

Coursework 1

Programme Control

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Submitted in part fulfilment for the requirements of the module ‘Construction Management’ (ACBA 6000) for the completion of a BSc In Civil Engineering at UWTSD.

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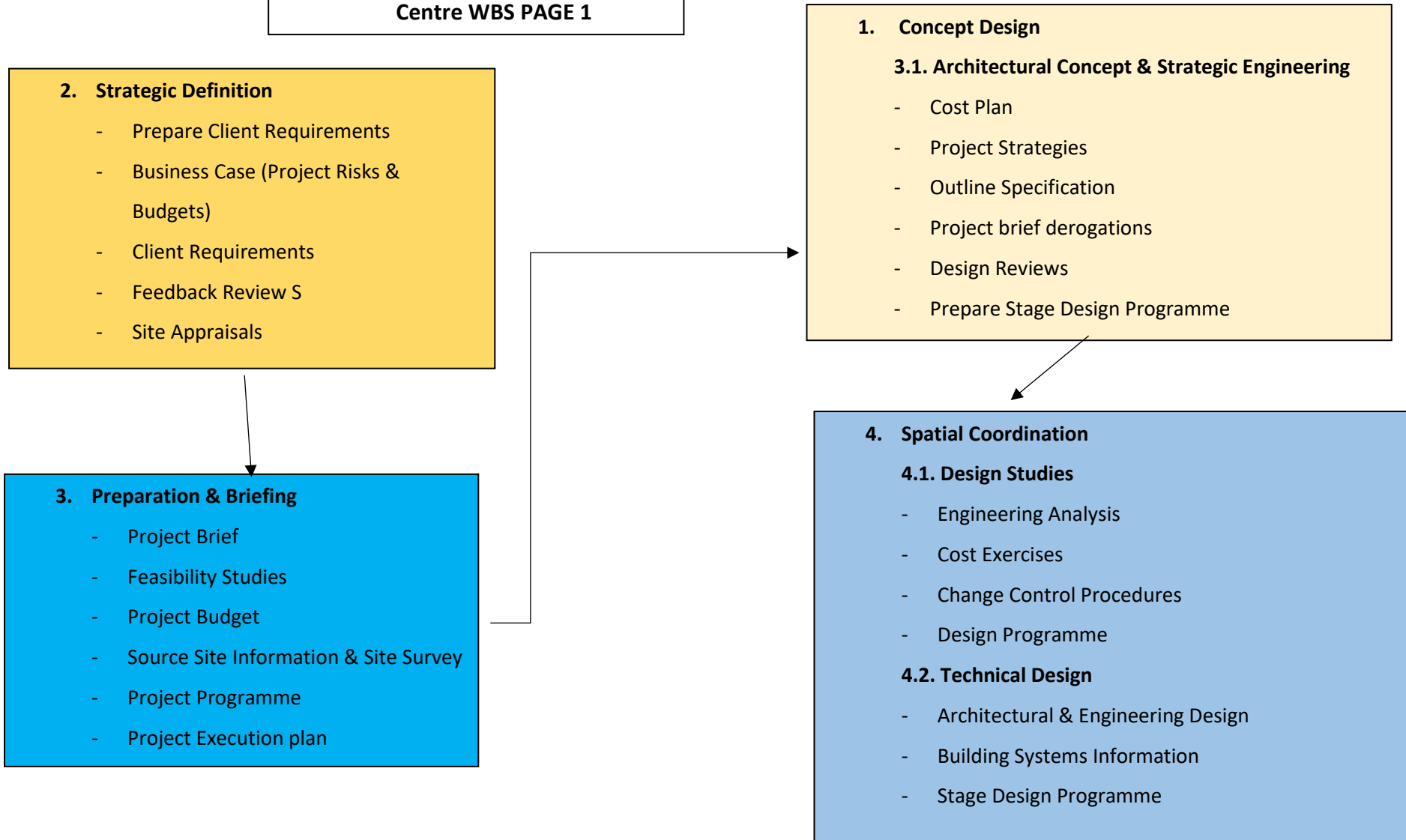
Introduction

Stride Treglown, UWTSD and Kier are proposing the construction of a new 'Swansea Waterfront Innovation Quarter' on the SA1 Campus in Swansea. The scheme aims to encourage development in Swansea to allow employers, communities, and students to help drive innovation in the area by directly connecting with the University and its links with STEM that can aid in research. It will support up to 124 students and 12 staff along with start-up businesses. It is a 3000m² building with an internal 900m² area for businesses.

The main construction works for the building are proposed to start on the 6th of March 2023, with all project planning, feasibility, strategic approach, concept design, spatial coordination, and technical design to be carried out before this date commences all of which are outlined in the RIBA Plan of Work (2020) and shall be followed accordingly. These stages are followed specifically in our Critical Path.

The new building will utilise a detailed work breakdown structure for all major activities from start to finish that are indicated in the sections below, a construction schedule utilising a presentable Gantt chart that will indicate the duration, resources, and materials of any given activity with specific reference to the foundation construction of the building and the steps within. The resources, costs and labour that are linked with each given task will link to each preceding activity to provide all involved in a detailed breakdown of what is needed to construct the innovation building. There are also links formulated in delays caused by a concrete company that is set to strike for 5 weeks on the first day that concrete is required on site. The Gantt chart will show this delay and how it will be dealt with contractually, we will also look at methods to incentivise our workforce/contractor through contracts, extrinsic and extrinsic methods and how to improve productivity after a foreseen delay.

**Swansea Waterfront Innovation
Centre WBS PAGE 1**



**Swansea Waterfront Innovation
Centre WBS PAGE 2**

5. Manufacturing and Construction

5.1. Site Set Up

- Access to site
- Perimeter Hoarding
- Site Compound Setup
- Welfare Facilities Delivered
- Electrical supply
- Water Supply
- Portable Site Office Delivery
- Identification of Services
- Protection measure of Services
- Temporary access route
- Install temporary signage
- Setup Crane Location Ground Test (Stoning)
- Delivery of Crane
- Material delivery
- Plant Delivery

5.2. Execution of Building site

- Site Clearing and Cleaning
- Levelling of Site
- Marking on site as per drawings (layout)

6. Substructure

6.2. Phase 1 Piling North Side

- Construct Piling Mats
- Mobilise Pile Rig
- Driven 24 no. Piles
- Install Reinforcement on Piles
- Concrete Pour on Piles
- Concrete Curing
- Crop (Cut) piles to correct level
- Steel Reinforcement on top of piles
- Shutter Piles for Pile Cap
- Pour Concrete to Pile cap
- Concrete Curing
- Remove/Strike Shutters

6.2. Phase 2 Piling Middle Structure

- Construct Piling Mats
- Mobilise Pile Rig
- Driven 24 no. Piles
- Install Reinforcement on Piles
- Concrete Pour on Piles
- Concrete Curing
- Crop (Cut) piles to correct level
- Steel Reinforcement on top of piles
- Shutter Piles for Pile Cap
- Pour Concrete to Pile cap
- Concrete Curing
- Remove/Strike Shutters

**Swansea Waterfront Innovation
Centre WBS PAGE 3**

6.2. Phase 2 Piling Middle Structure

- Construct Piling Mats
- Mobilise Pile Rig
- Driven 24 no. Piles
- Install Reinforcement on Piles
- Concrete Pour on Piles
- Concrete Curing
- Crop (Cut) piles to correct level
- Steel Reinforcement on top of piles
- Shutter Piles for Pile Cap
- Pour Concrete to Pile cap
- Concrete Curing
- Remove/Strike Shutters

6.2. Phase 2 Piling South Side

- Construct Piling Mats
- Mobilise Pile Rig
- Driven 24 no. Piles
- Install Reinforcement on Piles
- Concrete Pour on Piles
- Concrete Curing
- Crop (Cut) piles to correct level
- Steel Reinforcement on top of piles
- Shutter Piles for Pile Cap
- Pour Concrete to Pile cap
- Concrete Curing
- Remove/Strike Shutters

**7.1.2 Steel Frame Installation Phase 2
Middle Section**

- Set Steel
- Framing

**7.1.3 Steel Frame Installation Phase 3
South Side**

- Set Steel
- Framing

7. Internal structure

- Perimeter Scaffold
- Pre-cast Stairs
- Internal Slabs

9. Superstructure

7.1. Steel Frame Construction

**7.1.1 Steel Frame Installation Phase 1
North Side**

- Set Steel
- Framing

8. Roof Installation

- Shutter Roof Beam and Fascia
- Installation of Roof Sheets

**Swansea Waterfront Innovation
Centre WBS PAGE 4**

11. Wall Cladding

- MEWPS & Scaffold Phase 1
- Wall cladding Phase 1 North
- MEWPS & Scaffold Phase 2
- Wall cladding Phase 2 Middle
- MEWPS & Scaffold Phase 3
- Wall cladding Phase 3 South

13. Finishes

- Window Panel Installation
- Door Installation
- Water Proofing
- Electrical Work i.e. sockets/lights etc
- Plumbing installation
- M&E work
- Carpentry Work
- Flooring All Levels
- Plastering All Levels
- Painting All Levels
- Staircase Handrails
- Ceiling Finishes

- General Cleaning
- First Fix Check
- Second Fix Check

12. Car Park and Road Construction

- Plant Mobilise Surfacing
- Install Binder Course 60mm
- Bond coat
- Install Surface Course 40mm
- Lining
- Studs

15. Monitoring & Performance Checks

- M&E Checks
- Quality Checks of Building
- Final Site Clean (External & internal)

10. Handover

- Health & Safety File Handover
- As Built Drawings
- Building Logbook
- Testing & commissioning data
- Certificates & Warranties
- BREEAM Handover
- Client Feedback

14. Use

- Post-occupancy evaluation
- Review Project Performance
- Research and development

A Gantt chart has been produced that shows the critical path above along with associated resources, costs, and durations for each given activity. It is shown in the accompanying document submitted.

Costs & Resources Report

The project has allowed us to generate a variety of different reports that can help to visualise the costs, time, and resources for the project as a whole and has focused on the individual substructure work of foundations. These reports are defined in detail below.

Resources Reports

Figure 1 shows the number of hours for the resources used for the whole project. The largest amount of man hours come from labour where there is upwards of 7000 hours for labourers and are the largest amount of resource. All other resource fall under 2000 hours with the next highest number being supervisors' hours, hours to install steel reinforcement, steel frame, and supervisor hours. Everything else falls under 1000 working hours. All work comes to a total of 11,385.15 hours.

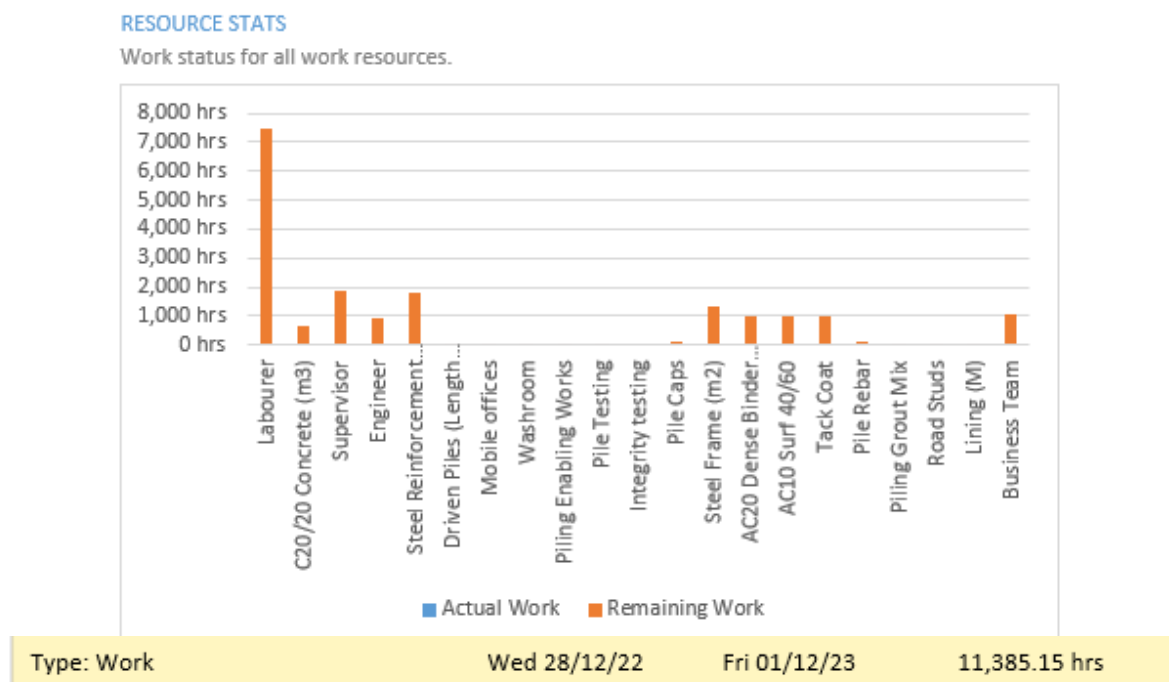


Figure 2 shows the work status for work resources between 20/03/22 and 30/05/22 specifically for our foundation work. This compared with the whole project still identifies the largest amount of resource coming from our labourers there should be careful consideration given in the planning stage to ensure that there is sufficient resource to cover this stage.

RESOURCE STATS

Work status for all work resources between 20/03/22 and 30/05/22

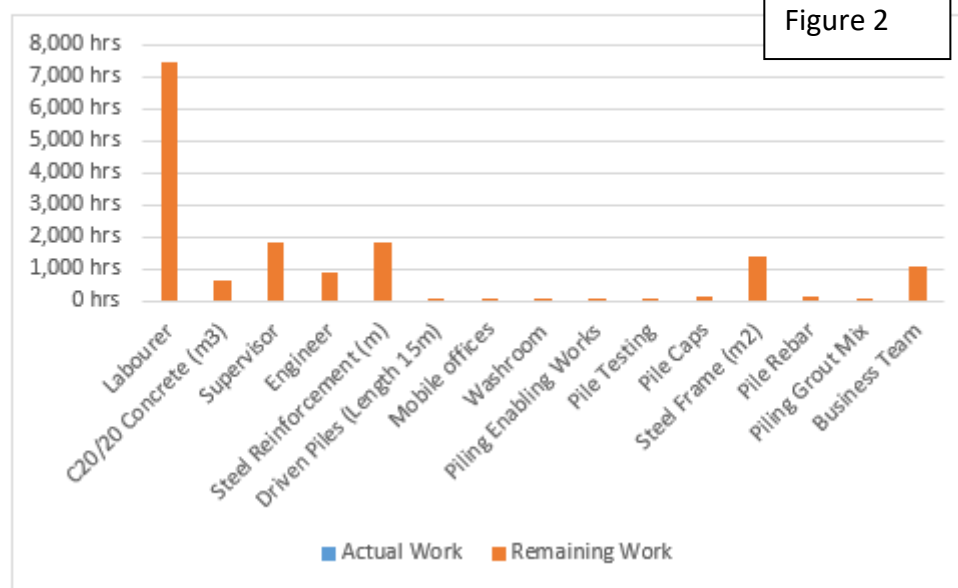


Figure 3 shows a breakdown in hours for the works resources in terms of hours in a more readable format for purely work resources and their duration.

RESOURCE STATUS

Remaining work for all work resources.

Figure 3

Name	Start	Finish	Remaining Work
Labourer	Mon 06/03/23	Wed 25/10/23	7,443.81 hrs
Supervisor	Mon 06/03/23	Mon 13/11/23	1,848 hrs
Engineer	Mon 13/02/23	Mon 04/09/23	909.33 hrs
Mobile offices	Thu 09/03/23	Thu 09/03/23	8 hrs
Washroom	Thu 09/03/23	Thu 09/03/23	8 hrs
Integrity testing	NA	NA	0 hrs
Pile Caps	Thu 04/05/23	Fri 26/05/23	104 hrs
Business Team	Wed 28/12/22	Fri 01/12/23	1,064 hrs

Figure 4 also highlights resources for materials and how much resource is required for the tasks and when they are required at start and finish points in the project. The largest amount of material is steel reinforcement, concrete (m³). It should be noted that although these are large in number it may not always correlate as the highest cost.

RESOURCE STATUS

Remaining work for all work resources.

Figure 4

Name	Start	Finish	Remaining Work
C20/20 Concrete (m3)	Wed 26/04/23	Fri 26/05/23	624 Concrete
Steel Reinforcement (m)	Tue 21/03/23	Wed 14/06/23	1,800 Steel
Driven Piles (Length 15m)	Mon 20/03/23	Fri 12/05/23	72 Steel
Piling Enabling Works	Thu 09/03/23	Thu 11/05/23	4
Pile Testing	Mon 20/03/23	Fri 12/05/23	3
Steel Frame (m2)	Tue 09/05/23	Wed 14/06/23	1,350
AC20 Dense Binder 40/60	Wed 30/08/23	Wed 30/08/23	1,000
AC10 Surf 40/60	Fri 01/09/23	Fri 01/09/23	1,000
Tack Coat	Thu 31/08/23	Thu 31/08/23	1,000
Pile Rebar	Tue 02/05/23	Mon 22/05/23	150
Piling Grout Mix	Thu 04/05/23	Fri 26/05/23	72
Road Studs	Mon 04/09/23	Mon 04/09/23	25
Lining (M)	Mon 04/09/23	Mon 04/09/23	50

Cost Resources

Figure 5 shows the cost resource for the project in its totality where figure 6 as a comparison shows the cost of the project only set at our specific task for the foundation work.

COST DISTRIBUTION

How costs are spread out amongst different resource types.

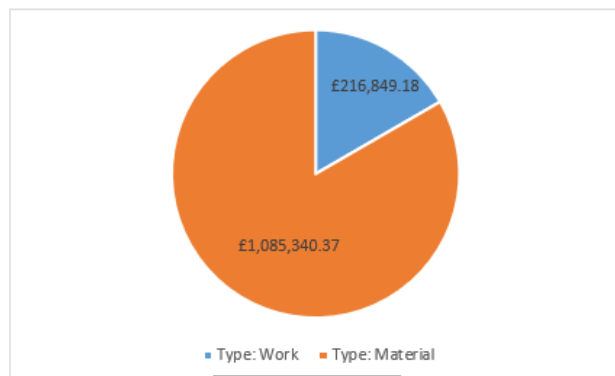


Figure 5

COST DISTRIBUTION

How costs are spread out amongst different resource types for the substructure work between date range 16.03.22 & 30.05.22.

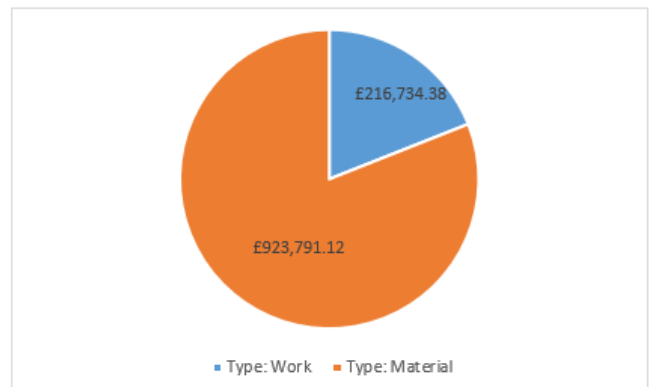


Figure 6

From this comparison we can see that the total cost of the project in totality vs for foundations is only £161,664.05, with the majority of cost variance coming from our work ours and not from materials.

Figure 7 shows the resource cost variance of the project where the largest costs are £484,896.96, for cashflow the following month this should be taken into consideration for the client when budgeting each month for the project to ensure security in cash flows, this can be seen in the readable format below the graph.

RESOURCE COST VARIANCE

Cost variance for all the work resources.

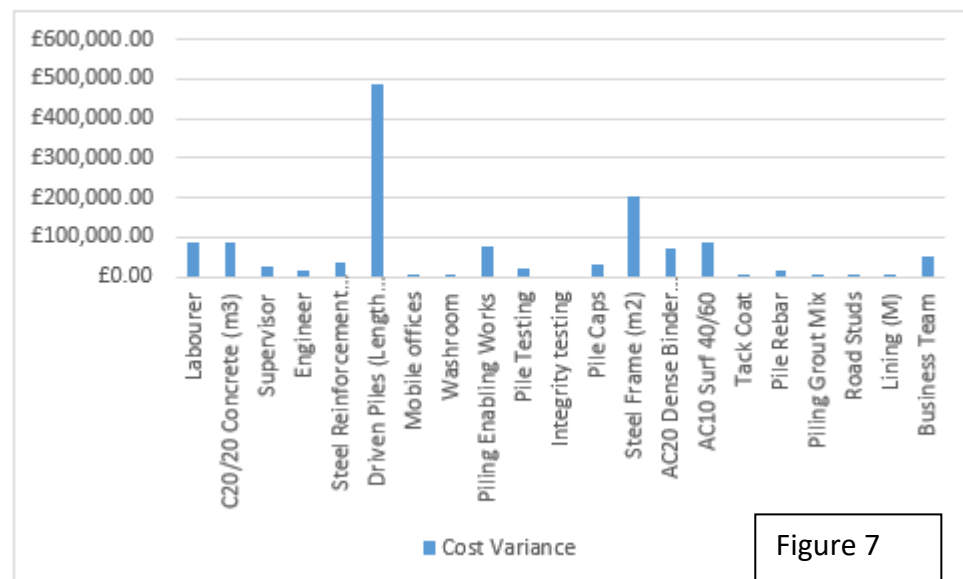
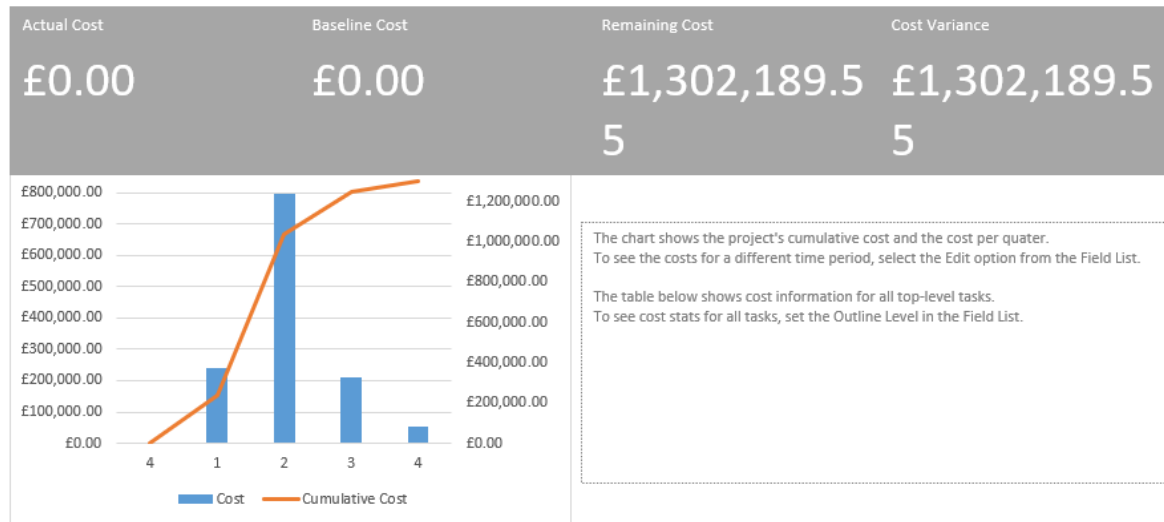


Figure 7

Name	Cost	Cost Variance
C20/20 Concrete (m3)	£84,789.12	£84,789.12
Steel Reinforcement (m)	£36,000.00	£36,000.00
Driven Piles (Length 15m)	£484,896.96	£484,896.96
Piling Enabling Works	£76,000.00	£76,000.00
Pile Testing	£23,700.00	£23,700.00
Steel Frame (m2)	£202,500.00	£202,500.00
AC20 Dense Binder 40/60	£73,540.00	£73,540.00
AC10 Surf 40/60	£87,580.00	£87,580.00
Tack Coat	£300.00	£300.00
Pile Rebar	£15,000.00	£15,000.00
Piling Grout Mix	£905.04	£905.04
Road Studs	£39.25	£39.25
Lining (M)	£90.00	£90.00

The below Figure (8) Shows the duration of the project where cost is shown per quarter in the bar chart and the overall cumulative cost as the orange line graph. The current cost is at £0 as the project has not commenced yet. The target remaining cost is at £1,302,189.50 with largest spend in quarter 2 of 2023 thus where our foundations are constructed.

Figure 8



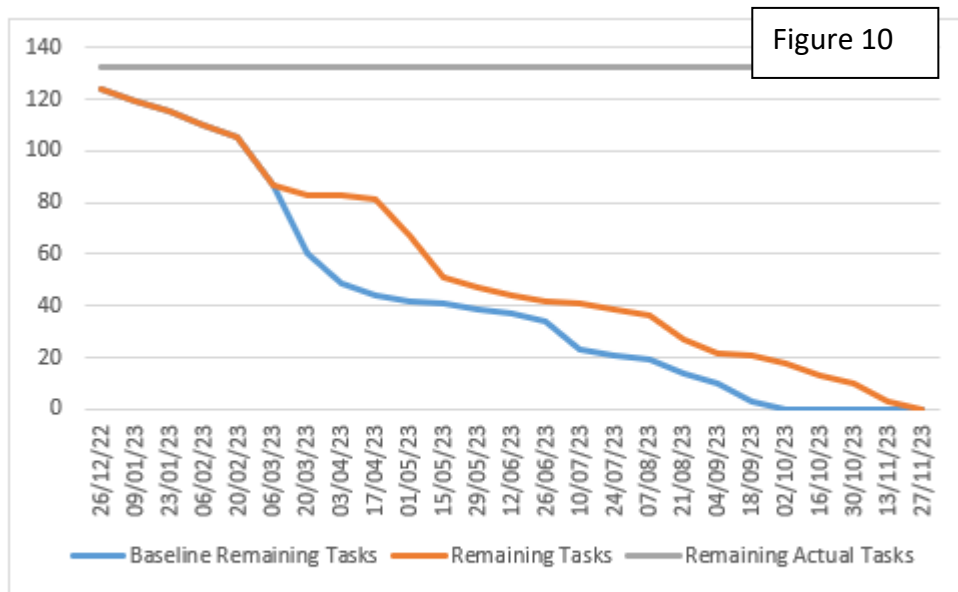
Finally figure 9 shows our resource list where the rates and allocated resources are indicated. This gives us a breakdown of exactly how much each of the resources individually are going to cost us along with some resources their cost per use. If additional resources are required further into our project, we can easily refer and calculate out if there are enough resources available and their associated cost

Figure 9

Resource Name	Type	Material	Initials	Group	Max.	Std. Rate	Ovt.	Cost/Use	Accrue	Base
Labourer	Work		LBR		25,000%	£12.00/hr	£0.00/hr	£0.00	Prorated	Standard
C20/20 Concrete (m3)	Material	Concrete	C			£135.88		£0.00	Prorated	Standard
Supervisor	Work		S		1,000%	£14.00/hr	£0.00/hr	£0.00	Prorated	Standard
Engineer	Work		E		1,000%	£20.00/hr	£0.00/hr	£0.00	Prorated	Standard
Steel Reinforcement (m)	Material	Steel	SR			£20.00		£0.00	Prorated	
Driven Piles (Length 15m)	Material	Steel	DP15			£6,734.68		£0.00	Prorated	
Mobile offices	Work		MO		100%	£502.00/wk	£0.00/hr	£0.00	Prorated	Standard
Washroom	Work		W		100%	£72.00/wk	£0.00/hr	£0.00	Prorated	Standard
Piling Enabling Works	Material		PEW			£19,000.00		£0.00	Prorated	
Pile Testing	Material		PT			£7,900.00		£0.00	Prorated	
Integrity testing	Work		I		100%	£0.00/hr	£0.00/hr	£16.00	Prorated	Standard
Pile Caps	Work		PC		1,000%	£0.00/hr	£0.00/hr	£1,675.00	Prorated	Standard
Steel Frame (m2)	Material		SF			£150.00		£0.00	Prorated	
AC20 Dense Binder 40/60	Material		AC20			£73.54		£0.00	Prorated	
AC10 Surf 40/60	Material		AC10			£87.58		£0.00	Prorated	
Tack Coat	Material		TC			£0.30		£0.00	Prorated	
Pile Rebar	Material		PR			£100.00		£0.00	Prorated	
Piling Grout Mix	Material		P			£12.57		£0.00	Prorated	
Road Studs	Material		RS			£1.57		£0.00	Prorated	
Lining (M)	Material		L			£1.80		£0.00	Prorated	
Business Team	Work		B		800%	£2,000.00/wk	£0.00/hr	£0.00	Prorated	Standard

Time/Duration Resource breakdown

Figure 10 shows the baseline tasks vs. remaining tasks over the duration of the project. It is noted that the two lines are on track until it has been noted that there will be a delay in concrete delivery on site due to a strike, this then causes a 6-week stop on all foundation works due to the concrete works being required until all other works can continue. However, through proper planning measures this has been reduced to only a 4-week delay in the project at the end where the original end date was 11/10/23 compared to the actual final date of 01/12/23 that will help save the contractor and client time and money.



TASK BURNDOWN

Shows how many tasks you have completed and how many you have left. If the remaining tasks line is steeper, then your project may be late.

The Project statistics in figure 11 shows the project start date at baseline from pre-construction works commencing 28/12/22 and finishing 11/10/23 (where on the ground construction begins 06th March 2023). However, due to delays in the project we have a new end date of 01/12/22 with a variance of 37 days.

The overall project still is budgeted at £1,302,189.55 but any changes in the project can easily be found in this section and gives a fast and readable overview of the project.

	Start	Finish
Current	Wed 28/12/22	Fri 01/12/23
Baseline	Wed 28/12/22	Wed 11/10/23
Actual	NA	NA
Variance	0d	37d

	Duration	Work	Cost
Current	243d	11,385.14h	£1,302,189.55
Baseline	206d	0h	£0.00
Actual	0d	0h	£0.00
Remaining	243d	11,385.14h	£1,302,189.55

Percent complete:

Duration: 0% Work: 0%

Close

Figure 11

How to address performance issues in productivity through incentivisation

Addressing performance issues in construction contracts can present the client several challenges throughout a project, these can include establishing an effective contract, controlling costs, managing contractor execution, managing relationship with the contractor and ensuring that the project is delivered on time (Bryde & Joby, 2007).

Each of these issues can be addressed in a variety of ways however not every method is applicable to each individual person or contractor and therefore needs to be managed effectively to ensure that all these performance issues are satisfied. To do this we need to incentivise both the contractor and they need to incentivise their workforce. The client typically tenders their work via outsourcing for both management and construction of the project itself (Hassanien and Losekoot, 2002).

Productivity can be defined as the efficiency for which resources such as labour, time and materials are utilised to produce a service in this instance our new building, in our construction project, productivity is typically measured on how much work is completed within a time frame (Green, B. 2016). Incentivisation in construction projects can be defined as the method to use a positive reinforcement via the use of bonuses, rewards or other intrinsic or extrinsic methods to encourage the smooth construction. Incentives are often used by clients and contractors alike to overall improve the productivity i.e., motivate the team to complete on-time, within budget and to a high level of quality.

Methods of Incentivisation (Project)

Contracts are a good method in which we can incentivise a project and the initial set-up strategy can help motivate a contractor to get this best out of them.

A 'lump sum' contract in this project has been disregarded as it is a construction project where the contractor bids for a fixed price for the entirety of the project regardless of the final cost of the work, this method is seen as better for the client as most of the risk is passed onto the contractor due to it providing a fixed price and any unforeseen issues or overruns are put onto the contractor. This may

lower the incentive for the contractor and result in sacrificing quality of workmanship and quality in the finished project (Designing Buildings, 2023). In addition, it can make changes or additions to the project during construction difficult to do once the contract has been formalised as additional funds may be required or bid for.

Therefore, this project will utilise a gain share method of incentivisation and a pain share method of contract. This will allow the risk to be shared as a split with the contractor and the client. It will allow the contractor to be motivated to maximise their efficiency and will share a profit if they complete ahead of the schedule and under budget with the client (Walsh, P. 2015). This also can work against the contractor and client where if they contractor exceeds the budget and the schedule then they will both have to manage the additional cost between them, but not all the risk is on the contractor like the fixed lump sum contractor and therefore can be more beneficial for both parties, improving communication and workmanship. We will use a gain share split of 50/50 between client and contractor, the pain share split will be 70(client)/30(contractor) so that if the project does come in over budget it is fair on both parties and will incentivise and increase productivity. This will align with our projects goals to complete within timeframe outlined in the CPM.

Individuals Incentivisation

An individual will be motivated in our project by incentivisation in a variety of ways and fall under two categories, extrinsic incentivisation and intrinsic incentivisation. Careful consideration should be used when choosing these methods as different individuals are motivated in different ways.

Extrinsic Methods

Extrinsic methods are referred to as 'rewards' and/or 'benefits' that are given to the group or individuals to motivate and encourage them to finish the construction project (Reiss, S, 2012). They are external to the individual such as bonuses, gifts, financial/material rewards, or other benefits (Rolette, G., 2020). Examples of these extrinsic incentives are listed below.

1. Financial
 - Bonuses, pay rises, profit-sharing; provide strong motivation for individuals to work harder and perform better.
2. Material
 - Gifts such as company cars, company phones, extra holiday allowance or any other gift that motivates an individual
3. Promotions
 - The better you perform the more likely you are to advance in your career, this can also give some individuals additional responsibilities
4. Time-based incentives

- Completing the project ahead of the time schedule and being rewarded for doing so in other forms
- 5. Quality-based
 - High levels of workmanship and meeting high quality standards can be rewarded in a variety of ways
- 6. Safety-based
 - Completing the project with a safe working environment where no accidents/injuries occur on site can be benefitted and overall creates a good working environment

It should be noted that extrinsic methods can be beneficial to a wide range of individuals however, to reach these goals some workers may end up cutting corners to reach their goals/rewards and we will use these accordingly within our project.

Intrinsic Methods

Intrinsic methods of incentivisation are regarded as the use of motivation internally that may aid in encouraging or inspiring an individual or group of peoples within a project (Reiss, S., 2012). They allow a sense of accomplishment, growth, and a sense of belonging to a team or organisation (indeed, 2023). Examples of these methods are listed below.

1. A Sense of accomplishment
 - An individual being satisfied that they have completed the set task giving them a 'sense of accomplishment'
2. A sense of belonging
 - Motivating someone to work as a team or group to work towards the overall team's goals
3. Growth
 - Personal growth through learning or development via career advancement etc.
4. Recognition
 - Being aware of an individual's contribution to the project and encouraging them and realising their work ethic can be a strong motivation or a simple thank you for their hard work
5. Independence
 - Allowing an individual to make their own decisions and taking ownership of their work can help realise that the project owner has faith that they will deliver to a high standard.

Over a longer period, intrinsic methods are more sustainable and can provide an individual with a good self-worth as they are not reliant on external factors such as funding or the state of the economy to facilitate ultimately, they realise an individual's internal values. We will use these accordingly within our project to get the most out of a workforce.

Project Delay

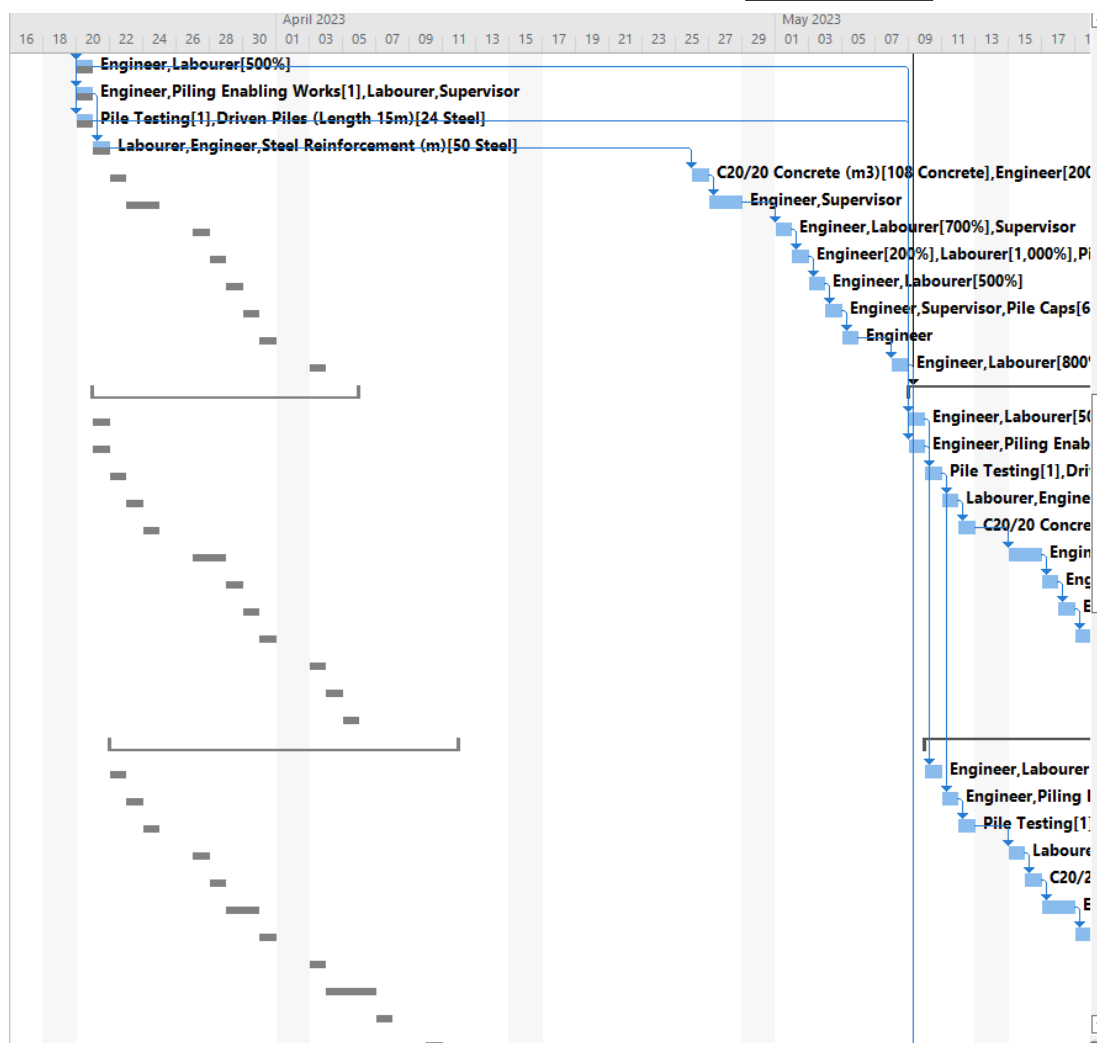
There is a delay in the project due to a local concrete company going on strike on the first day that we require concrete on site. This strike is to last 5 weeks total. This strike will have a significant impact on the overall delivery of the project.

From a contractual perspective we would consider it an “excusable delay” as it because of a third party causing it and not the contractor (Designing Buildings, 2023). We would request that there is an extension of time of 5 weeks to complete the work as a result if we cannot deliver within the original time outlined.

The delay has been factored into the Gantt chart with the original date for concrete pour on piles being “23.03.22” will now be delayed until “26.04.22” due to the nature of these works and the requirement for these foundation works be carried out before anything else on the project there is nothing that can be done to reduce the time until after this point.

Figure 12 shows the baseline in grey and the actual time delay as a result in blue that shows the time delay of 5 weeks on the project.

Figure 12



As a contractor we will endeavour to explore alternative sources of concrete with different suppliers by importing it from another location, however, it should be noted that this may cause an increased rate of concrete due to short notice, haulage distances and different rates of cost. The contractor has been made aware of this potential risk in the form of an Early Warning Notice (Klein, R. 2023) that instigates the notification of any changes within a project.

The overall project it's self will also be reviewed and will highlight any critical paths that can be undertaken while the strike is going ahead. All relevant stakeholders will also be informed of this delay along with the supply chain as soon as possible to ensure there are no further delays on the project. If there is additional compensation to be bid for because of additional costs these will be broken down and identified at earliest convenience. The project will therefore have a new completion date of 01.12.23 and a delay of 37 days to the project where 27 are working days.

To improve productivity within our project through this delay we will also explore alternative avenues to try and recoup some of our lost time. We will do this by offering overtime to the workforce to try and encourage additional work hours to re-coup some of the lost time and bring the programme back under control. We will also try and resource additional staff where safe and possible to do so to try and get activities back to baseline. We will try and group staff in areas in the finishes, the additional work force will reduce pressure on the current workforce and will prevent poor construction and potential defects down the line.

Conclusion

The project has utilised a variety of methods to show how the project will run and be completed. These have been identified in a critical path, Gantt charts and the resource reviews to help provide a clear direction from the contractor to the client for duration and monetary spend with delays accounted for. The critical path has enabled a logical and readable understanding of the projects planning, construction and handover steps to show the construction of the new building in SA1.

Figures 1-11 have given the client a clear representation and understanding of the project as a whole and how the work has been formalised with accurate resourcing, costs and time but is only indicative if the problem does not see any unforeseen such as the concrete delay which has been identified above and resulted in a 5 week delay on the project. Early warning of these changes is essential to the client, supply chain and stakeholder planning to ensure a smooth delivery of the project.

Finally, by putting in place a gain share contract all parties will be satisfied in the contractual element of the project, with their being a benefit for both client and contractor. Combining this with incentives for the workforce and the contractor will mean that all parties come away satisfied and the work being finished to a high quality and standard.

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