

**APPENDIX GA36b*****LEVEL 5 ASSESSMENT SPECIFICATION***

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ACBA5000 Modern and Traditional Construction**Assignment 1 Construction Portfolio Case Study****Contents Page**

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1) Introduction

In this project there will be a vast range of materials, techniques and constructional forms suited to the construction of medium to high-rise buildings. Throughout the project, all components will be considered frequently to ensure the highest quality is delivered. The primary objective of the project is to deliver an energy efficient, functional building that provides a safe environment to use. Additionally, buildability is imperative, as it must have a long lifespan with minimal maintenance to ensure that office can be used frequently.

2) System of Primary Structure

In this section of the project, the primary structure of the office block will be identified and explained, alongside CAD drawings and sketches to present the design. Furthermore, the use of regulations, standards and technical documents will be used throughout to ensure the design follows UK Building Standards. A primary structure is everything load bearing. Typically, in steel construction this means foundations, floors, columns, braces, beams.

2.1) Steel Frame Design (Universal Columns and I-Beams)

A steel frame design is a simple, but effective way of constructing an office building. Once installed it requires little maintenance. In terms of the strength and durability, it performs significantly better than timber and concrete alternatives. [1] “A typical weight-bearing steel fabrication is 30%-50% lighter than a wooden equivalent.” This makes it the ideal material for constructing a medium sized office block. Furthermore, it can be erected quickly, without the requirement for skilled workers to assemble the structure. The assembly can be completed using a crane and a cherry picker, which is low cost and fast. Columns are then fitted in position using a base plate, which attaches to the foundations using bolts and transfers the load.

[1] “Steel frame constructions are highly resistant to fire, reducing the fire risk to a building and retarding the spread of a fire should one occur.” This is crucial when ensuring the safety of the occupants inside, as in an office there can be hundreds of computers/electrical technologies which could catch fire, then spread. By selecting steel, this eliminates the threat from insects and mammals burrowing into the material and damaging it.

Furthermore, Steel can have good moisture resistant properties, depending on its carbon content and coating. However, for this project the columns and beams will be fitted internally

and therefore, weatherproofing isn't necessary. [2] "For steel I beams, the quick way to size a steel beam is to divide the span by 20. For a 12m clear span, the beam would be approximately 600mm deep." Given that according to the design, no beam is longer than 9m, a beam of 450mm deep would be required to ensure the safety and account for extra imposed loads such as services or snow loads. "The column size will depend on the floor area it is supporting and the imposed loads on the floor area."

2.2) Steel Bolt Connections with Steel Base Plates

These will be used to connect the beams and columns together and attach the subframe to the foundations. [3] "With bolting it is possible to assemble structural steelwork parts quickly and cost-effectively." This is crucial, as if parts must be welded together, then erection of the sub structure will take significantly longer. Additionally, [3] "bolting is less susceptible to poor weather conditions" and therefore, should require less maintenance and inspections. [3] "Connections in such structures must comply with strict quality requirements and standards for the design (the Eurocodes) and fabrication (EN 1090-2) of structural steelwork." As long as they are assembled correctly and well maintained, then they should adhere to these.

The steel base plate is effective as the steel beams are kept internally and so there should be minimal corrosion. They can be installed to the foundations by drilling holes and fitting anchor bolts and nuts to hold the base plate in position. Grout should be poured around the base plate to ensure the load is transferred effectively through the foundations.

2.3) External Walls Thermalite Aircrete Blocks

Instead of using conventional bricks, thermalite aircrete blocks will be used, which although expensive, will improve the building's energy efficiency due to their excellent thermal performance. They also perform exceptionally well with moisture as they contain [4] "millions of tiny pockets of trapped air, preventing the passage of water." This combined with the brick slips should ensure full lifetime waterproofing with very high thermal performance. These can be constructed quickly due to their lightweight properties, however, perform exceptionally well upon compression.

2.4) Reinforced Concrete Foundations

The purpose of using reinforced concrete is the strength and rigidity it brings. Steel is very strong under tension, whilst concrete is very strong under compression. This will ensure that the building can withstand a significant amount of weight and can be used however, is necessary. The load will be spread effectively through the steel beams, then through the columns, where the load will be distributed across the reinforced concrete foundations. Even though the initial cost of installing this type of floor and foundation is more expensive than other alternatives, it will increase the longevity of the building and reduce maintenance, whilst totally removing issues like insects burrowing into the material. Furthermore, reinforced concrete has a low thermal conductivity and so increases the fire safety and decreases the likelihood of fire spreading between floors.

In terms of construction, this method requires extra work and resources. Firstly, formwork is assembled to identify where the concrete must be poured in order to construct the slab or foundations. Then the steel reinforcement must be organised correctly and assembled ready for the pour. Any underground services should be installed before the pour. The concrete is then poured using a concrete pump and concrete lorries, then compacted. Finally, the concrete is cured and treated if necessary to ensure the required finish. The building will have a commonly used a smooth finish, which is completed using a power float. It is important to allow the concrete enough time for the water to bleed off before doing so.

2.5) Composite Slab with Metal Decking

This comprises of a metal deck which is fitted with reinforcement and then filled with concrete. In terms of an office building filled with technology and people it is crucial that the floor is strong and can transfer the weight effectively. Furthermore, it eliminates any threat from insects and performs a high level of fire resistance. Although, one of the more expensive options it should increase the lifespan of the building and decrease the amount of maintenance required in comparison to other alternatives.

2.6) Steel Cross Bracing

[5] This will be fitted to mitigate the effect of wind load upon the structure. Even though the building is only 3 stories tall, it can still be affected by high winds. This type of bracing requires very little material in comparison to other alternatives, whilst still providing plenty

of additional strength to a building. The main benefit of using steel cross bracing is that it can be connected easily to the steel frame and can help equally distribute lateral loads as well as vertical loads through the columns.

3) System of Enclosure

This is part of any building that physically separates the exterior environment from the interior environment. The primary function of the enclosure is to separate the interior environment from the exterior environment which it is exposed to. [6] “This needs to be designed for thermal performance, moisture protection, sustainability, and durability. The materials specified to build these subsystems should be considered with care because subsystems are designed and constructed to stop air, shed water, reduce heat transfer, and dry to the outside.” Additional factors that must be considered are the aesthetics of the building and any services that must be fitted.

3.1) Internal Plaster Slab/Glass Partition Walls and Doors

Plaster slab walls have been selected as they can be installed easily with minimal expense. These tend to be made out of burnt gypsum mixed with sawdust or other fibrous materials to reduce its weight. This is important in terms of design, as it reduces the weight upon the slabs, whilst insulating the different rooms. These are usually prepared [7] “in an iron or timber mould with a size of 1-2m long, 300mm high and 50-100mm thick.” These may take longer to install in comparison to other alternatives, however, will be perfect for storage cupboards and toilets where privacy is required.

The glass partition wall will be used in some of communal offices to give a more cohesive, friendly atmosphere, which should improve productivity. [7] “By fixing a sheet of glass in a wooden framework this wall is constructed and in timber framework, using timber beadings to fix the glass”. However, these walls provide great sound proofing and allow for private conversations and business meetings.

3.2) Brick Slip Panels

Brick slip panels will improve the visual exterior and can be installed cheap and quickly, whilst providing similar weatherproofing properties to cladding. Additionally, they will increase the longevity of the building, as they are very weather resistant and corrode

significantly slower than cladding, whilst giving a more traditional aesthetic. If these are purchased in quantity, then they can be quite affordable as an alternative to using traditional bricks. Furthermore, this can reduce time, as a whole panel can be installed, rather than individually laying bricks. Finally, most brick slips [8] “are incombustible and inert, fired to over 1200 degrees Celsius they will offer some level of protection against heat and fire.” This combined with the insulation blocks should provide a high level of fire resistance and low level of thermal conductivity.

3.3) Foam PIR Board Insulation

Foam board insulation will be fitted to mitigate heat loss throughout the building. These tend to work best on larger projects as it can be installed quickly, whilst still provide high R-values of around 4.5. When installing it is important to seal the gaps between boards to achieve optimum performance. [9] “It uses a closed cell structure to minimise the absorption of moisture or water vapour.” This should ensure that heat loss is at a minimum and energy efficiency is high.

3.4) uPVC Double Glazed Windows and Doors

The reason for selecting uPVC windows is because they have a high level of security with locking windows, customisation available for different size requirements and are easy to install, whilst requiring very low maintenance. Additionally, they are eco-friendly, can last [10] “between 40-80 years and are made from mostly recyclable materials”. These will be used for all external doors and a mixture of wooden and glass doors will be used internally depending on the surroundings.

3.5) PVC Flat Roof

This will be sloped at 2 degrees to ensure that water runs off, therefore, minimal height and expense is added to the project. Additionally, it will be the perfect place to fit solar panels and ventilation units. This allows the internal space to be used more productively and increase the number of storage cupboards, offices etc. In terms of maintenance, the roof can be accessed and worked on very easily, which mitigates the chances of significant issues occurring. If correctly maintained, they will [11] “remain 100% waterproof and withstand all elements, including high winds, ice, snow, and damaging UV rays.” The overall cost of installing a flat roof is significantly less in comparison to other alternatives and can be

installed quicker, as they only require a subtle pitch. [12] “When the sheets of PVC are rolled out, the seams are sealed with hot air. That makes PVC roofing membranes virtually impermeable to water.” The roof will comprise of a superior quality bottom ply at the bottom, followed by a flexible fiberglass mat on top of that, a durable weathering film in case any water seeps through the top layer of acrylic finish. [12] “When installed properly, PVC lasts 20 to 30 years on a flat roof and doesn’t need much maintenance.”

3.6) Services

[13] The main services that must be included in the office building are an effective water management system to ensure that water flows off the roof effectively, even in very hard rainfall. It will be fitted with solar panels, which will be used to power the electronics in the offices below, including computers, printers etc. Additionally, electric charging points will be fitted outside for employees to recharge their vehicles as they work. Solar water heating will be installed to provide heating for the building alongside a conventional heating system. This will save money in the future, especially with ever rising gas prices. There will be sufficient service ducts fitted to ensure that cables and pipes can be hidden away, along with the building being well ventilated.

Furthermore, an appropriate sprinkler system will be installed to ensure that in the case of a fire, it can be put out quickly and effectively before it spreads. There will be a number of fire extinguishers for the workers to use in case of an emergency accordance with BS12845:2021. [14] “To maintain the validity of a certificate of conformity the system must be serviced and maintained by an approved sprinkler servicing contractor, from the time the sprinkler system is commissioned.” This is crucial, as if the system fails due to insufficient maintenance, then there could be severe court cases as to who was to blame for the failure or even worse, people could be injured trying to escape the building.

4) Conclusions

Overall, I believe the project has covered all the required structural elements of the building have been carefully considered, selected, and described. The building should provide a high level of energy efficiency, whilst being constructed out of sustainable, reusable materials. It can be erected quickly without the need for skilled workers or specialised heavy machinery, so in terms of buildability it performs exceptionally. All the different aspects of design align

with the specification of the building. The CAD drawings and column and beam layout clearly represent the initial design and correspond with the elements mentioned. Throughout all legislation, regulations and standards have been followed in order to produce a design that delivers on the crucial factors specified at the start of the project.

The system of primary structure transfers the imposed load effectively from the slabs to the beams and through the columns before being distributed across the reinforced concrete foundations. All the materials listed were selected due to their longevity and simplicity of instalment. Additionally, the majority of them are environmentally friendly or recyclable, which means when the building is dismantled, the materials can be reused.

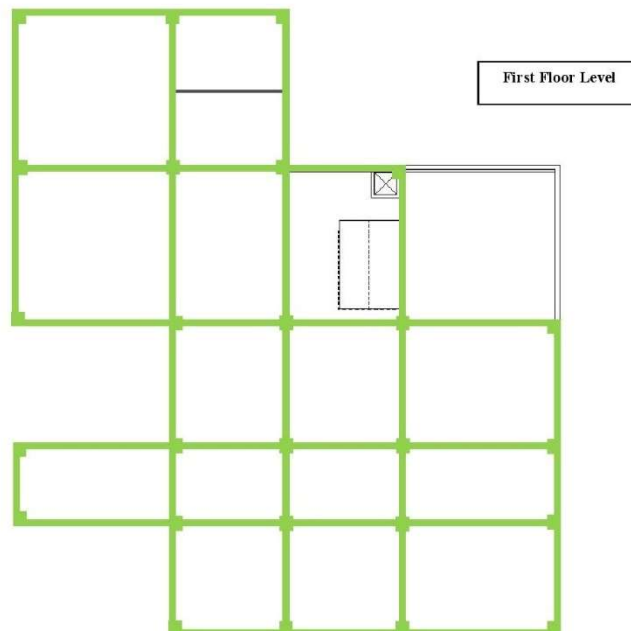
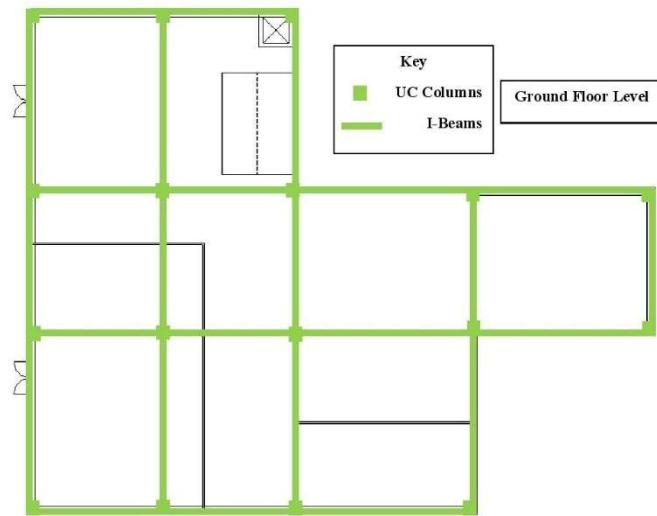
The system of enclosure provides an aesthetically pleasing, professional, energy efficient external shell to the building. The services ensure that the office block is safe, reliable and can provide a positive, collaborative environment for all users. Furthermore, ventilation and large opening windows will keep them comfortable, allowing them to complete their work to high standard. The solar panels will produce electricity to lower running costs and increase profit margins. Whilst fire proofing, alarms and the sprinkler system will ensure the safety of occupants in case of an emergency.

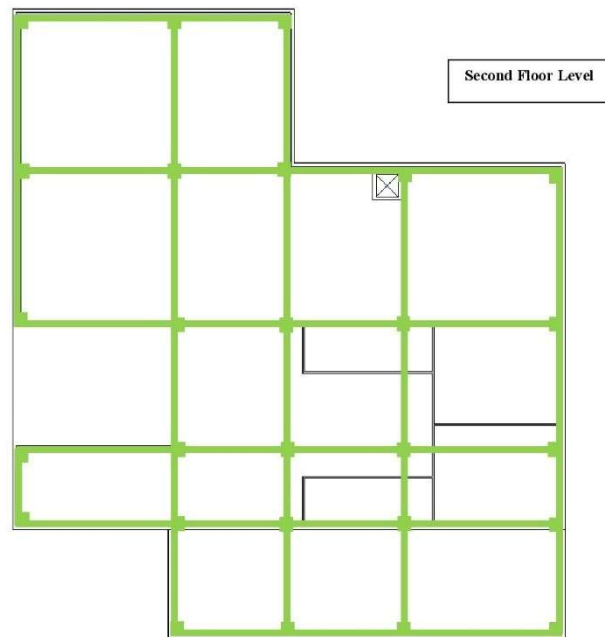
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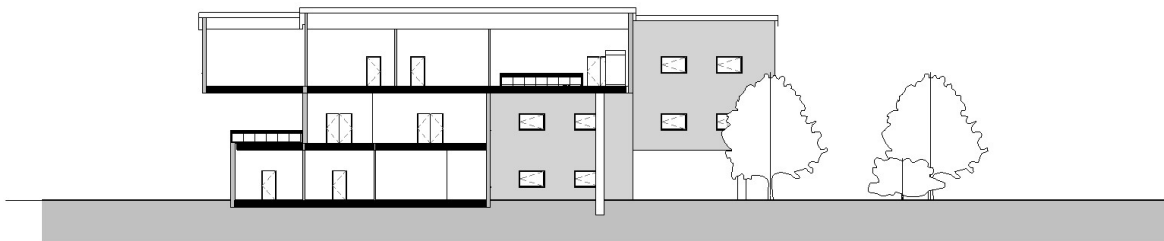
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6) Appendixes

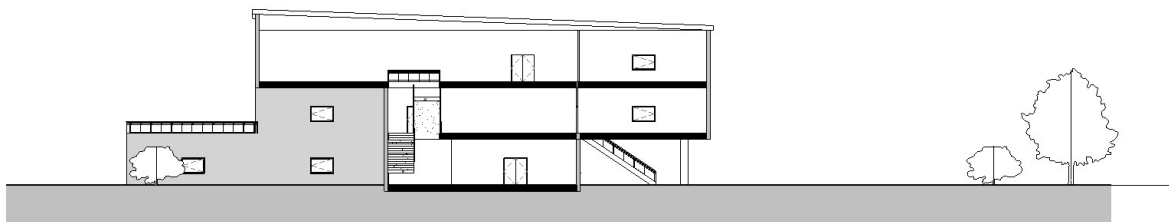




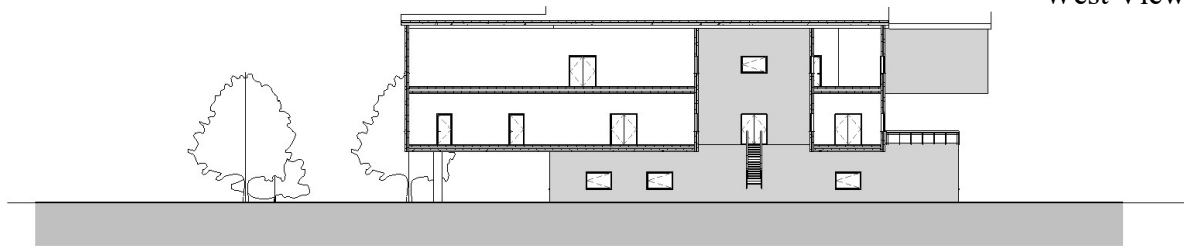
East View



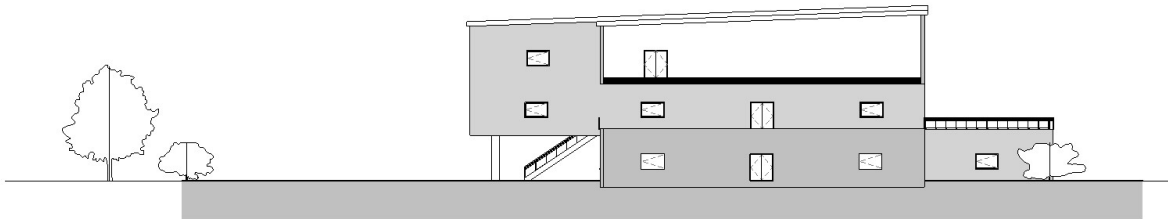
North View



West View



South View



3D View

