

6033 - Steel Museum

Construction Methods & Machinery

Ace Capital Projects Ltd

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Contents

Chapter	Page
Introduction	4
1. Proposed Construction Methods	5
1.1. Pre-fabrication of Steels	5
1.2. Precast Concrete Elements	5
2. Plant & Machinery	7
2.1. Crane	7
2.2. Excavators	8
2.3. Compaction Rollers	8
2.4. Piling Rig	9
2.5. Dumpers	11
2.6. Telehandlers	12
References	13

Figures

Figure 1 - View of Precast Concrete moulds for Drainage Elements	6
Figure 2-1 - Crawler Crane 7120 (Kobelco, n.d.)	7
Figure 2-2 - Excavator Weight Classes (Wedgelock, n.d.)	8
Figure 2-3 - Sheepfoot and Double Drum Roller (www.eaglepowerandequipment.com, 2019)	9
Figure 2-4 - CFA Piling Process (Trevi, n.d.)	10
Figure 2-5 - CFA Piling Rig (Skanska, 2021)	10
Figure 2-6 - 6T Dumper & Specification (CP Hire, n.d.)	11
Figure 2-7 - JCB 540 - 200 Telehandler Specification (Morris Leslie Plant Hire, n.d.)	12

Introduction

This brief report outlines the construction methods used for different aspects of construction work, specified within the project scope. It also offers the justification as to why these choices were made justifying the useability in terms of cost, effectiveness and suitability of conditions. Further to this an outline is also provided of the machinery and plant used, detailing specifications and key attributes and functionality of machinery. Looking also into how this links into other aspects of construction such as Health & Safety and Quality.

1. Proposed Construction Methods

Below is a brief outline of some of the proposed construction methods for different areas of the project and the justification behind the selection of these methods. Justification has considered various approaches such as Environmental, economic, safety and quality. This has helped influence our choices and select the most effective methods with minimal impact to the specified fields.

1.1. Pre-fabrication of Steels

For the structural frame of the building please refer to the Structural Calculations for details on beam sizes. It has been proposed that the steel for the frame is to be fabricated offsite by a company called William Hare Group located in Risca, Newport. This location is approximately 25 Miles from the proposed site location which allows for a relatively low embodied carbon footprint from transport costing. The additional purposes of fabricating the steel offsite, also makes for a more efficient process with less waste. It also negates the need for heavy lifting machinery to be hired to site which will mitigate costs in this area marginally. This also then has a wider positive impact on the environment as now welding will be undertaken on site with the possibility of causing harm or disruption to the environment and built-up surrounding areas. Once fabricated the Steel beams & columns will undertake a quality audit to ensure adequate suitability and snagging procedures are undertaken before the transport of the steels are taken to site and then erected. All Steels are to be fully Certified by William Hare and fully compliant with BS EN 1090.

1.2. Precast Concrete Elements

Some of the drainage elements added as part of the ground works stage are also proposed to be precast concrete which are made offsite then transported to site prior to approval of Material Approval Request (MAR). Some of these elements include chamber bases, chamber rings, Chamber concrete cover slab and concrete risers. An example of these can be seen below:



Figure 1 - View of Precast Concrete moulds for Drainage Elements

Once approval has been received for the precast concrete elements of the project they are to be documented and stored correctly in order to prevent injury of damage to the materials. It is also far more cost effective and easier to achieve correct dimensions to comply with relevant standards by using these methods. The labour needs to be able to construct such elements on site wouldn't be beneficial to project. They would need a lot more time and resource in order to satisfy the relevant standards by pouring these chambers on site. This may then lead to other potential issues such as contamination of surrounding areas, COSHH regulations and more rigorous quality checks on site, which Blueprint are aiming to avoid. (CivilCast, n.d.).

2. Plant & Machinery

In order to achieve suitable working arrangements on site heavy plant and machinery will need to be hired or procured as part of the project to undertake excavations, lifting, concrete pours and many other daily site activities, to help ensure the efficacy and safety of site operations are at their best. Some of the plant and machinery used on site can be outlined with specifications below:

2.1. Crane

For heavy lifting to be achieved on site it is imperative that a crane is used in order to lift some of the larger objects on site into place. This will be used to assist with the piling works by lifting any reinforcement cages, pile casings and any other heavy machinery around the site. It is also crucial that a lift plan is in place for any lifting activities it is also stated that a lift supervisor is needed, along with the relevant size lifting aids which also undertake through checking under BS EN 12077 – Cranes Safety (HSE, n.d.). The type of crane needed for the works on site will likely be a Crawler crane this is to be able to allow it to move around site given the spacing on site may be a little tight at times the maximum lifting capacity for the crane used on site will be 120 tonnes. This is a little higher than what's expected to be lifted, but careful consideration and procurement of this has been considered:

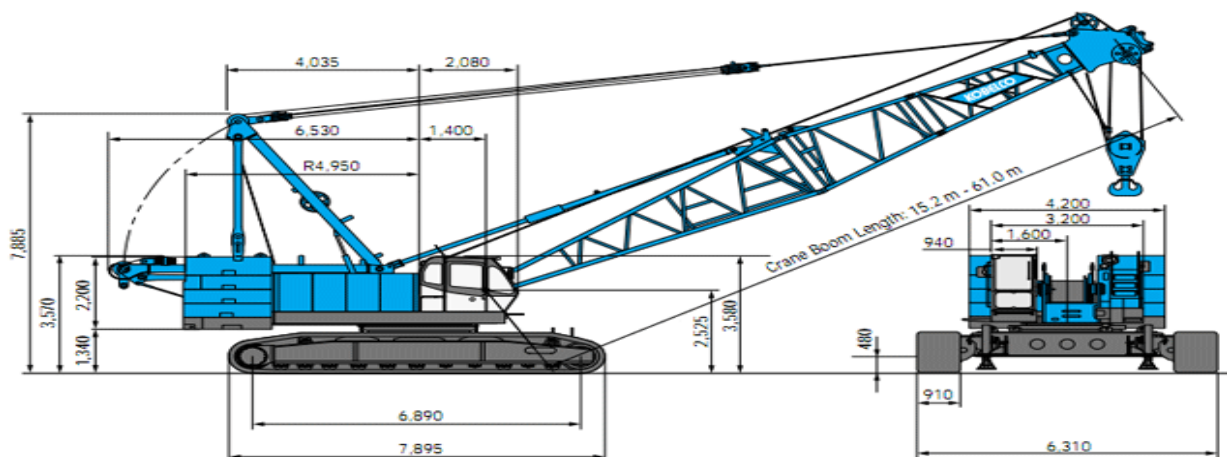


Figure 2-1 - Crawler Crane 7120 (Kobelco, n.d.)

2.2. Excavators

An excavator is needed on site for a lot of various site activities and will most likely be needed throughout the construction life of the project. It will be needed to undertake any kind of excavation including earthworks for footings, drainage works, service diversions, site clearance works and landscaping and any batter works. Excavators will also be hired on a size basis with larger machines needed for things like erection of crane pads and excavation for foundations. Whereas a smaller machine will be more suitable to undertake drainage works a guide to excavator weight classes is shown below:

Guide to excavator weights in Wedgelock Weight Classes★

022 1.5t to 2.2t	028 2.3t to 2.8t	037 2.9t to 3.8t
055 3.9t to 6t	070 6.1t to 9t	099 9t to 11t
130 11.1t to 14.5t	170 14.6t to 18t	210 18.1t to 23.5t
270 23.6t to 29t	320 29t to 38t	450 39t to 50t
Larger Over 55t		

Figure 2-2 - Excavator Weight Classes (Wedgelock, n.d.)

Looking at the excavator weight class table above it is more than likely that a 210 or 270 class machine will be needed for large groundworks and a 055 or 070 class machine will be needed for service works and drainage type activities. These will be procured on a hire basis which gives the project flexibility should a larger excavator be needed at short notice.

2.3. Compaction Rollers

A compaction roller will be used on site to ensure ground conditions are suitable and well compacted to avoid the possibility of any settlement within the ground. This will help to ensure the sub-formation of the overall structure of the steel museum is suitable and will be tested to clarify this suitability. Again, rollers come in different sizes and types such as sheep'sfoot

rollers, double wheeled rollers, vibratory rollers, and also smooth wheeled rollers. Given the ground conditions of site for sub-formation dead rolling a sheepsfoot roller may be more suitable as the ground is generally built up of a more clayey type of substrate. Although it may not be cost effective to hire a roller for such a small amount of rolling it could be suggested to procure a standard smooth wheeled vibratory roller and assess compaction through testing before understanding if a sheepsfoot roller will be needed. A small vibratory roller around 3-5t for general re-compaction of trenches will be required along with a larger single wheeled 13t vibratory roller for compaction of sub-formation and erection of the crane pad will be needed.



Figure 2-3 - Sheepsfoot and Double Drum Roller (www.eaglepowerandequipment.com, 2019)

2.4. Piling Rig

Along with a one of the crane operations a piling rig will also need to be used in order complete the excavations for the bored piles. In this case a cased continuous flight auger (CFA) piling rig will be used. This will be done by inserting the casing into the ground and the drilling down with the auger, once at the toe of the pile the pile arising are brought up and removed. The reinforcement is then able to be placed into the pile excavation and concrete poured. Once cured the casing is then to be removed and the next pile can be drilled. This is outlined below:

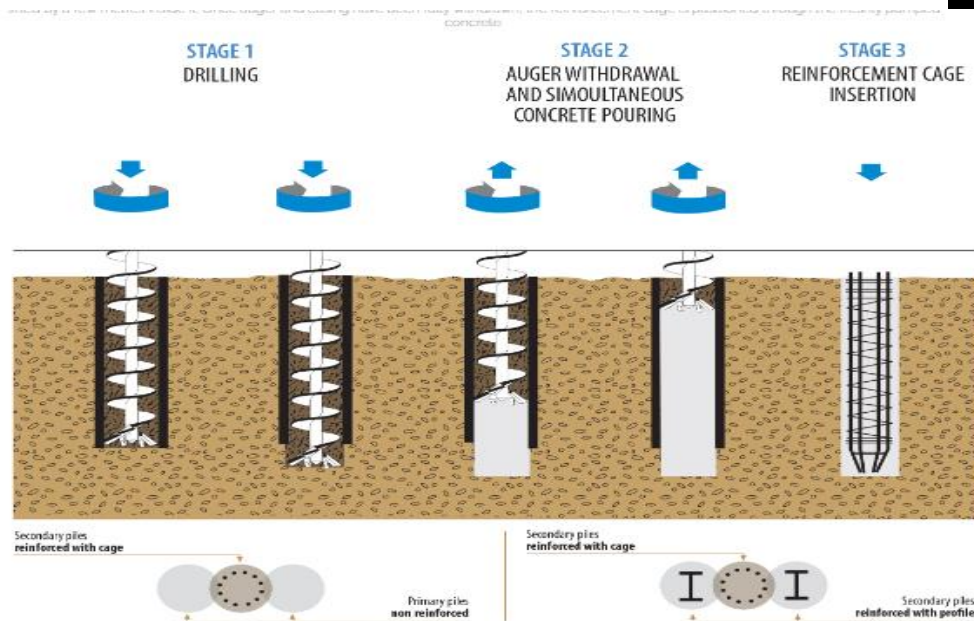


Figure 2-4 - CFA Piling Process (Trevi, n.d.)

This type of piling was also outlined within our Foundation substantiation report, as it allows minimal ground disruption. This type of rig is also well suited to soft ground and is the quietest known form of piling which will be beneficial given the site is located within a built-up area. (Skanska, 2021)



Figure 2-5 - CFA Piling Rig (Skanska, 2021)

2.5. Dumpers

In addition to the use of excavators on site this will be accompanied by the use of dumpers which will aid in the removal of ground spoil around the site helping to dispose of and also reuse material where needed. It will also be necessary to use this to transport some materials around site given its great load capacity. Again, dumpers come in lots of varying sizes but a standard 6t or 9t dumper will all that is required for the project as the amount of ground arisings from excavation works will be limited. These dumpers allow a reversible cab with a forward tip motion to allow groundworkers to have maximum visibility.

	PAYLOAD	6000 KG
	WIDTH	2300 MM
	HEIGHT	2906 MM
	ENGINE SIZE	55 KW
	FUEL TANK CAP	65 LTRS
	WEIGHT	4195 KG
	TRANSMISSION	POWERSHUTTLE

Figure 2-6 - 6T Dumper & Specification (CP Hire, n.d.)

2.6. Telehandlers

A telehandler is a form of lifting plant which will be generally used to transport materials around site and to different levels of the building, it has an extendable boom which will allow materials to be lifted onto scaffolding etc. A 20m reach will be required for this project given the height of the steel museum. A basic specification can be found below outlining lift performance and also wheel track movements.

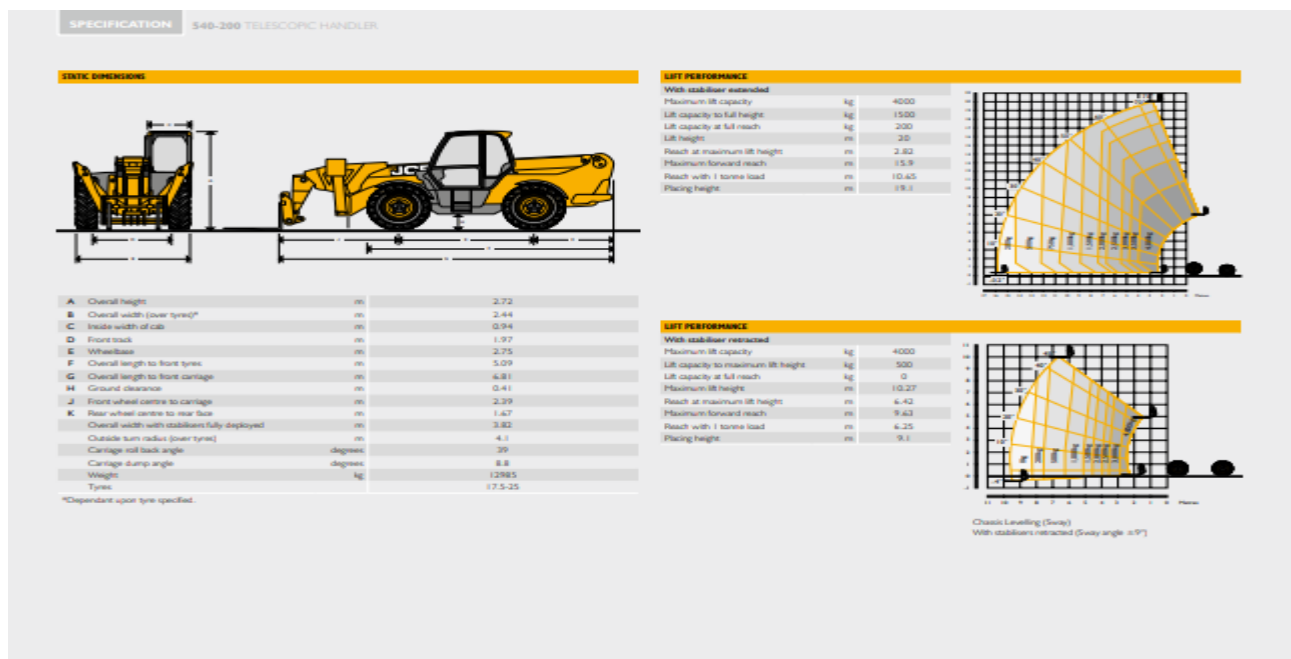


Figure 2-7 - JCB 540 - 200 Telehandler Specification (Morris Leslie Plant Hire, n.d.)

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