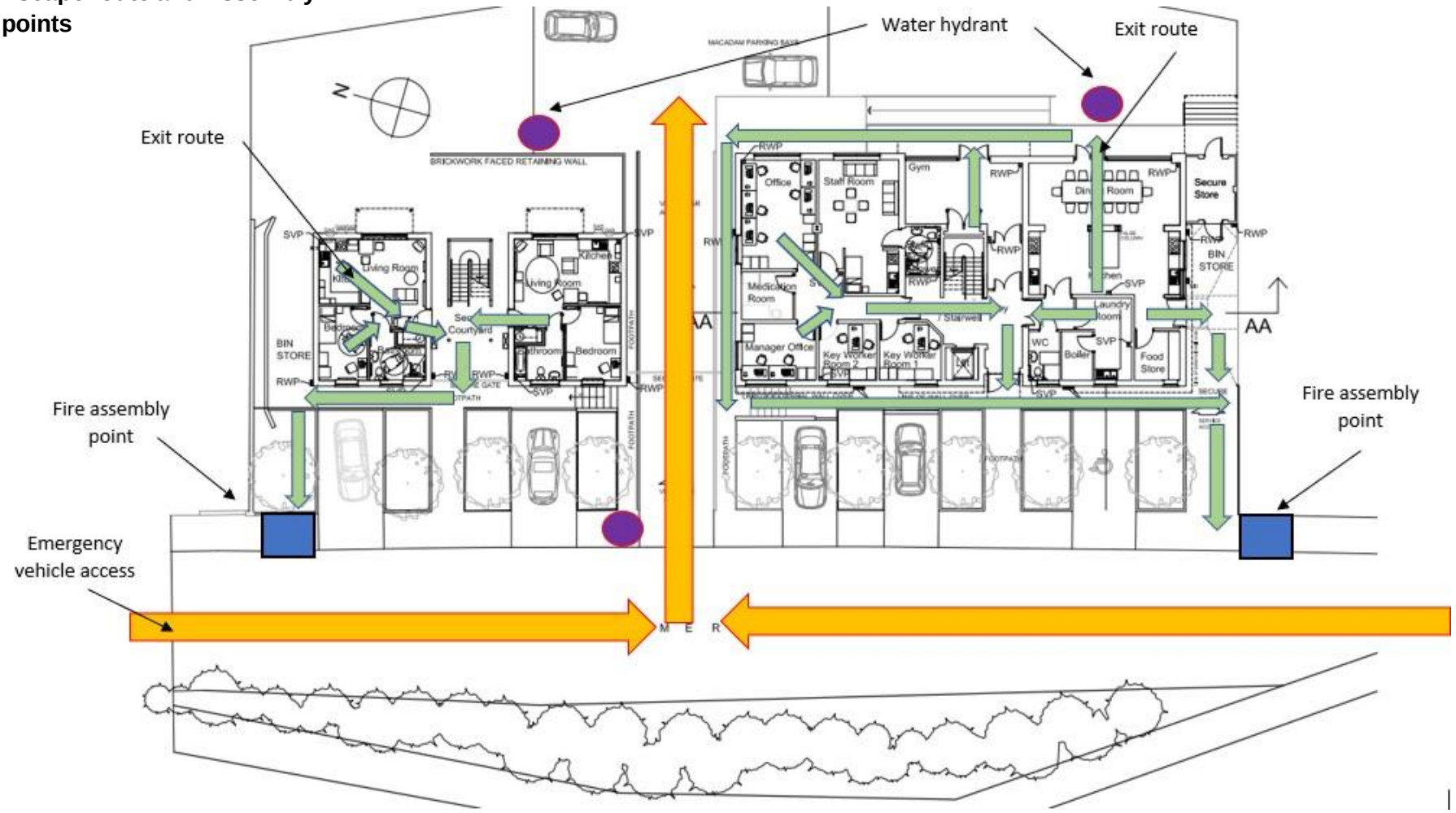
Weekly fire checks are crucial to detecting any faults with the AFP and PFP. Fire Marshals are to be provided with the relevant training. Anyone responsible can train to be a fire marshal, so this could be a positive way of developing staff at the ERC.

MJB design have provided a technical drawing illustrating the passive fire protection measures for the development, as well as an annotated drawing showing the escape route in the event of evacuation.

Passive Fire protection



Escape route and Assembly points



5. Part C

MJB Design have considered various options in relation to Off Site Manufacture (OSM) for the Move on flats at the ERC. There are a lot of positives to introducing OSM to the ERC, as we can reap the environmental, quality and cost benefits. There are also drawbacks that OSM can create that we must be mindful of when considering this approach. Benefits include improved quality of goods that have been manufactured off site. Goods will come with a warranty that guarantees the life cycle of the component but also reassures that any manufacturing errors can be corrected by the manufacturing company. The manufacturing process is predictable which reduces waste, less greenhouse gases and diesel emissions and components manufactured in a factory are mostly unaffected by the adverse weather in the UK. Also, the digital factory machinery and CNC machinery is calibrated to ensure each item is produced identically, which could reduce down time on site altering components to fit. OSM will increase productivity, improve quality, reduce waste on site going to landfill, and reduce labour costs. Assembly costs are less with an automated approach in comparison to manual assembly which can be subject to human error and can increase the chance of a defect. OSM will allow for the sequence of works to be more precise, thus potentially reducing down time on site.

Obstacles using OSM can be size limitations. Prefabricated items may need to be limited in size due to transportation restrictions, for example maximum road width restrictions. Also, alterations to the design are not an option once instructions are given to the factory for any OSM components, this leads to less flexibility and innovation.

By manufacturing the internal FD60S doorsets off site, we can guarantee each doorset will be accurately electronically manufactured to the exact size and specification required for the Move on Flats and be fitted without issue. The doorsets can be delivered to site when we are ready to install meaning storage on site will not be required. The concrete staircase to the Secure courtyard of the Move on flats could also be manufactured off site, being precast in a

controlled environment to the exact dimensions where curing can be monitored for defects and delivered to site when ready to be fitted.

Another opportunity for OSM is to pre order the kitchens and bathrooms for the Move on flats as a pod. Pods can be made off site and fitted in just a few hours. These can be manufactured exactly to fit the aperture left in the external envelope during the initial stages of construction, and all plumbing and electrical works can be connected in a short period of time. This would speed up construction and eliminate the need to store any kitchen or bathroom materials on site, whilst reducing labour, waste and assembly costs for this element of the build.

The Timber roof framing for the move on Flats could also be included when considering components for OSM, ensuring great time management as the frame could be ordered and delivered to site on the day of instal reducing lost time on site for bad weather, or if for example there was a shortage of joinery skills on site due to a pandemic or Brexit

6. Conclusion

Part A of this report evaluates and describes different methods of construction for the Core house, and it is our conclusion that a pile and slab foundation is the most suitable due to the depth required to ensure stability and support for the imposed loads, and the high water table of 0.5M below ground. MJB Design would recommend a Hull Core structure with a steel frame, integrated sheer walls, and block internal walls and concrete floors as our preferred method to construct the superstructure of the Core House at the ERC as this will provide strength, durability and resists lateral forces.

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CIOB Architects Drawings XP/12/A; XP/12/B: XP/12/C; XP/12/D; XP/12/E.

Final draft scenario XP/12/P.