

A Systematic Approach to Detailed Estimation and Cost Evaluation of Road Infrastructure Projects

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Received: 10 May 2025/ Accepted: 15 June 2025

Abstract:-

Road infrastructure is a vital element of the transportation network, as it connects different regions and supports the smooth movement of people and commodities. By improving accessibility and mobility, it strengthens economic activities and plays an important role in promoting overall economic stability, environmental balance, and social development. In road construction projects, cost estimation is a key managerial function. It helps project teams understand the financial impact of proposed resources and activities, enabling systematic budgeting and effective cost monitoring throughout various stages of project execution. Reliable estimates contribute to better financial discipline and minimize the risk of unexpected expenditures. Based on the review of previous studies, construction estimates are generally grouped into three types: preliminary, definitive, and detailed estimates. Different techniques are applied in preparing these estimates, such as judgment-based (subjective) estimation, parametric estimation, comparative estimation, and analytical estimation. Among these techniques, analytical estimation is considered the most dependable because it involves a thorough breakdown and careful assessment of each project component. Therefore, for improved precision and dependable financial planning in road construction works, the analytical estimation approach is strongly recommended.

Keywords: *Road Infrastructure, Transportation Network, Economic Development, Sustainable Development.*

Introduction

The Detailed Estimate is generally considered as the project estimate types. It represents the complete (or almost complete) project or product design.

The other estimate types are:

- Conceptual of Magnitude estimates
- Preliminary estimates
- Definitive estimates
- Annual Repair estimate
- Supplementary estimate
- Final estimates

Detailed estimate consists of:

- Report
- General specifications.
- Detailed specifications.
- Drawing
- Calculation and design
- Analysis of rates

Literature Review

Ismael Ghajar, Akbar Najafi, Amir Mohsen Karimimajd, Kevin Boston, and Seyed Ali Torabi proposed a structured cost estimation framework for forest road construction based on the engineer's estimation approach. Their model incorporates geometric cross-sectional properties along with terrain slope and vegetation characteristics specific to the project location. The total construction cost is determined by considering six major components: clearing activities, embankment works, pavement layers, grading operations, culvert installation, and drainage ditch construction.

Varun Kumar Gupta, Pradeep Kumar Gupta, and R.K. Khitoliya investigated the persistent issue of cost overruns in highway construction projects. Since profit realization remains the primary objective of construction firms, their study focused on identifying the significant factors responsible for budget escalations. Through a comprehensive review of previous research, they identified the most influential elements contributing to financial overruns in highway development projects.

Abdelrahman Osman Elfaki, Saleh Alatawi, and Eyad Abushandi examined the role of intelligent techniques in improving construction cost estimation practices. Their research reviewed studies conducted over the past decade and implemented a two-phase methodology. The first phase involved systematic data collection from selected scholarly journals, while the second phase consisted of critical analysis of the collected studies. Their findings highlighted existing research gaps in construction cost estimation and suggested potential future research directions aimed at achieving more accurate and optimized estimation models.

In practice, cost estimation for construction projects is often challenged by several constraints, including insufficient initial data, lack of comprehensive cost databases for road works, and difficulties in selecting suitable estimation techniques. Estimation represents the preliminary step in quantifying work items and forecasting the expected project cost prior to construction. A detailed estimate is prepared by dividing the project into individual components and calculating costs item by item.

To accommodate unforeseen minor expenses, a contingency allowance typically ranging from 3% to 5% of the estimated cost is included. Similarly, provisions of about 1.5% to 2% are allocated for work-charged establishment expenses. A complete project estimate also accounts for preliminary investigations, surveying costs, land acquisition expenses, site preparation, and external service requirements. In addition, supervision or departmental charges—



generally between 5% and 10% of the estimated amount—are incorporated to ensure proper administrative and managerial control of the project.

Site: - Baraua-pichhore Road, Near Sithouli Railway Station, Gwalior, Madhya Pradesh 474001



This is around 1km from Institute of Technology and Management on NH-75

Survey and Levelling at Site:-With the help of instruments mentioned before, we have done levelling at the site of 350m or 0.35km with chainage of 25m.

Readings are given below:

| STATION | B.S | I.S | F.S | H.I | R.L | REMARK |
|----------|-------|-------|-------|---------|---------|--------|
| A | 0.950 | | | 100.95 | 100 | |
| | | 3.040 | | | 97.91 | |
| B | 1.410 | | 3.750 | 98.61 | 97.2 | CP |
| | | 1.485 | | | 97.125 | |
| C | 1.375 | | 1.500 | 98.485 | 97.11 | CP |
| | | 1.355 | | | 97.13 | |
| | | 1.235 | | | 97.25 | |
| D | 2.770 | | 1.085 | 100.17 | 97.4 | CP |
| E | 1.985 | | 0.665 | 101.49 | 99.505 | CP |
| F | 2.210 | | 1.050 | 102.65 | 100.44 | CP |
| | | 0.750 | | | 101.9 | |
| | | 0.400 | | | 102.25 | |
| G | 1.690 | | 0.105 | 104.235 | 102.545 | CP |
| | | 1.135 | | | 103.1 | |
| H | | | 1.215 | | 103.2 | |

Checks are applied and hence values are correct.



Calculation for cutting and filling of road

F.L. = 102m,

Side Slope Banking =3:1,

Breadth = 4m,

Side Slope Cutting = 2:1

Downward Gradient – 1in50 for 0-200m Upward Gradient – 1in25 for 200-350m

Subtract in F.L. (for Downward Gradient) = $1 \times 25 / 50$

=0.5m

Addition in F.L. (for Upward Gradient) = $1 \times 25 / 25 = 1\text{m}$

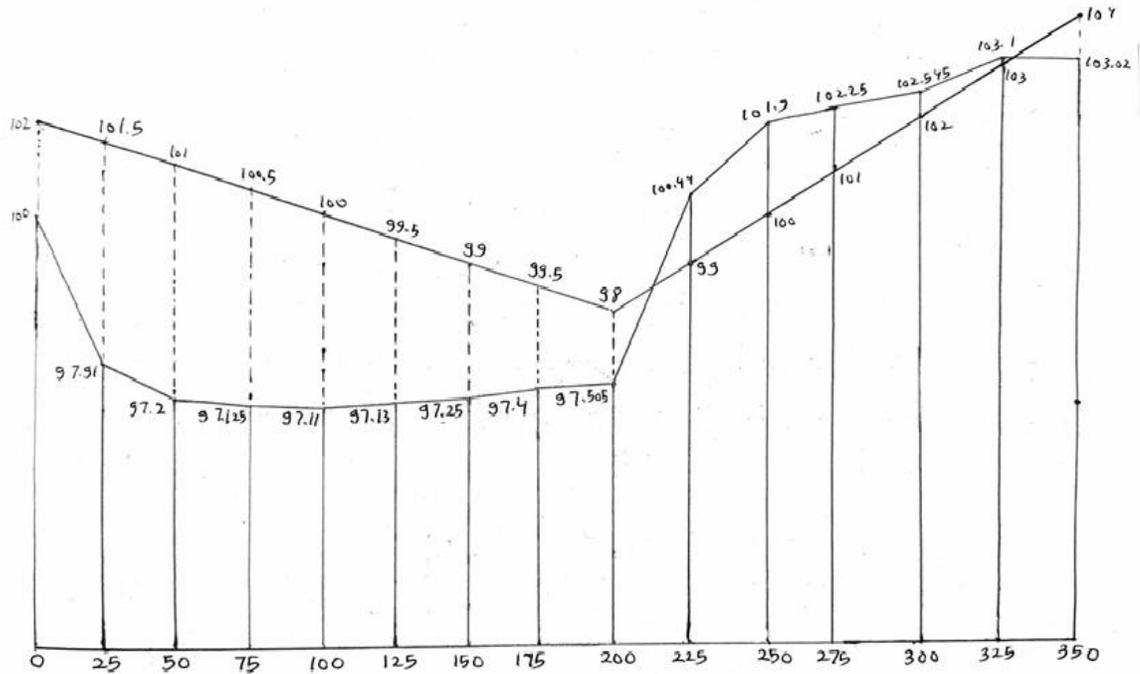
Using these values prepare table for formation level and depth of banking (filling) and cutting.

| Chainage (m) | R.L. (m) | F.L. (m) | Depth (F.L.–R.L.) (m) | |
|--------------|-------------|-------------|---------------------------|---------|
| | | | Banking | Cutting |
| 0 | 100 | 102 | 2 | |
| 25 | 97.91 | 101.5 | 3.59 | |
| 50 | 97.2 | 101 | 3.8 | |
| 75 | 97.125 | 100.5 | 3.375 | |
| 100 | 97.11 | 100 | 2.89 | |
| 125 | 97.13 | 99.5 | 2.37 | |
| 150 | 97.25 | 99 | 1.75 | |
| 175 | 97.4 | 98.5 | 0.995 | |
| 200 | 97.505 | 98 | 0.495 | |
| 225 | 100.44 | 99 | | 1.44 |

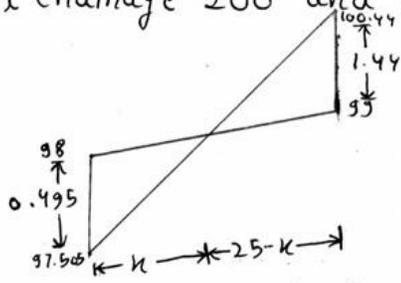
| | | | | |
|-----|---------|-----|------|-------|
| 250 | 101.9 | 100 | | 1.9 |
| 275 | 102.25 | 101 | | 1.25 |
| 300 | 102.545 | 102 | | 0.545 |
| 325 | 103.1 | 103 | | 0.1 |
| 350 | 103.02 | 104 | 0.98 | |



L-Section of road



At chainage 200 and 225



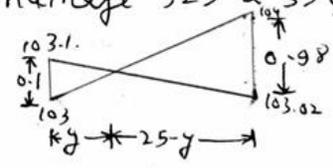
By similar triangle Properties

$$\frac{k}{0.495} = \frac{25-k}{1.44}$$

$$1.44k = 12.375 - 0.495k$$

$$k = 6.40 \quad 25-k = 18.60$$

At chainage 325 & 350



By similar triangle properties

$$\frac{y}{0.1} = \frac{25-y}{0.98}$$

$$0.98y = 2.5 - 0.1y$$

$$1.08y = 2.5$$

$$y = 2.31$$

$$25-y = 22.69$$



| Station/ Chainage meter | Height / Depth meter | Mean Depth meter | Central Area meter ² | Side Area meter ² | Total Sectional Area meter ² | Length in Between Station meter | Quantity (B*dm+S*dm ²)L meter ³ | |
|-----------------------------------|-----------------------------------|----------------------------|---|--|---|--|--|---------------------------|
| | | | | | | | D dm | B*dm S*dm ² |
| 0 | 2 | | | | | | | |
| 25 | 3.59 | 2.795 | 11.18 | 23.436 | 34.616 | 25 | 865.4 | |
| 50 | 3.8 | 3.695 | 14.78 | 40.959 | 55.739 | 25 | 1393.47 | |
| 75 | 3.375 | 3.585 | 14.34 | 38.599 | 52.939 | 25 | 1323.47 | |
| 100 | 2.89 | 3.132 | 12.528 | 29.42 | 41.948 | 25 | 1048.7 | |
| 125 | 2.37 | 2.63 | 10.52 | 20.75 | 31.27 | 25 | 781.75 | |
| 150 | 1.75 | 2.06 | 8.24 | 12.73 | 20.97 | 25 | 524.25 | |
| 175 | 0.995 | 1.372 | 5.488 | 5.647 | 11.135 | 25 | 278.375 | |
| 200 | 0.495 | 0.745 | 2.98 | 1.665 | 4.645 | 25 | 116.125 | |
| 206.4 | 0 | 0.247 | 0.988 | 0.183 | 1.171 | 6.4 | 7.494 | |
| 225 | 1.44 | 0.72 | 2.88 | 1.036 | 3.916 | 18.6 | | 72.83 |
| 250 | 1.9 | 1.67 | 6.68 | 5.57 | 12.25 | 26 | | 306.25 |
| 275 | 1.25 | 1.575 | 6.3 | 4.961 | 11.261 | 25 | | 281.525 |
| 300 | 0.545 | 0.897 | 3.588 | 1.609 | 5.197 | 25 | | 129.925 |
| 325 | 0.1 | 0.322 | 1.288 | 0.207 | 1.495 | 25 | | 37.375 |
| 327.31 | 0 | 0.05 | 0.2 | 0.005 | 0.205 | 2.31 | | 0.473 |

| | | | | | | | | |
|-----|------|------|------|------|------|-------|----------------|---------------|
| 350 | 0.98 | 0.49 | 1.96 | 0.72 | 2.68 | 22.69 | 60.809 | |
| | | | | | | | 6399.85 | 828.37 |
| | | | | | | | 3 | 8 |

Conclusion

Final Rate Analysis

| DESCRIPTION | UNITS | RATE | FINAL RATE |
|--|-------|-------|--|
| EARTHWORK IN ROUGH EXCAVATION, FILLING EXCAVATED EARTH, ON BANKING FOR 4M WIDTH, TOP SURFACE HAVING HARD SOIL TO BE LEVELED AND NEATLY DRESSED | CUM | 41.76 | 6399.853CUM*41.76 = 2,67,257.86 |
| EARTHWORK IN ROUGH EXCAVATION OF CUTTING THE EXCAVATED EARTH FOR 4M WIDTH, DENSE SOIL TO BE LEVELED AND NEATLY DRESSED | CUM | 37.83 | 828.378CUM*37.83 = 31,337.53 |

Total Cost in cutting and filling of road is

$$= 267257.86(\text{banking}) + 31337.53(\text{cutting})$$

$$= \text{₹ } 298595.39$$

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