

# Estimation and Construction-activity scheduling of Health Center-IIT Tirupati

## CE401L Term Project Presentation

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# Outline

- 1 Introduction
- 2 Quantity and Cost estimation for subheads in the project
  - Earth-work
  - Masonry work
  - Concrete works
  - Structural steel work
  - Flooring work
  - Finishing work
  - Reinforcement works
- 3 Cumulative cost of construction
  - Approximate cost through plinth area analysis
- 4 Construction Activity Scheduling
  - Summary of Construction activity schedule
- 5 Conclusion

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## Problem Statement

The objective of the work is to:

- estimate the probable construction cost of the Health Centre at IIT Tirupati satisfying requirements imposed by provided architectural and structural drawings.
- prepare a sequence plan for the construction of the assigned building.

## Details of Assigned Building



Figure: Health Center, IIT Tirupati (Picture courtesy: IIT Tirupati)

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## Subheads in estimation

The following subheads were considered

- Earthwork
- Masonry work
- Concrete work
- Structural steel work
- Flooring work
- roofing work
- Finishing work
- Reinforcement for R.C.C members

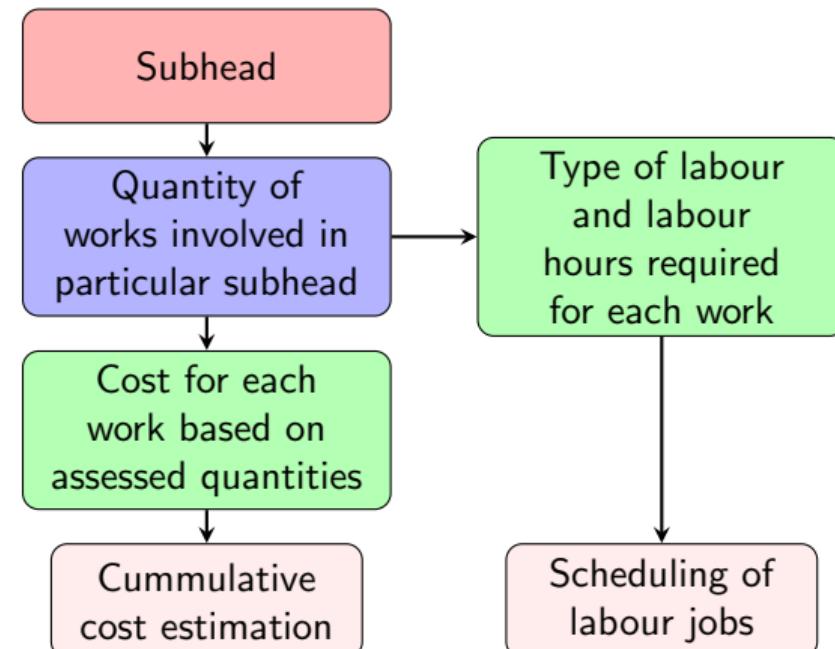


Figure: Workflow for estimation of each subhead

# Outline

## 1 Introduction

## 2 Quantity and Cost estimation for subheads in the project

### ■ Earth-work

- Masonry work
- Concrete works
- Structural steel work
- Flooring work
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- Reinforcement works

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### ■ Approximate cost through plinth area analysis

## 4 Construction Activity Scheduling

### ■ Summary of Construction activity schedule

## 5 Conclusion

# Earthwork

Earthwork refers to engineering activities involving reshaping a site's terrain by digging deep, moving large quantities of earth or rock, and cutting and filling soil as per the approved drawings

## Assumptions

- Based on the reported design safe bearing capacity of  $200\text{KN}/m^2$ , the soil is considered dense and predominantly granular
- The excess excavated soil could be safely and legally disposed of within a 5km radius.

## Earthwork(cont'd..)

Description	Footing Type	Excavation Volume( $m^3$ )	Filling Volume( $m^3$ )
Excavation of footings	Isolated-Footing	631.47	-
	Strip-Footing	319.89	-
Filling of excavated footing space till F.G.L	Isolated-Footing	-	646.63
	Strip-Footing	-	147.50
Leveling Plinth region	-	536.45	134.09
	Total	<b>1487.80</b>	<b>928.22</b>

Table: Summary of Earthwork calculation

S.No	Description of Activity	Cost
1	Site clearing	₹17,000
2	Excavation work	₹2,64,120
3	Filling of excavated soil	₹1,55,642
4	Filling in plinth layer	₹2,84,770
5	Disposal of excess excavated soil	₹3,91,993
	Total	<b>₹11,13,500</b>

Table: Cost Summary of Earthwork subhead

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# Masonry work

Masonry work refers to the craft of building structures with brick, stone or other materials. Masonry units have to be properly placed, aligned and plastered with appropriate PCC to ensure bonding between elements.

## Assumptions

- The masonry assumed to be used in this work is AAC(Aerated autoclave concrete) blocks.

## Additional details

- Appropriate deductions and additions were made for miscellaneous items(stairs, openings, etc.)

## Masonry (cont'd...)

Masonry Requirement	Masonry Volume( $m^3$ )
between G and G+1 floors	112.25
between G+1 floor and roof	175.26
Parapet walls	28.95
Total	<b>316.45</b>

Table: Summary of Masonry volume

### Cost Estimate

- The cost of  $1m^3$  of masonry including the costs of the adhesive motor is expected to be ₹8333.65(Clause 6.47-DSR-I-2023).
- The cost for masonry works in the project is expected to be ₹26,37,200.

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## Concreting works

Concrete work accounts for all work germane to concrete. The associated cost for concrete work accounts for costs including raw materials, mixing, shuttering, centring, placement, vibration, curing, form work-stripping and labour to perform necessary tasks.

### Particular Details

- All concrete used in R.C.C members are of grade M35.
- Formwork stripping time is assumed as per the suggestions of IS 456.

## Concrete works(cont'd..)

Description	Volume of Concrete( $m^3$ )	Volume of Plaster ( $m^3$ )	Surface area required for formwork( $m^2$ )
<b>Footings</b>	264.777	93.5685*	98.58
<b>Columns</b>	186.22	25.74	211.38
<b>Beams-Plinth</b>	50.35	8.78	585.57
<b>Beams-G+1</b>	97.10	14.41	960.47
<b>Beams-Roof</b>	76.61	11.27	751.23
<b>Slabs-G floor</b>	148.82	14.88	1984.26
<b>Slabs-G+1 floor</b>	76.83	14.45	963.54
<b>Roof Slabs</b>	49.45	10.21	680.40
<b>Miscallaneous-First -floor store room</b>	27.93	5.76	383.73
<b>Miscallenous-Staircase</b>	2.77	0.52	34.75
<b>Miscallenous-Structure -supporting Water Tank</b>	5.34	0.81	68.55
<b>Total</b>	<b>721.43</b>	<b>106.83</b>	<b>6623.86</b>

Table: Summary of concrete works

└ Quantity and Cost estimation for subheads in the project

└ Concrete works

## Concrete works(cont'd..)

S.No	Description of Activity	Cost
1	M35 (materials, mixing, placing)	₹70,74,850
2	Shuttering and centring footings	₹55,610
3	Shutting and centring soil columns	₹2,03,200
4	shuttering and centring beams	₹16,91,700
5	shuttering and centring sabs/floor	₹37,83,700
6	Stairs	₹26,600
7	P.C.C	₹6,37,400
	Total	₹1,34,73,060

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## Structural Steel work

The subhead includes costs of all structural steel-related work(except reinforcement), the cost includes cost for cutting, welding/bolting/riveting, hoisting, placement and primer coating of the structural steel.

ID in Drawings	Description	Number of bars	Length of each	Mass of steel
SB4	ISM-C-300 Box	8	5860	1668.89
SB3	RHS 300 × 150 × 6mm	16	5860	4335.31
SB1	RHS 120 × 60 × 3.6	6	2425	236.96
SHS	RHS 150 × 150 × 5	16	6000	2208.96
SB2	RHS 200 × 100 × 5	#Refer STR-12		3759.83
P1	RHS 100 × 50 × 3.2	16	10970	1985.13
P2	RHS 80 × 40 × 3.2	144	2425	3132.32
				Total <b>17327.42kg</b>

Table: Summary of Steel-works

### Cost Estimate

- The total cost accounted for steel works in the structure is approximately ₹23,17,000.

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## Flooring work

The floor work accounts for all activities related to tiles including procurement cost of tiles, labour cost and cost for placement of tiles.

### Assumptions

- Vitrified blocks of  $2' \times 2'$  is assumed to be used everywhere.

S.No	Description of Activity	Cost
1	Tiles-floor	₹21,57,321
2	Skirting and Dadooing	₹10,244
3	Tiling in stairs	₹32,886
	Total	<b>₹22,00,451</b>

Table: Cost of structural steel work

### Cost Estimate

- The total cost accounted for flooring works in the structure is approximately ₹22,00,500.

## Roofing works

Roofing work refers to activities involving installing any covering for decorative or weatherproofing reasons above any floor.

### Assumptions

- Expanded polystyrene is assumed to be installed in roof for thermal insulation.
- False ceiling is assumed to be provided.

S.No	Description of Activity	Cost
1	Fixing false ceiling	₹12,65,249
2	Thermal insulation of roof	₹2,96,704
	Total	₹15,61,953

Table: Cost of roofing works

### Cost Estimate

- The total cost accounted for roofing works in the structure is approximately ₹15,62,000.

└ Quantity and Cost estimation for subheads in the project

└ Finishing work

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## Finishing works

Finishing works include the costs for plastering, pointing and painting exposed surfaces.

### Assumptions

- For exterior surfaces, two coatings of paint over a primer coating are assumed.
- For interior surfaces, two or more coats of paint over the white-washed surfaces is assumed.

S.No	Description of Activity	Cost
1	External surfaces	₹1,17,593
2	Internal Surfaces	₹2,59,511
	Total	₹3,77,104

Table: Cost of finishing works

### Cost Estimate

- The total cost accounted for finishing works in the structure is approximately ₹3,77,000.

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## Reinforcement associated works

The costs ascribed to this subhead account for R.C.C. work including straightening, bending, cutting and placement of rebars. The bar bending schedule is appropriately subdivided and accordingly prepared based on bar bending specifications suggested by IS-456.

### Cost Estimate

- The total cost accounted for reinforcement in RCC members is approximately ₹69,87,000.

## Reinforcement associated works(cont'd..)

Steel Reinforcement Requirement-Summary		
<b>Footings</b>	Longitudinal Reinforcement	5979.03
<b>Columns</b>	Longitudinal Reinforcement	12381.37
<b>Columns</b>	Lateral Ties	3273.34
<b>Plinth and Grade Beams</b>	Longitudinal Reinforcement	3970.94
<b>Plinth and Grade Beams</b>	Lateral Ties	1943.26
<b>Beams(G+1)</b>	Longitudinal Reinforcement	6846.26
<b>Beams(G+1)</b>	Lateral Ties	2692.47
<b>Beams(G+2)</b>	Longitudinal Reinforcement	6761.92
<b>Beams(G+2)</b>	Lateral Ties	2233.18
<b>Slabs-G floor</b>	Longitudinal Reinforcement	8757.83
<b>Slabs-G+1 floor</b>	Longitudinal Reinforcement	7241.80
<b>Slabs-G+2 floor</b>	Longitudinal Reinforcement	6137.92
<b>Miscellaneous- Slabs-First floor common room</b>	Longitudinal Reinforcement	1572.25
<b>Miscellaneous-Water Tank</b>	Longitudinal Reinforcement	312.60
	Total(kg)	<b>70104.17</b>

Table: Summary of Reinforcement Requirement for RCC members

## Reinforcement associated works(cont'd..)

Footings						
S.No	L(mm)	a(mm)	Rebar Type	Bar Dia(mm)	Number of bars	Bar Type
1	3100	550	FE 500	12	28	A
2	2700	550	FE 500	12	43	A
3	2400	550	FE 500	12	19	A
4	2400	550	FE 500	12	33	A
5	1700	550	FE 500	12	11	A
6	1400	550	FE 500	10	13	A
7	1800	550	FE 500	10	26	A
8	1700	550	FE 500	10	26	A
9	1400	550	FE 500	10	118	A
10	1900	550	FE 500	10	232	A
11	3200	550	FE 500	12	56	A
12	4900	550	FE 500	10	173	B

Table: Bar-Bending Schedule for footings

Column-Longitudinal Reinforcement						
S.No	L(mm)	A(mm)	Rebar Type	Bar Dia(mm)	Number of bars	Bar Type
1	5550	450	FE 500	25	312	B
2	5550	450	FE 500	20	268	B
3	5550	450	FE 500	32	60	B
4	5550	450	FE 500	16	132	B

Table: Bar-Bending Schedule for Columns(Longitudinal)

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# Cummulative Cost of Construction

Cumulative Cost Estimate		
S.No	Sub-head	Cost
1	Earth-work	₹11,13,500
2	Masonry-work	₹26,37,200
3	Concrete-work	₹1,34,72,500
4	Reinforcement Costs	₹69,87,000
5	Steel-works	₹23,17,000
6	Flooring-works	₹22,00,500
7	Roofing works	₹15,62,000
8	Finishing-works	₹3,77,000
9	Architectural-works(Including pergolas, procurement of fabricated components, etc)	15% of project cost
10	Plumbing-works	8% of project cost
11	Electrical works	8% of project cost
Total		₹4,44,20,000

Table: Calculated cumulative cost of project

## Cummulative Cost of Construction(cont'd)

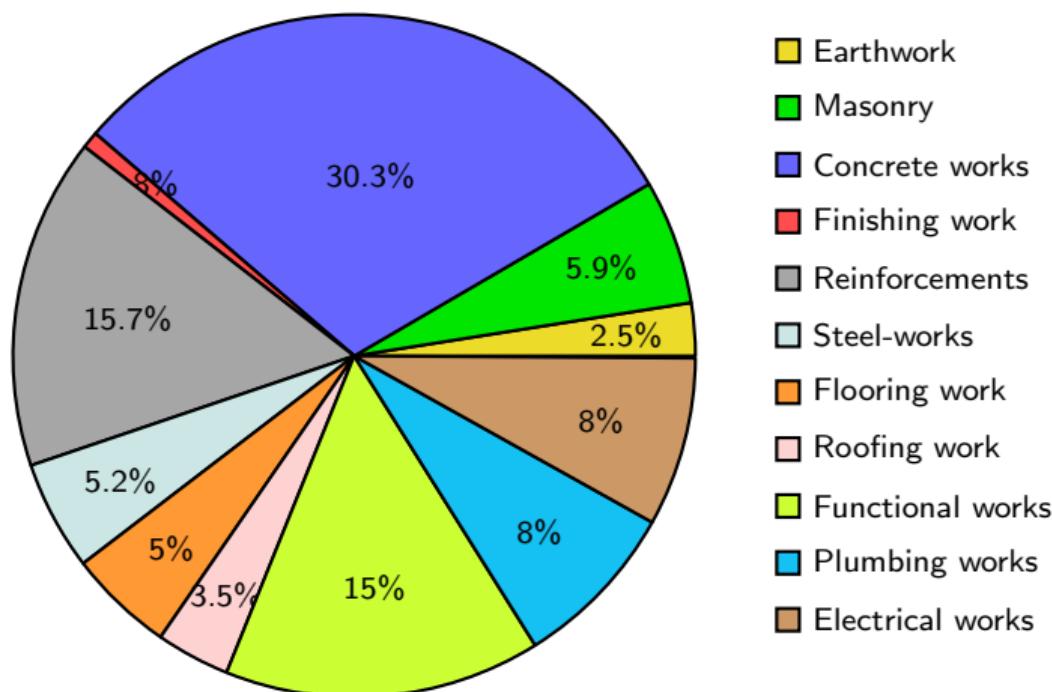


Figure: Breakdown of costs

└ Cumulative cost of construction

└ Approximate cost through plinth area analysis

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- └ Cumulative cost of construction

- └ Approximate cost through plinth area analysis

## Approximate cost through plinth area analysis

<b>Approximate cost through plinth rate estimates</b>			
<b>Description</b>	<b>Cost per unit area</b>	<b>Area</b>	<b>Total</b>
RCC framed structure	₹26,120.00	711.04	₹1,85,72,365
Basement Floor	₹23,610.00	711.04	₹1,67,87,654
Fire fighting+ Fire-alarm	₹1,060.00	711.04	₹7,53,702
Internal water and sanitary applications	5.00%	-	₹9,28,618
Electrical	3.75%	-	₹6,96,464
Electrical Insulation	12.50%	-	₹23,21,546
Approval for tree cutting	1.25%	-	₹2,32,155
Water tank	23 per litre	13,150 litre capacity	₹3,02,496
		Total	<b>₹4,05,95,000</b>

Table: Plinth area estimate of project cost

└ Cumulative cost of construction

└ Approximate cost through plinth area analysis

## Summary

### Detailed Cost Estimation

- The total cost of construction through detailed analysis is ₹4,44,20,000.
- The plinth area rate of the building is 62,472 ₹/m<sup>2</sup> or 5803.83 ₹/sq.ft.

### Approximate Cost Estimation through Plinth Rate Analysis

- The approximate cost of construction through plinth rate analysis is ₹4,05,95,000.

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# Construction Activity Scheduling

## Construction Management Charts

On the basis of efficient resource allocation and progress monitoring, a schedule breakdown is prepared along with the labour requirement chart. In this work the following charts are prepared,

- Milestone chart
- Detailed Gantt Chart
- Critical path analysis
- Labor schedule

# Milestone Gantt Chart

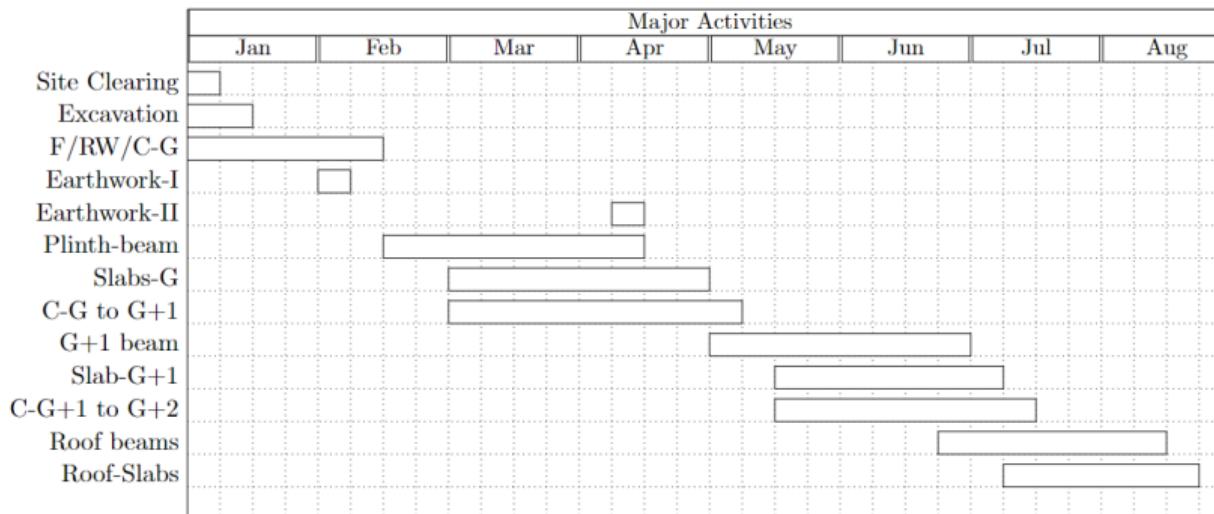


Figure: Summary of Project work(Project start:-1<sup>st</sup> Jan)

## Detailed Gantt Chart

The Gantt chart for the project is prepared and submitted both as an Excel workbook titled "Health Center IIT-Tirupati-CE401L-Term project.xlsx" and a Microsoft Project workbook is created under the following public domain name "Health Center IIT-Tirupati-CE401L-Term project" (QR code provided below)



Figure: Microsoft Project workbook

## Critical Path Analysis/Labour Schedule

Critical path analysis is performed for the construction schedule and is presented in the attached QR below.



Figure: Critical Path Analysis

Labour hours and type of labour required for each activity is estimated from DSR-2023 and are reported along with the submitted documents.

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## Summary of Construction activity schedule

### Project Completion time

The predicted sub-optimal project duration is around **272 days** with the expected optimized project duration as **218** days as per Microsoft Project.

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# Conclusion

In this work the construction cost of Health center, IIT Tirupati is estimated and construction activity schedule is prepared for the project.

## Predicted Cost of Construction

The total cost of construction is estimated to be **₹4,44,20,000**.

## Predicted project completion time

The estimated time for completion of the project is **218 days**.