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SITE PRODUCTION & PROJECT MANAGEMENT CASE STUDY ASSIGNMENT

SITE PRODUCTION & PROJECT MANAGEMENT

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Project & Construction Management

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Abbreviations

PM: Project Manager	
QS: Quantity Surveyor	
SE: Structural Engineer	
UK: United Kingdom	
BS: British Standards.....	
CDM: Construction Design & Management.....	
EU: European Union	
JCT: Joint Contracts Tribunal	



1.0 Introduction

Barratt Homes LTD are executing a project where two symmetrical dwellings are to be constructed in Swansea's SA1 area. The project has been awarded on an JCT Design & Build contract basis. This method of procurement is when the main contractor is appointed to design and construct the works and can employ sub-contracts for certain works. The construction detail for the dwellings can be found on **appendix A.1**.

The client and the contractor have set a fixed price for the whole project. The price remains the same even if the total cost of the project is proven to be higher lower than the agreed amount. Meaning that it is highly important that the project is executed on time and professionally by the project manager and his in-house team of; building surveyors, quantity surveyors, structural engineers, civil engineers and architects. Construction of the project is due to commence on the 1st of April 2019. The properties are already purchased so the construction should be completed efficiently whilst maintaining a high standard of workmanship.

1.0.1 Project Managers Role

The duties of a project manager (PM) vary on the client's expertise and requirements. So, the action of the project manager will be dependent on the relationship with the client, but always there is the continuous duty of exercising control of project time, cost and performance. It is achieved through forward thinking and the provision of good information as the basis for decisions for both the project manager and the client. Some other PM responsibilities include;

- Putting together the budget and negotiate cost estimates,
- Arrange the work timetables,
- Choose the most efficient construction method and strategies,
- Stay in touch with the clients for work or budget related issues,
- Discuss about technical and contract details with workers and other professional parties,
- Keep an eye on the personnel in construction onsite,
- Cooperate with building and construction specialists,
- Ensure workers adhere strictly to health & safety requirements on site,
- Boost resources and make further acquisition of workforce and equipment if necessary,
- Efficient development of solid communication between the agents for resolving any conflicts that may arise.



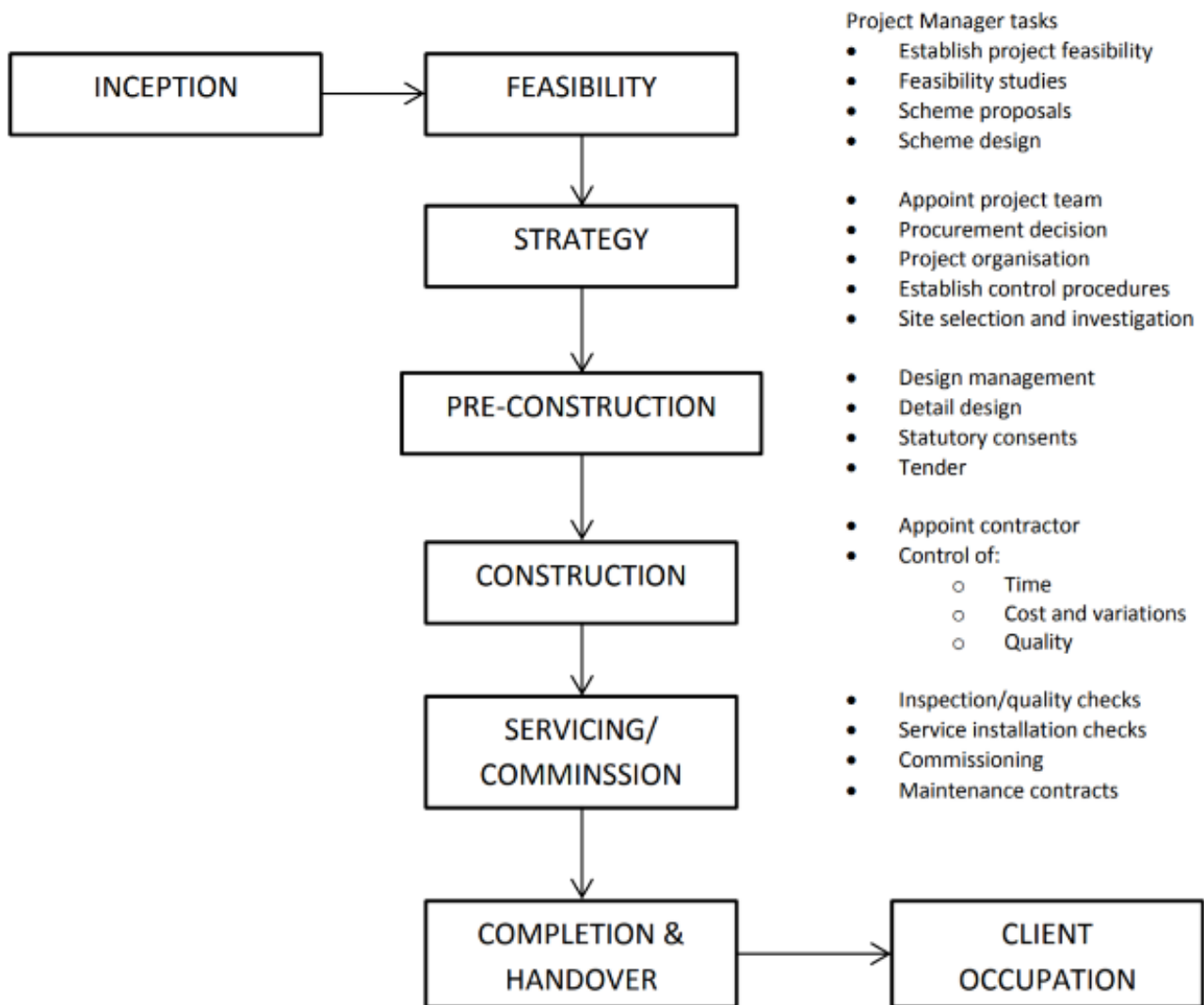


Figure 1: The above table highlights the project managers responsibilities from the feasibility stage right up to client occupation (Koutsogiannis, 2017)

1.1 Method of Project Delivery

The project manager will work in amalgamation with his in-house team in using the SPON's Price Book 2018. SPON's is an estimating book for the construction industry in the UK published by the Taylor & Frances Group.

"Compiled by AECOM, the Architects' and Builders' Price Book provides accurate and detailed price information covering building, mechanical and electrical services, civil engineering and landscaping. It can be used for a wide range of project sizes, and its Tender Index allows users to adjust for changing market conditions. It is described as the only price book available which sets out a detailed cost base for contracts that exceed £4 million in value." (designingbuildings.co.uk, 2018)

The book contains thousands of prices for the items that are most frequently specified by constructors, including labour constants and detailed build-ups. The book also gives guidance on typical gang build ups which can be used in cost and duration calculations. A gang is a group of people assembled together to carry out certain trades, generally



associated with building, in the execution of the tasks of a work. For example, groundworks, carpentry and formwork.

With the information provides by the SPON's price book, case studies and professional experience the project manager will solve the construction method, listing each construction stage in chronological order. He will then calculate the duration and cost of each stage to create a first cost estimate. This information will then be represented in the form of a Gantt chart and network diagram form where links between tasks can be identified. The critical path will be important to establish as well as the float for each construction task. Some key definitions for Gantt chat and network diagram creation are as follows;

- **Critical Path;** A critical path is determined by identifying the longest stretch of dependent activities and measuring the time required to complete them from start to finish.
- **Float;** In project management, float or slack is the amount of time that a task in a project network can be delayed without causing a delay to subsequent tasks "free float" and project completion date "total float"
- **Start-Start;** This is when two construction tasks start at the same time, the task cannot start before the predecessor starts.
- **End-Start;** This is when one construction task must end so another can begin.
- **Start-End;** This construction task cannot end before the predecessor starts.
- **End-End;** This construction task cannot end before the predecessor ends.

Gantt charts are useful for planning and scheduling projects. They help assess how long a project should take, determine the resources needed, and plan the order in which you'll complete tasks. They're also helpful for managing the dependencies between tasks. The number of workers of site at each time will also be calculated to ensure that disciplines are not in each other's way and effecting their productivity.

ASTA Powerproject in the industry leader in construction-based Gantt chart creation, it is easy to use and is designed to support the way construction planners work and has evolved over many years with input from construction companies to meet the requirements of the industry. It is therefore advised that the project manager use this software for the construction task.

1.1 Pre-construction

The *Construction (Design and Management) Regulations 2015* require that construction clients provide pre-construction information as soon as is practicable to every designer and contractor appointed, or being considered for appointment, to the project. Next, construction drawings must be sent to the local authority as an application in the attempt to gain planning permission for the impending construction works. Once this permission has be gained the PM can begin to plan the construction process and begin tendering and contracting.

1.2 Identification of Construction Tasks

Using a recent project completed by Morganstone LTD in constructing 4 detached timber framed dwellings at Laburnham Drive, Newport. The type of construction found here is very similar to the construction detail for this impending construction, see **appendix A.7**. The



project manager can use this as precedent as to what can be adopted for his own development. It will also be a useful guideline to measure against when assessing costs and profit margins.

1.2.1 Construction Tasks & Prices for Measured Works

The project manager has decided that the tasks 1–17 be followed in the order found in **figure 2**. Their prices for measured works are also given, these were obtained from the SPON's Price Book 2018. Definitions for the measured works are as follows;

Prime Cost (PC) £ - This is the actual price of materials such as concrete, bricks, timber, tiles as sold by suppliers.

Labour Hours – This figure is the unit of work that represents the productive effort of one person in one hour.

Labour £ - This figure is calculated from the gang wage rate as defined in **figure 4** as well as their working hours to complete the task.

Plant £ - This figure defines the use of machinery if applicable to the task. Machinery included can include excavators for trenches and crane & ball plant for demolition.

Material £ - This price includes the cost of any additional materials such as nails and screw, which may be needed in association for the task at hand.

Unit – The unit is the unit of measurement of what each task costs, for example to dig a $1m^2$ trench would be £8.47. Other units include m^3 , tonne, metre, nr and litre.

Total Cost (£ / unit) – The total cost considers all the above cost influences and calculates a final average cost per unit. For example, it will cost £15.23 / metre to implement 100mm x 200mm timber floor members.

All definitions taken from SPON's Architects and Builders Price Book, 2018.

Figure 2: Construction tasks & prices for measured works								
	Activity	PC £	Labour Hours	Labour £	Plant £	Material £	Unit	Total Cost (£ / unit)
1	<i>Demolition (Page 215)</i> Demolishing by machine to ground level a single storey brick structure of approximately 200m ³ .	-	8.2	15.11	12.75	-	m^3	48.63
2	<i>Excavation & Filling (Pages 230 -236)</i> <u>Excavating by machine;</u> Trenches 0.30m wide with a maximum depth	-	0.33	4.46	4.01	-	m^3	8.47



	not exceeding 2.00m. <u>Additional excavation by hand:</u> Pits 0.3m wide not exceeding 0.25 in depth. <u>Filling to make up levels on site:</u> By machine average thickness exceeding 500mm.	-	2.13	28.82	-	-	m ³	28.82
		-	1.02	13.81	3.42	-	m ³	17.23
3	Foundations (Page 253) Reinforced in-situ ready mixed designated concrete 30N foundations.	96.42	1.02	16.26	-	106.30	m ³	122.56
4	Sawn Softwood Framing & Timber Trusses (Pages 325 – 327) <u>Floor members:</u> 100mm x 200mm <u>Wall & Partition members:</u> 100mm x 100mm <u>Joist herringbone strutting:</u> 47mm x 50mm, depth 200mm <u>Roof members pitched:</u> 75mm x 100 mm	-	0.21	450	-	10.73	m	15.23
		-	0.19	4.07	-	5.85	m	9.92
		-	0.46	9.86	-	2.95	m	12.81
		-	0.23	4.92	-	5.21	m	10.13
5	Brick & Block Walls (Pages 276 – 314) <u>Basic motor prices:</u> ▪ Cement ▪ Sand							
						119.30	1t	119.30
						24.54	1t	24.54
						159.60	1t	159.60



	▪ Lime ▪ White Cement ▪ Plasticizer <u>Supply of bricks:</u> ▪ Brown rustic Prime cost for brick walls, 1 brick thick <u>Block walling:</u> <u>Page 298</u> 100mm Thick <u>Damp proof course:</u> 100mm width exceeding horizontal in brick or block course <u>Lintels: plate, prestressed, bedded:</u> 100mm x 70mm x 900mm long					199.50 6.73 413.30 54.28 16.88 0.09 9.30	1t Litre 1000 m^2 m^2 m nr	199.50 6.73 413.30 82.57 25.16 0.29 16.71
6	Roof Coverings (Pages 348 – 375) <u>2-layer polyester roof covering:</u> 400mm x 600mm girth <u>Lead flashing:</u> 600mm girth <u>Tiles</u> Concrete plain tiles; BS EN 490. 267mm x 165mm (PC £ per 1000)	- - 400.5	1.0 1.20 4.21	12.19 26.50 14.63	- - -	7.74 25.80 420.52	m m 1000	19.93 52.30 420.52
7	Windows & Doors (Pages 438 – 450) <u>Standard windows:</u>							



	1200mm x 750mm; Ref LEW207C	90.3	1.06	22.72	-	129.99	nr	152.71
	<u>External doors;</u>							
	762mm x 1981mm x 44mm	64.32	0.75	16.08	-	67.71	nr	83.79
	<u>Internal doors;</u>							
	686mm x 762mm x 838 door with lining	14.73	0.70	15.00	-	15.65	nr	30.65
8	Staircase (Page 484)							
	<u>Standard staircase, wrought softwood;</u>							
	Straight flight 838mm wide; 2676mm going; 2600mm rise with 2 newel posts	-	6.48	138.87	-	389.70	nr	528.57
9	Wall & Ceiling Finishes (Pages 516 – 517)							
	<u>Plastered & rendered walls;</u>							
	3mm thick work to walls; one coat plaster skim; to plaster base over 600mm wide	-	0.25	5.85	-	0.06	m ²	5.91
	<u>Plastered & rendered ceilings;</u>							
	3mm thick work to ceiling; one coat plaster skim; to plaster base over 600mm wide	-	0.25	5.85	-	0.06	m ²	5.91
10	Sanitary Fittings (Pages 555 – 559)							
	Sink;	126.6	2.13	47.03	-	183.43	nr	230.46
	Bath;	187.8	3.50	77.29	-	197.23	nr	274.52
	Shower tray & fittings;	361.5	5.00	110.41	-	379.59	nr	490.00
11	Kitchen Installation (Pages 553 – 554)							



	<u>Floor units;</u> 500mm x 300mm x 720mm	120.0	1.16	19.34	-	126.15	nr	123.66
	<u>Wall units;</u> 500mm x 600mm x 870mm	175.0	1.16	19.34	-	183.90	nr	203.24
	<u>Sink & unit;</u>	275.0	4.16	24.68	-	288.90	nr	313.58
12	Water Installations (Page 623) <u>Service Runs;</u> Water main; all laid in trenches including excavation and backfill. MDPE pipe; 50mm diameter.	-	2.85	36.73	9.93	66.63	m	112.68
13	Electrical Installations (Page 619) <u>Lighting points;</u> <u>Socket outlet points;</u>	- -	0.28 0.46	4.76 8.17	- -	- -	nr nr	4.76 8.17
14	Floor Finishes (Page 495 – 509) <u>Screed;</u> Cement and sand (1:3) screed; steel towelled, 50mm thick <u>Fitted Carpet;</u> Forbo flooring 2.0m wide roll <u>Skirting;</u> 150mm high; ref SI150	- 22.00 -	0.52 0.45 0.22	12.16 9.64 5.15	0.38 - -	1.84 25.00 3.84	m ² m ² m	14.38 34.64 8.99
15	Furniture Finishes (Pages 548 – 551) <u>Internal blinds;</u> Roller 1016mm wide	7.93	0.93	12.48	-	50.33	nr	62.81



	<u>Shelves:</u> 25mm x 50mm x 800mm	-	0.22	12.48	-	14.75	nr	18.65
16	External Drainage (Page 574) <u>Channel and grate system:</u> S100 F900	-	1.00	13.43	-	162.07	m	175.50
17	Landscaping (Pages 614 – 617) <u>Turfing:</u> Cultivated grass <u>Planting:</u> Hedge plants <u>Fencing:</u> Timber 900mm x 2.5m	2.39 - -	0.10 0.56 2.30	1.35 7.58 -	- - -	2.15 - -	m ² nr nr	3.86 7.58 14.33

1.2.2 Project Characteristics Obtained from Planning Detail

When assigning roles and costs to the project, the drawing details must first be consulted for clarity on what gangs are required and what workload they should expect. From the drawing details, the project manager has highlighted the following characteristics of the planned dwellings;

Figure 3: Important Planning Detail		
Feature	Quantity (Per Dwelling)	Unit (m²)
Floorspace	-	100m ² each
Roof Area	-	125m ² overall
Garden	-	150m ² each
Total Building circumference	-	80m
Wall Height	-	6m
Kitchen	2 (1)	nr
Windows	18 (9)	nr
External Doors	4 (2)	nr
Internal Doors	26 (13)	nr
Bathrooms	2 (1)	nr
Plumbing Systems	2 (1)	nr
Electrical Services	2 (1)	nr
Special Installations	2 (1)	nr

The project drawing details can be found on **appendix 1.A**.



1.3 Calculations & First Estimation

This section will calculate the total cost of the construction activities, their total duration and the weekly expenditure and daily labourer attendance.

1.3.1 Labour Rate Calculations

The following typical gang build-up and their associated labour rates are a useful resource for the project manager to consult when assigning labour to construction tasks. This resource is essential for the project manager to control the duration of works by adding/subtracting laborers, this also gives the PM more power over cost control. Labour rates have already been worked out by the Spon's book, but the calculation is as follows;

$$\text{Labour Rate} = \frac{\text{Typical Gang Cost}}{\text{Total Productive Working Hours}}$$

Figure 4: Typical Gang Build-up for Measured Works				
Typical Gang Build-up	Rate £/hour	Unit Rate £/hour	Productive Hours	Labour Rate £/hour
Groundwork Gang 1 Ganger 6 Labourers	12.79 11.83	12.97 70.99 83.78	/ 6.5 =	12.89
Concreting Gang 1 Foreman 4 Skilled Labourers	16.84 12.79	16.84 51.16 68.00	/ 4.5 =	15.11
Steel Fixing Gang 1 Foreman 4 Steel Fixers	16.84 15.88	16.84 63.53 80.37	/4.5 =	17.86
Formwork Gang 1 Foreman 10 Carpenters 1 Labourer	16.84 15.88 11.83	16.84 158.83 11.83 187.50	/ 10.5 =	17.86
Bricklaying / Blockwork Gang 1 Foreman 6 Bricklayers 1 Labourer	16.84 15.88 11.83	16.84 95.30 11.83 123.97	/ 6.5 =	19.07
Carpentry / Joinery Gang 1 Foreman 5 Carpenters 1 Labourer	16.84 15.88 11.83	16.84 79.41 11.83 108.09	/ 5.5 =	19.65
Painter, Slater, etc. 1 Craft Operative	15.88	15.88		



		15.88	/ 1 =	15.88
2 and 1 Gang				
2 Craft Operatives	15.88	31.77		
1 Skilled Labourer	12.78	12.79		
		44.56	/ 2 =	22.28
Small Labouring Gang				
1 Foreman	16.84	16.84		
4 Skilled Labourers	12.79	51.16		
		68.00	/ 4.5 =	15.11
Drain Laying Gang / Clayware				
2 Skilled Labourers	12.79	25.58		
		25.58	/ 2 =	12.79

Typical gang build-up and labour rate calculations. (SPONS's 2018, Page 51)

1.3.2 Cost & Duration Calculations

Using the following equations, the project manager will proceed to calculate the duration of the works as well as the total cost for each, producing a final estimate.

$$\text{Production Rate} = \frac{\text{Quantity of Work Produced}}{\text{Time Duration}}$$

$$\text{Labour Hours} = \frac{\text{Total Labour Hours of Gang}}{\text{Daily Output}}$$

$$\text{Weighted Wage Rate} = \frac{\text{Total Labour Cost}}{\text{Number of Labourers}}$$

$$\text{Labour Unit Cost} = \frac{\text{Weighted Wage Rate} \times \text{Total Labour Hours}}{\text{Daily Output}}$$

Finally, the PM will calculate the total cost and total works duration. The calculations for the first construction task, demolition are as follows;

1) Demolition

Activity	Equation	Total
Demolishing by machine to ground level a single storey brick structure of approximately 200m ³	200m ³ (Unit) x £48.63 (Total Cost - £ / Unit)	= £9,726
Total: £9,726		



$$\text{Works Duration} = \frac{\text{Labour Hours (8.2)} \times \text{Demolition (200)}}{\text{Small Labouring Gang (5)}} = 8.8 \text{ Days}$$

The complete cost and duration calculations for the 17 construction tasks can be found on **appendix A.2**. The final calculations of the tasks are shown below:

Figure 5: Construction Tasks 1–17 Total Cost, Daily Cost & Duration					
No.	Activity	No. of Labourers	Duration	Estimated Cost £	Daily Cost £
1	Demolition	5	9 Days	/ £9,726.00	= £1,080.60
2	Excavation & Filling	7	2 Days	/ £1,773.90	= £886.95
3	Foundations	5	4 Days	/ £9,788.80	= £2447.20
4	Sawn Softwood Framing & Timber Trusses	12	5 Days	/ £7,103.75	= £1,420.75
5	Brick & Block Walls	7	11 Days	/ £21,998.62	= £1,999.87
6	Roof Coverings	12	3 Days	/ £6,890.81	= £2,296.94
7	Window & Door Installations	5	3 Days	/ £3,880.84	= £3,882.14
8	Staircase Installations	3	2 Days	/ £1,057.14	= £528.57
9	Wall & Ceiling Finishes	7	4 Days	/ £744.66	= £186.17
10	Sanitary Fittings	3	1 Week	/ £1,989.96	= £284.28
11	Kitchen Installations	3	1 Week	/ £1,280.96	= £182.99
12	Water Installations	2	5 Days	/ £2,253.60	= £450.72
13	Electrical Installations	5	4 Days	/ £4,696.50	= £1,174.13
14	Floor Finishes	12	1 Week	/ £6,700.00	= £957.14
15	Furniture Finishes	5	2 Days	/ £1,503.58	= £751.79
16	External Drainage	4	3 Days	/ £14,040.00	= £4,680.00
17	Landscaping	15	1 Week	/ £2,894.20	= £413.46
Total;			85 Days	£98,323.32	

Figure 5 shows each construction tasks duration, number of laborers. Cost of each activity and daily cost of conducting that activity. Using this table and the project Gantt chart found on **appendix A.3** a weekly estimated cost and weekly number of laborers on site per week can be calculated. These constraints are shown in the below table **figure 6**:

Figure 6: Project Weeks 1 - 12 Weekly Cost & Labourer Attendance					
Wk .	Construction Activities	Weekly Labourers	Duration	Calculation	Weekly Cost
1	▪ Demolition	5	5 Days	x £1,080.60	Σ = £5,403.00
2	▪ Demolition ▪ Excavation & Filling ▪ Foundations	5 7 5 = 17	4 Days 1 Day 1 Day	x £1,080.60 x £886.95 x £2447.20	Σ = £7,656.55
3	▪ Excavation & Filling ▪ Foundations	7 5 = 12	1 Day 3 Days	x £886.95 x £2447.20	Σ = £8,228.55
4	▪ Sawn Softwood	12	5 Days	x £1,420.75	Σ = £7,103.75



	Framing & Timber Trusses				
5	▪ Brick & Block Walls	7	5 Days	x £1,999.87	Σ = £9,999.35
6	▪ Brick & Block Walls	7	5 Days	x £1,999.87	£14,593.23
	▪ Roof Coverings	12 = 19	2 Days	x £2,296.94	
7	▪ Brick & Block Walls	7	2 Days	x £1,999.87	Σ = £18,471.66
	▪ Roof Coverings	12	1 Day	x £2,296.94	
	▪ Window & Door Installations	5	3 Days	x £3,882.14	
	▪ Staircase Installation	3 = 27	2 Days	x £528.57	
8	▪ Wall & Ceiling Finishes	7	4 Days	x £186.17	Σ = £2,129.96
	▪ Sanitary Fittings	3	2 Days	x £284.28	
	▪ Kitchen Installations	3	2 Days	x £182.99	
	▪ Water Installations	2 = 15	1 Day	x £450.72	
9	▪ Sanitary Fittings	3	5 Days	x £284.28	Σ = £4,139.23
	▪ Kitchen Installations	3	5 Days	x £182.99	
	▪ Water Installations	2 = 8	4 Days	x £450.72	
10	▪ Electrical Installations	5	4 Days	x £1,174.13	Σ = £10,333.66
	▪ Floor Finishes	12	1 Day	x £957.14	
	▪ External Drainage	4 = 21	1 Day	x £4,680.00	
11	▪ Floor Finishes	12	5 Days	x £957.14	Σ = £16,891.66
	▪ Furniture Finishes	5	2 Days	x £751.79	
	▪ External Drainage	4	2 Days	x £4,680.00	
	▪ Landscaping	15 = 34	3 Days	x £413.46	
12	▪ Floor Finishes	12	1 Day	x £957.14	Σ = £2,610.98
	▪ Landscaping	15 = 27	4 Days	x £413.46	



See also **appendix A.8** for a weekly cost x weekly labourers comparison graph.

1.4 Construction Programme and Total Duration of Works

1.4.1 Cost Forecast and Total Project Budget

Four basic parameters that a project manager should keep in mind when cost forecasting and project budgeting;

1. Analysis of the project: The first action that has to be taken is the clarification of the different objectives and limitations for the upcoming project. Once you do that, you can have a better idea of what you want to achieve and who exactly do you need in order to do it.

2. Estimation of the budget: After having put all the priorities of your project in order, it's time to organize your budget in conjunction with a solid timeline. Now it's also a good time to ask for bids from interested contractors.

3. Monitoring of the cost: As soon as the construction project put in work, it's very essential to start keeping an eye on project costs. The sooner you start doing this the better, since it will allow you to detect any potential misuses of resources before it's too late.

4. Accounting: Having a highly competent accounting department is vital. In collaboration with the project team, they will be responsible for keeping all the financial agreements running according to plan.

1.4.2 Gantt Chart & Cost Charts

It is without doubt one of the most practical systems that a project team can have at its disposal. A Gantt chart can offer you an overview of a construction project and let you know about tasks that are left behind or being completed on time. Critical Paths and task flexibility and colour/line/labelling of tasks. See also in the appendix;

- Gantt chart (**See appendix A.3**)
- Gantt chart with monthly costs (**See appendix A.4**)

The critical path of the construction project can be clearly seen highlighted in red. The float of those not on the critical path can also be clearly defined. According to the Gantt chart, the most labourers will be on site on in week 11 where there will be 34 labourers on site at once. The Gantt chart with monthly costs shows that during the first month of construction £27,800 will be spent, and then £17,635, £29,834 and £23,054 in the months following.

- Cost bar chart (**See appendix A.5**)

The cost bar chart shows that the most expensive construction task is the brick & block walls activity that costs £21,998.62. The pie chart on **appendix A.6** supports this fact by scheduling it as the longest activity in duration at 11 days.



- Network diagram (**See appendix A.7**)

The network diagram works as the first two values are the same as well as the last. It also supports the float values of each applicable task and defines them as;

- Roof Coverings (3 Days)
- Staircase Installation (5 Days)
- Floor Finishes (2 Days)
- Furniture Finishes (2 Days)

1.4.3 Project Progress

The project manager can track the progress of labourers on site by using the productivity formula shown below. This is useful to quantity surveyors in the PM's in-house team when completing payments.

$$\text{Construction Productivity} = \frac{\text{Quantity of Work Produced}}{\text{Time Duration}}$$

This result can also then be cross referenced to the SPON's book to compare the actual productivity with that projected in the literature.

1.5 Legislation & Legal Aspect

Figure 7: Construction Tasks 1 – 17 Building Legislation		
No.	Activity	Building Regulations & Legislation
1	Demolition	Demolition is dealt with under the Building Act 1984 .
2	Excavation & Filling	If the excavation runs alongside an existing footing then care will be needed - for example, by excavating and concreting the foundation in shorter sections to avoid undermining a whole length of an adjacent structure (see also guidance on the Party Wall Act 1996).
3	Foundations	Building Regulations Approved Document A: Structure
4	Sawn Softwood Framing & Timber Trusses	Building Regulations Approved Document A: Structure
5	Brick & Block Walls	Building Regulations Approved Document C .
6	Roof Coverings	Building Regulations Approved Document A: Structure
7	Window & Door Installations	Safety Glazing - Approved Document K Thermal heat loss - Approved Document L-1B, Table 1 .
8	Staircase Installations	Building Regulations Approved Document K : Protection from falling, collision and impact
9	Wall & Ceiling Finishes	Building Regulations Approved Document A: Structure
10	Sanitary Fittings	The Water Supply (Water Fittings) Regulations 1999 (England and Wales)
11	Kitchen Installations	Current building regulations require all kitchens to have "adequate air extraction"
12	Water Installations	The Water Supply (Water Fittings) Regulations 1999 (England and Wales)



13	Electrical Installations	<i>Electricity at Work Regulations 1989 & BS 7671 (IET Wiring Regulations)</i>
14	Floor Finishes	Building Regulations <i>Approved Document A: Structure</i>
15	Furniture Finishes	N/A
16	External Drainage	Building Regulations <i>Approved Document H - Drainage and Waste Disposal</i>
17	Landscaping	N/A

Important legal aspects of any construction project;

1. The parties: This refers to anyone who is involved in the construction project (contractors, consultants, sub-contractors, purchaser etc.)

2. Contracts: Even though there are certain fixed contract forms for construction projects, many times there is a need for changes in the agreements so legal advice is more than necessary.

3. Legislation & Regulation: A solid legal team can make sure that all the different legislations and regulations are followed properly.

4. Procurement: The procurement process refers to the purchase of all the different materials and services that are necessary for a construction project. It is crucial, then, that the whole project is thoroughly regulated from a legal aspect.

5. Insurance: A project manager should have been informed and taken care of every little detail concerning the insurance agreements.

1.6 Results & Discussion

When comparing the estimated total cost of this project with the Monganstone LTD Laburnham Drive, Newport development (*see appendix A.7*) it is apparent that this project is competitively priced. This project has been estimated to cost **£98,323.32** whereas the case study development was awarded on an **£120,000** contract. In addition to this, the proposed project is estimated to take 11 weeks and 4 days, the case studies development was constructed from demolition to snag & clean in 4 months. This cross referencing suggests that's the PM's duration calculations are accurate to this type of construction.

1.6.1 Project Managers Limitations

The project manager encountered limitations in creating this outlined schedule of works and budget estimate. First of all, the project manager was limited to using an out-dated SPON's 2018 book whereas an updated 2019 version is available for purchase. This means that the project manager's labour hours and total costs for measured works may be imprecise.

Also, the SPON's book is only a guide of what measured works may cost. Variations that are not included within the book that can influence prices and project duration include;

- Exchange Rates,



- Brexit,
- Construction material availability,
- Plant hire availability,
- Skilled labour availability.

The Gantt chart and cost charts produced also cannot predict adverse weather conditions, holidays taken by employees and the possibility of project setbacks such as finding archaeology or sewer mains below ground. The Gantt chart could be corrected as the project matures but unless the activities with float are affected, the project will overrun and cost the client and employer money.

The total project cost estimate also excludes fixed costs such as, PM, quantity surveyor (QS), structural engineer (SE) and architect's fees and the cost of land acquirement, site preparation, site layout, consultancy fees and planning permission fees. With these parameter's included, the project will likely rise to a similar price to that of the Laburnham Drive, Newport development.



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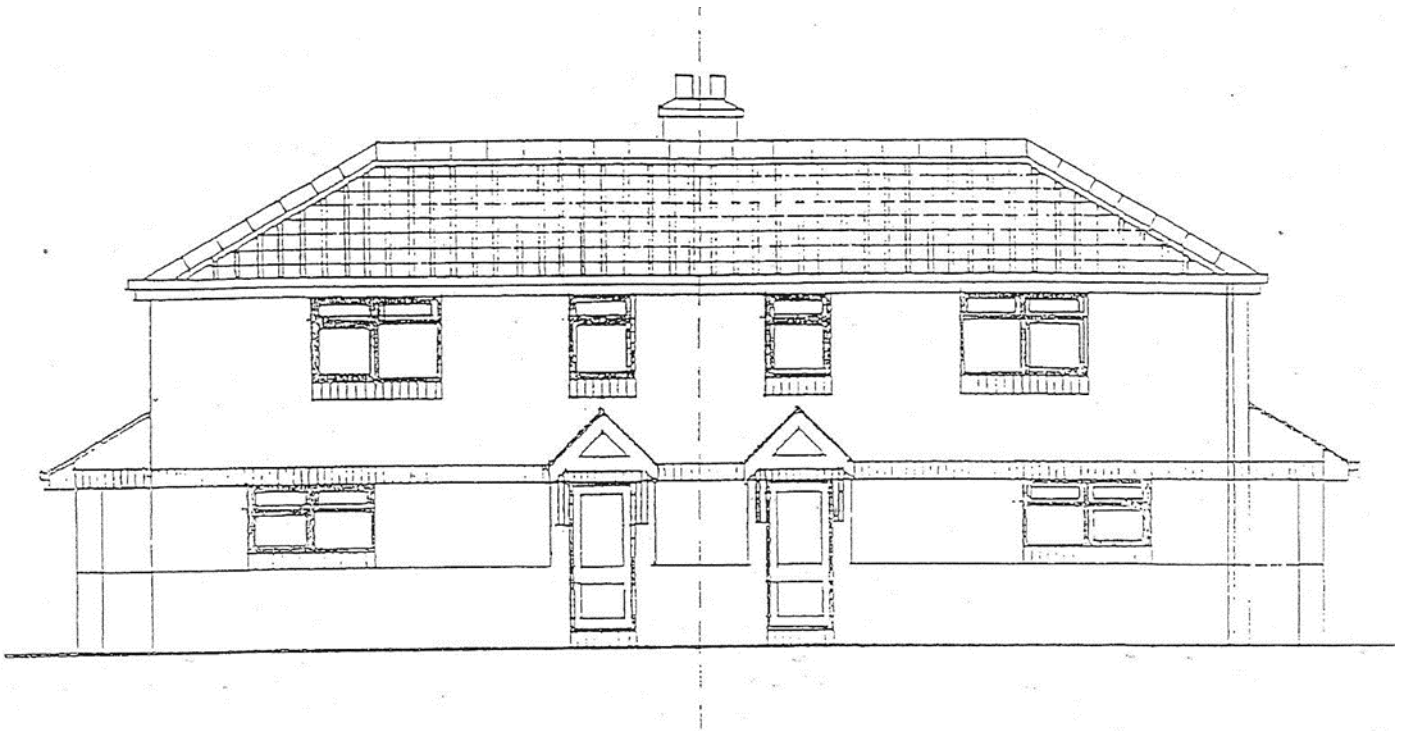
SPON's Architects and Builders Price Book (2018) (144 vols). Taylor & Francis, p. 215, 230 - 236, 253, 276 - 314, 325 - 327, 346 - 375, 438 - 450, 484, 495 - 509, 516 - 517, 548 - 551, 553 - 554, 555 - 559, 574, 614 - 617, 619, 623 .



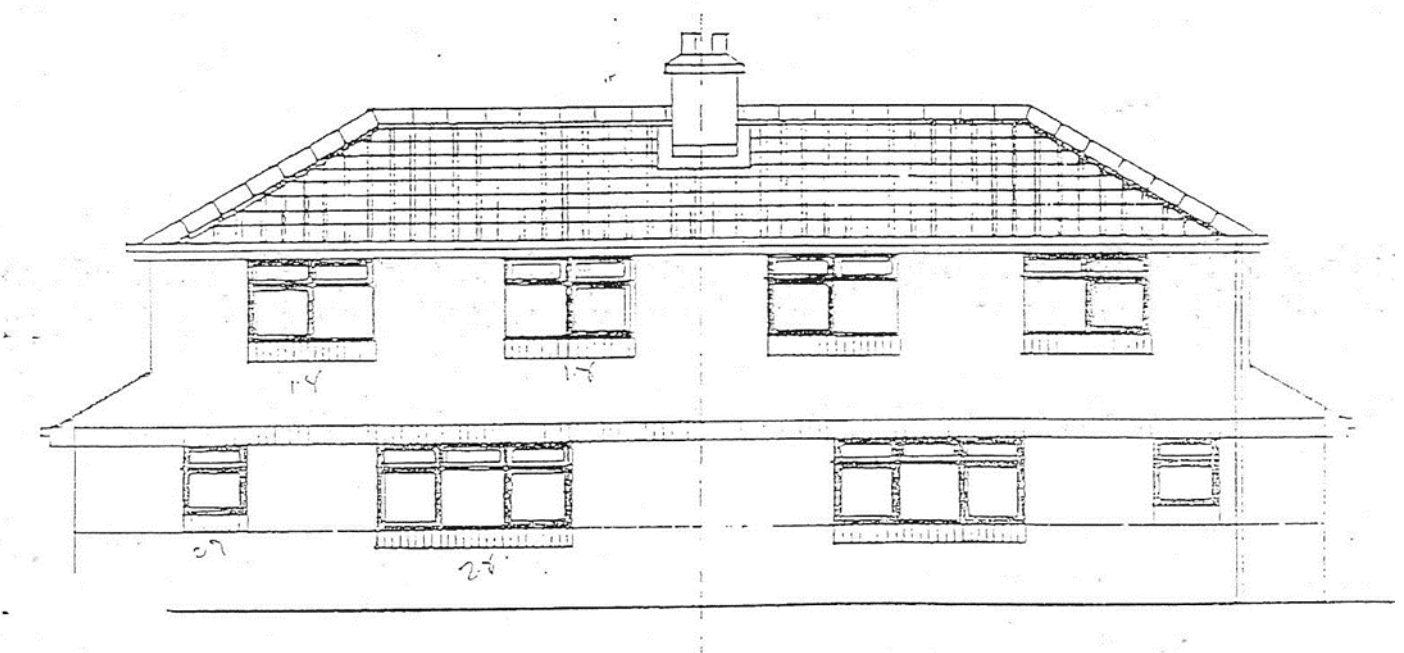
Appendices

Appendix A.1: Construction details.

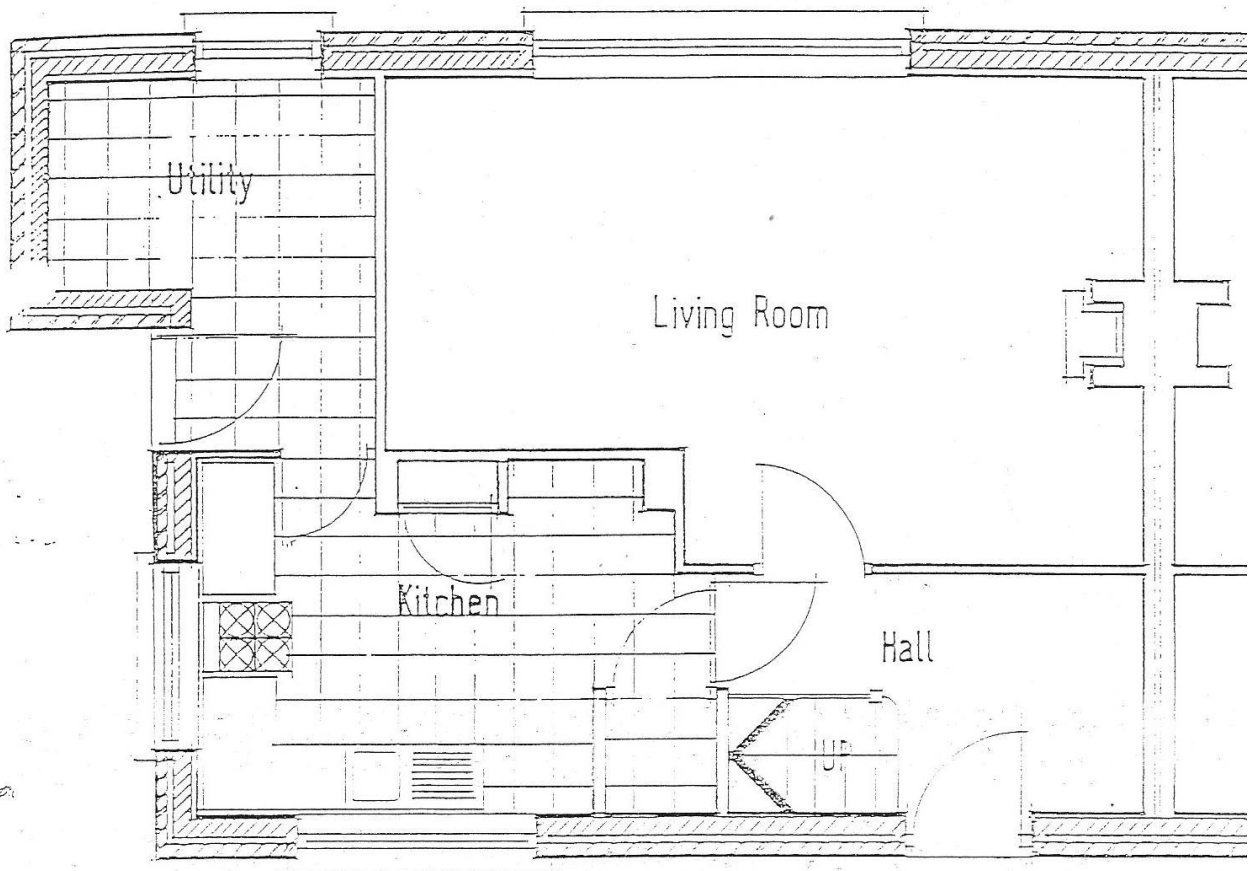
Front Elevation



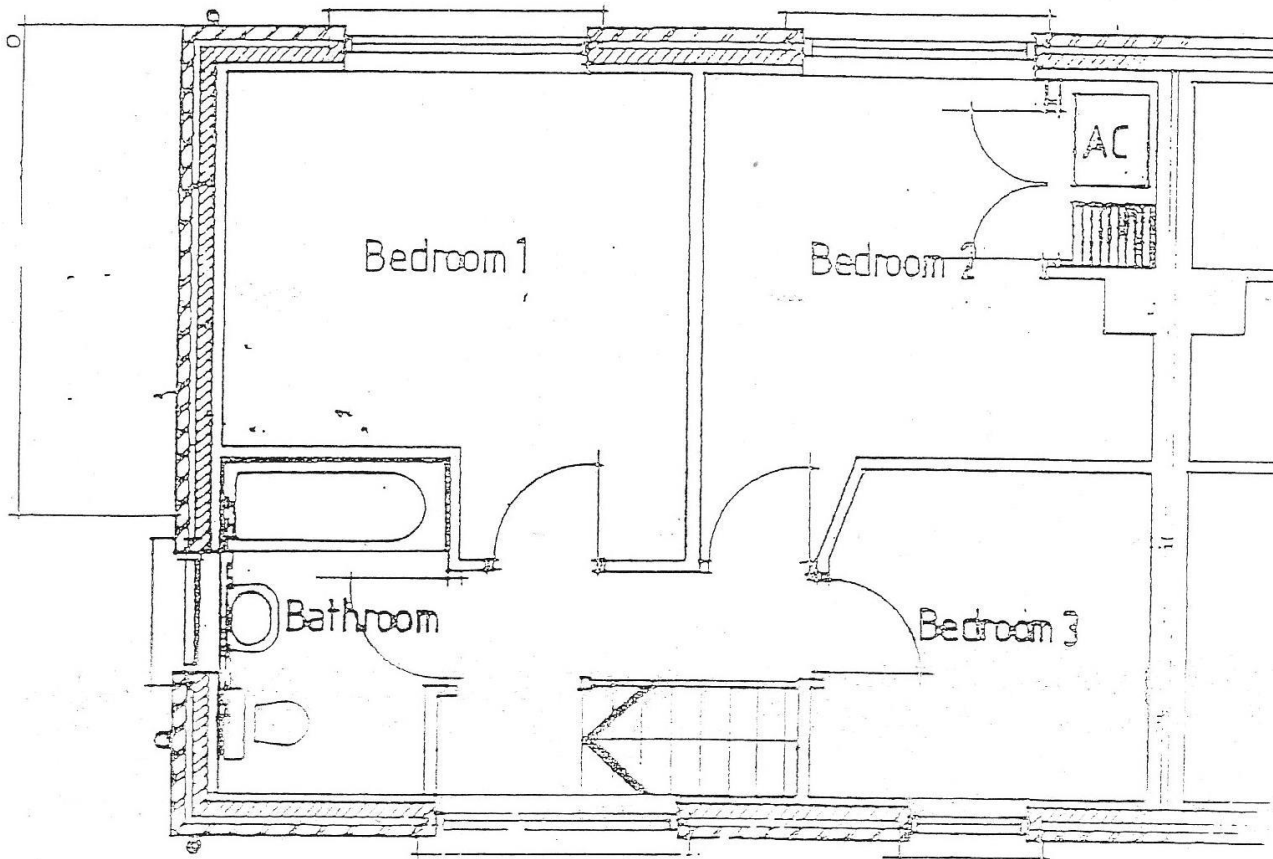
Back Elevation



Ground Floor



First Floor



Appendix A.2: Cost & duration calculations for construction tasks 1-17.

2) Excavation & Filling

Activity	Equation	Total
Excavating by machine; Trenches 0.30m wide with a maximum depth not exceeding 2.00m.	$£8.47 \times 80m^3$	= £677.60
Additional excavation by hand; Pits 0.3m wide not exceeding 0.25 in depth.	$£28.82 \times 20m^3$	= £576.40
Filling to make up levels on site; By machine average thickness exceeding 500mm.	$£17.23 \times 30m^3$	= £516.90
Total: £677.60 + £576.40 + £516.90 = £1,773.90		

$$\text{Works Duration} = \frac{(0.33 + 2.13 + 1.02) \times 130m^3}{\text{Groundwork Gang (7)}} = 1.97 \text{ Days}$$

3) Foundations

Activity	Equation	Total
Foundations; Reinforced in-situ ready mixed designated concrete 30N foundations.	$80m^3 \times £122.36$	£9,788.80
Total: £9,788.80		

$$\text{Works Duration} = \frac{1.02 \times 80m^3}{\text{Concreteing Gang (5)}} = 3.5 \text{ Days}$$

4) Sawn Softwood Framing & Timber Trusses

Activity	Equation	Total
Floor members; 100mm x 200mm	$200m^2 \times £15.23$	= £3,046
Wall & Partition members; 100mm x 100mm	$150m^2 \times £9.92$	= £1,488
Joist herringbone strutting; 47mm x 50mm, depth 200mm	$100m^2 \times £12.81$	= £1,281
Roof members pitched; 75mm x 100 mm	$125m^2 \times £10.31$	= £1,288.75
Total: £3,046 + £1,488 + £1,288.75 = £7,103.75		



$$\text{Works Duration} = \frac{(0.21 + 0.19 + 0.46 + 0.23) \times (200\text{m}^2 + 150\text{m}^2 + 100\text{m}^2 + 125\text{m}^2)}{\text{Formwork Gang (12)}} = 4.56 \text{ Days}$$

5) Brick & Block Walls

Activity	Equation	Total
Brown rustic brick wall; 1 brick thick	20 x 413.30 (1000 Bricks)	= £8,266
100mm Blocks	500 blocks x £26.16	= £13,080
OPC Cement	2 tonnes OPC x £119.30	= £238.60
Lintels: 100mm x 70mm x 900mm long	22 x £16.71	= £367.62
100mm width exceeding horizontal in brick or block course	160m x 0.29	= £46.40
Total: £8,266 + £13,080 + £238.60 + £367.62 + 46.40 = £21,998.62		

$$\text{Works Duration} = \frac{(1.41 + 0.41 + 0.01 + 0.37) \times (\text{Area (80m}^2) + \text{Wall Height (6)} + \text{Lintels (22)})}{\text{Brick \& Blockwork Gang (7)}} = 10.5 \text{ Days}$$

6) Roof Coverings

Activity	Equation	Total
2-layer polyester roof covering	125m ² x 19.93	= £2,491.25
Lead Flashings	60m ² x 52.30	= £3,138
Concrete plain tiles; BS EN 490. 267mm x 165mm	3 x £420.52 (1000)	= £1,261.56
Total: £2,491.25 + £3,138 + £1,261.56 = £6,890.81		

$$\text{Works Duration} = \frac{(1 + 1.2 + 4.21) \times (\text{Roof Covering (125m}^2) + \text{Flashing (60)} + \text{Tiles (125m}^2))}{\text{Formwork Gang (12)}} = 2.53 \text{ Days}$$

7) Windows & Door Installation

Activity	Equation	Total
Standard Windows	18 x £152.71	= £2,748.78
External Doors	4 x £83.79	= £335.16
Internal Doors	26 x £30.65	= £796.90
Total: £2,748.78 + £335.16 + £796.90 = £3,880.84		

$$\text{Works Duration} = \frac{(1.06 + 0.75 + 0.7) \times (\text{Windows (18)} + \text{Ext Doors (64)} + \text{Int Doors (26)})}{\text{Small Labouring Gang (5)}} = 2.13 \text{ Days}$$



8) Staircase Installation

Activity	Equation	Total
Standard wrought softwood straight flight staircase	2 x £528.57	= £1,057.14
Total: £1,057.14		

$$\text{Works Duration} = \frac{6.48 \times \text{Staircases (2)}}{2 \text{ and 1 Gang (3)}} = 1.3 \text{ Days}$$

9) Wall & Ceiling Finishes

Activity	Equation	Total
Plasterboard & Rendered Walls	100 boards x £5.91	= £591
Plasterboard & Rendered Ceilings	26 boards x £5.91	= £153.66
Total: £591 + £153.66 = £744.66		

$$\text{Works Duration} = \frac{(0.25 + 0.25) \times (\text{Wall Boards (100)} + \text{Ceiling Boards (26)})}{\text{Carpentry \& Joinery Gang (7)}} = 3.27 \text{ Days}$$

10) Sanitary Fittings

Activity	Equation	Total
Sink	2 x £230.46	= £460.92
Bath	2 x £274.52	= £549.04
Shower Tray & Fittings	2 x £490	= £980
Total: £460.92 + £549.02 + £980 = £1,989.96		

$$\text{Works Duration} = \frac{(2.13 + 2.5 + 5) \times (\text{Sink (2)} + \text{Bath (2)} + \text{Shower Tray \& Fittings (2)})}{2 \text{ and 1 Gang (3)}} = 1 \text{ Week}$$

11) Kitchen Installations

Activity	Equation	Total
Floor Units	2 x £123.66	= £247.32
Wall Units	2 x £203.24	= £406.48
Sink & Unit	2 x £313.58	= £627.16
Total: £247.32 + £406.48 + £627.16 = £1,280.96		

$$\text{Works Duration} = \frac{(1.16 + 1.16 + 4.16) \times (\text{Floor Units (2)} + \text{Wall Units (2)} + \text{Sink \& Unit (2)})}{2 \text{ and 1 Gang (3)}} = 1 \text{ Week}$$



12) Water Installations

Activity	Equation	Total
Service Runs	20m x £1,126.68	= £2,253.60
Total: £2,253.60		

$$\text{Works Duration} = \frac{2.85 \times \text{Service Runs (20m)}}{\text{Drain Laying Gang (2)}} = 5 \text{ Days}$$

13) Electrical Installations

Activity	Equation	Total
Lighting Points	30 light fittings x £47.6	= 1428
Socket Outlet Points	40 sockets x £82.17	= 3268
Total: £1,428 + £3,268 = £4696.00		

$$\text{Works Duration} = \frac{(0.28 + 0.46) \times (\text{Lighting Points (30)} + \text{Socket Outlet Points (40)})}{\text{Small Labouring Gang (5)}} = 3.1 \text{ Days}$$

14) Floor Finishes

Activity	Equation	Total
Screed	100m ² x £14.38	= £1,438
Fitted Carpet	100m ² x £34.64	= £3,464
Skirting	200m ² x £8.99	= £1,798
Total: £1,438 + £3,464 + £1,798 = £6700.00		

$$\text{Works Duration} = \frac{(0.52 + 0.45 + 0.22) \times (\text{Screed (100m}^2\text{)} + \text{Carpet (100m}^2\text{)} + \text{Skirting (200m}^2\text{)})}{2 \times \text{Carpentry \& Joinery Gangs (6)}} = 6.1 \text{ Days}$$

15) Furniture Finishes

Activity	Equation	Total
Internal Blinds	18 x £62.81	= £1130.58
Shelves	20 x £18.65	= £373
Total: £1,130.58 + £372 = £1,503.58		

$$\text{Works Duration} = \frac{(0.93 + 0.22) \times (\text{Internal Blinds (18)} + \text{Shelves (20)})}{\text{Small Labouring Gang (5)}} = 1.68 \text{ Days}$$



16) External Drainage

Activity	Equation	Total
Channel & Grate System	80m x £175.5	= £14,040
Total: £14,040		

$$\text{Works Duration} = \frac{1 \times \text{Channel \& Grate System (80)}}{2 \times \text{Drain Laying Gangs (2)}} = 2.5 \text{ Days}$$

17) Landscaping

Activity	Equation	Total
Turfing	300m ² x £3.86	= £1,158
Hedges	40 x £7.58	= £303.20
Fencing	100m ² x £14.33	= £1,433
Total: £1,158 + £303.20 + £1,433 = £2894.2		

$$\text{Works Duration} = \frac{(0.1 + 0.56 + 2.3) \times (\text{Turfing (300m}^2\text{)} + \text{Hedges (40)} + \text{Fencing (100m}^2\text{)})}{3 \times \text{Small Labouring Gangs (5)}} = 6.5 \text{ Days}$$

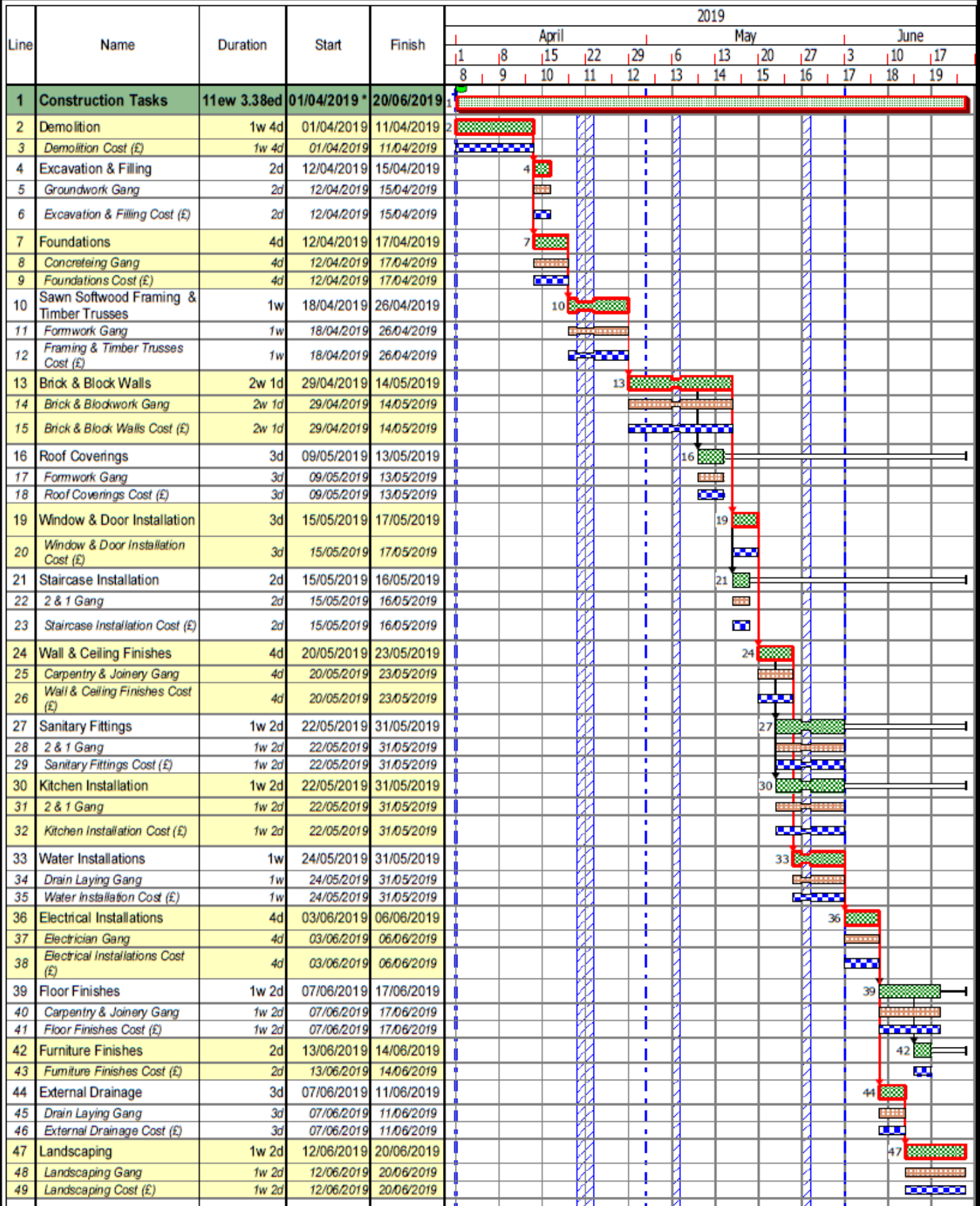


Appendix A.3: Gantt Chart

Bar Chart View

07/02/2019

Adam Meyrick (1706760)



Drawn by:

Dwg No.

Revision No.

Notes:

Project Ref. E:\UWTS\ASTA Assignment 1.pp

Planned by Asta Easyplan



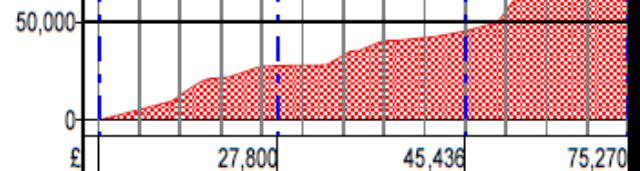
Appendix A.4: Monthly Cost Chart

07/02/2019

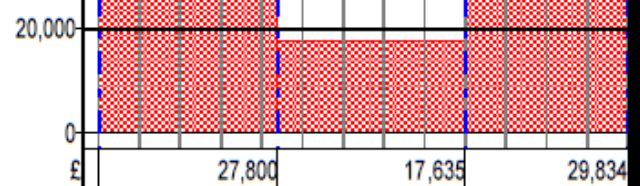
Adam Meyrick (1706760)

Line	Name	All Costs	Design Fees	Subcontractor	Labour	Materials	Plant	2019												
								April				May				June				
								1	8	15	22	29	6	13	20	27	3	10	17	24
								8	9	10	11	12	13	14	15	16	17	18	19	20
1	Demolition	£9,726.00	£9,726.00					1												
2	Excavation & Filling	£1,000.00			£1,000.00				2											
3	Foundations	£9,788.80				£9,788.80			3											
4	Sawn Softwood Framing & Timber Trusses	£7,103.75							4											
5	Brick & Block Walls	£1,000.00					£1,000.00						5							
6	Roof Coverings	£6,890.81												6						
7	Window & Door Installation	£3,880.84													7					
8	Staircase Installation	£1,057.14		£1,057.14											8					
9	Wall & Ceiling Finishes	£744.66														9				
10	Sanitary Fittings	£1,989.96														10				
11	Kitchen Installation															11				
12	Water Installations	£2,253.60															12			
13	Electrical Installations	£4,696.50																13		
14	Floor Finishes	£6,700.00																	14	
15	Furniture Finishes	£1,503.58																		15
16	External Drainage	£14,040.00																		16
17	Landscaping	£2,894.20																		17

1 Total Cost - Project Costs



2 Monthly Costs - Project Costs



Drawn by: Planner - Chart Properties Dwg No. 00001

Revision No. A

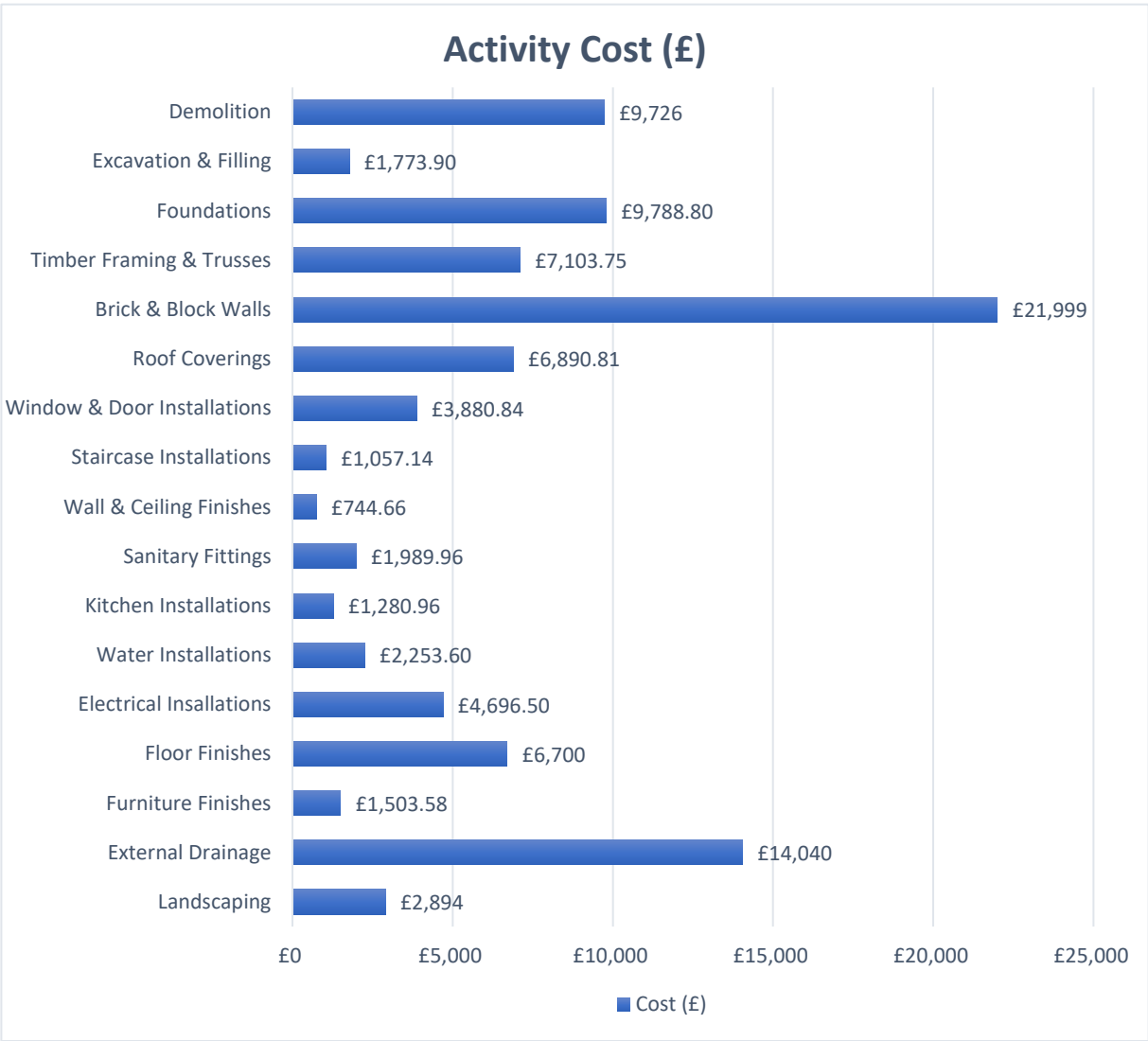
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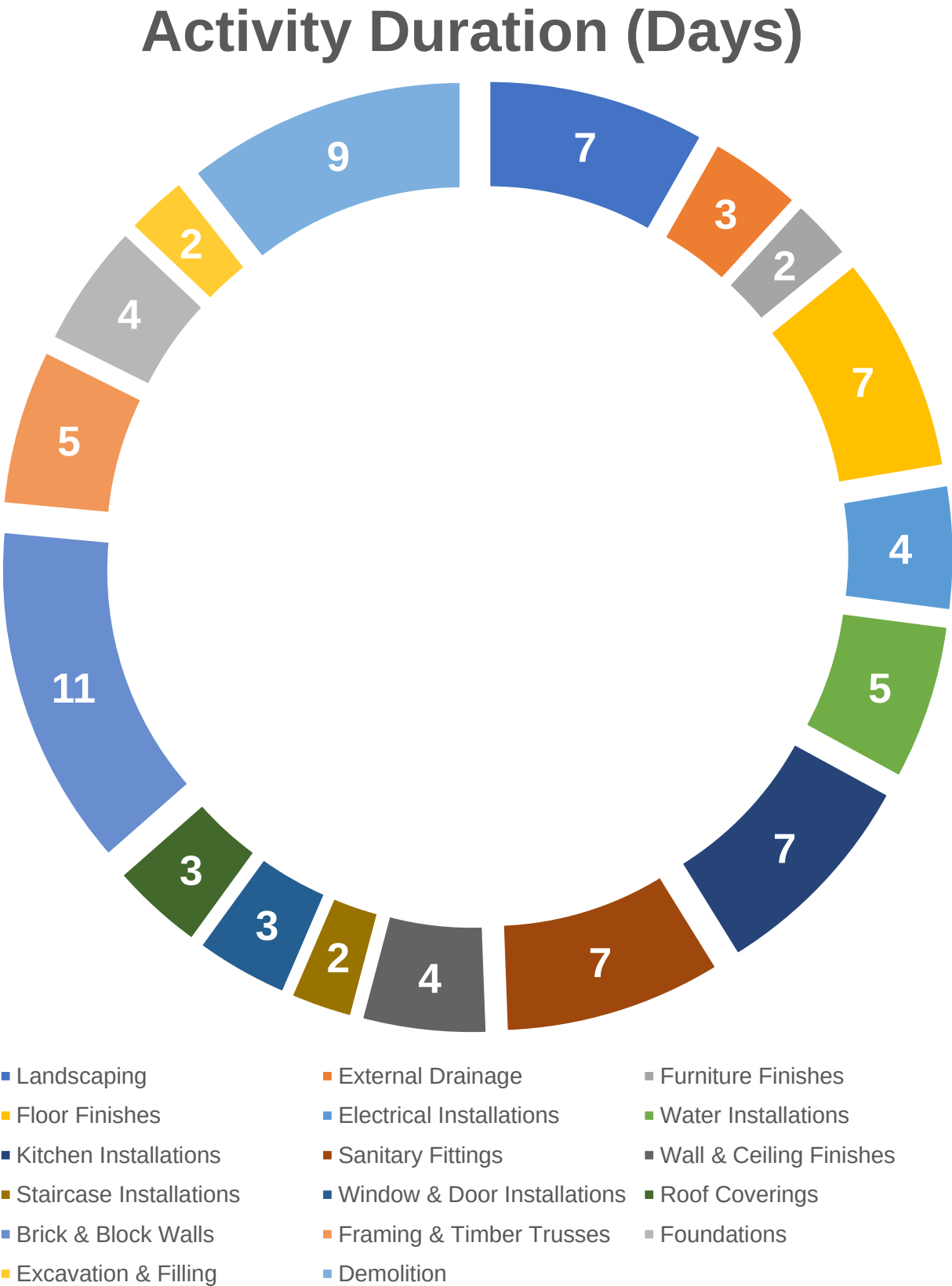
Planned by Asta Easyplan



Appendix A.5: Construction task cost bar chart.



Appendix A.6: Construction task duration pie chart.



Appendix A.7: Laburnham Drive construction case study, Newport.



Available at: <https://www.morganstone.co.uk/projects>

Client: Charter Housing

Status: Completed

Location: Laburnham Drive, Newport

Cost: £120,000

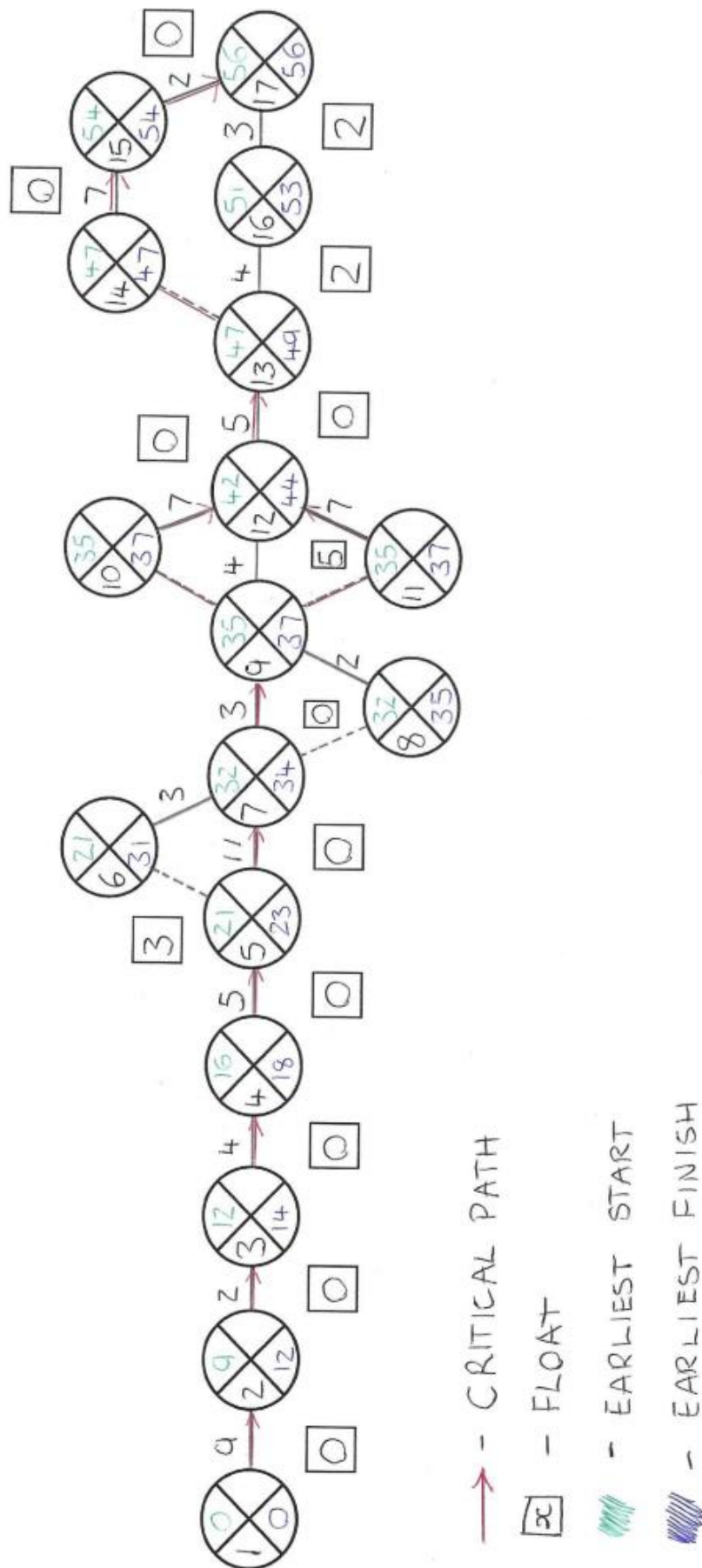
Project Duration: 4 Months

Abstract:

The project began with the demolition of the former community hall, which was situated at the centre of the site. Following demolition and subsequent site preparation, including extensive groundworks to amend the steepness of the site, the Morganstone team got to work constructing four timber framed properties.



Appendix A.7: Network Diagram of Project



ADAM MEYRICK

3/2/19



Appendix A.8: Weekly cost x Weekly Labourers comparison graph.

