



public works

Department:  
Public Works  
REPUBLIC OF SOUTH AFRICA



EXPANDED PUBLIC WORKS PROGRAMME

# TECHNICAL BRIEF

## Principles for Project Cost Estimating

Estimating costs for infrastructure projects is a very complex task which requires a lot of experience. It is important that you understand at least the principles of costing.

### Why estimate?

You may ask; **why do we need estimates?** Estimating can help to:

- **Prepare a tender/cost estimate:**

- by contractors to successfully bid and secure the job;
- by Client body (Engineer's Estimates) - to know how much the project will cost

- **Plan a Project:** Enables the Client body to realistically budget for a project. It also enables timely ordering of the project resources, enables project control and allows you to prepare a cashflow analysis.

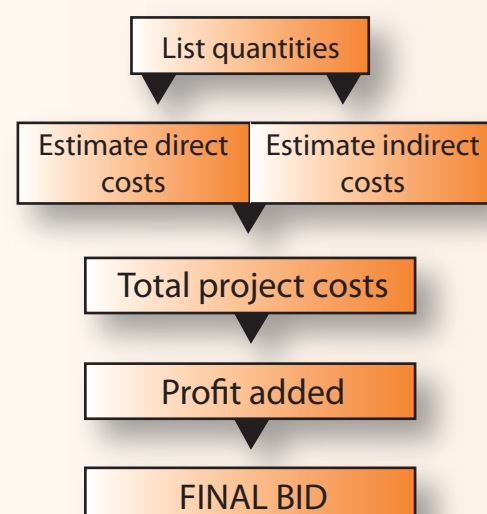
- **Financing:** allows the contractor to establish a source of financing, e.g. bank loan and to forward a cash flow forecast to financiers.

- **Construction:** enables you to control project progress and expenditures (cost overruns).

### Cost components

For normal tenders prepared by contractors the tender sum for any work item is made up using the procedure shown in the diagram.

If you prepare a cost estimate for a project to be implemented 'in-house' using your own agency workforce (Force Account) and resources, you will use the same system but you may not add the profit to arrive at the Final Cost.



Direct Costs are costs directly linked to activities required to do the work. The items for the **direct costs** are:

- Labour
- Equipment and tools
- Material
- Transportation of material and equipment

Indirect costs are costs incurred not directly linked to the works but have to be recovered by the company in doing the works. The items for the **indirect costs** are:

### Preliminaries

- site camp facilities
- insurance
- bonds
- road signs
- safety measures
- general transport, support or standby equipment
- tendering costs
- accommodation
- salaries, allowances and expenses for supervisory staff
- hire of support equipment

### Risks

(Here are some of the major risks to consider)

- bad weather
- work to be redone
- delayed payment
- carelessness by employees
- rising prices

### Company costs

- company facilities, i.e. offices, stores, workshop (a proportion of the costs to be covered by each contract)
- *interest on loans, etc. (e.g. bank loan to procure equipment or facilities)*
- *depreciation or replacement of equipment and/or facilities (several possibilities, for example it can be part of the preliminaries or included in the equipment cost when calculating the direct costs. Most important, make sure it is not forgotten).*
- general expenses (e.g. stationery for administration, electricity bills for office)
- cost for training of staff
- book-keeping, accountants and auditors fees
- protective clothing (can be used on many sites)

**Note:** Some of these items apply to contractors only. When you develop estimates for an 'in-house/force account' project, you can omit the items written in italics.

## Profit

Profit is over and above direct and indirect costs. It is often a percentage mark-up on the total direct and indirect costs. The actual percentage is influenced by factors such as competition in your construction industry and company size.

Sometimes a contractor may add a profit margin (e.g. 10%) to the project cost to remain competitive.

## Contingencies

A Lump sum amount (or a percentage) is often set aside to cover contingencies. This is an allowance for unforeseen costs resulting from activities not included in the contract. A contingency post helps all parties by offering an opportunity to i) cope with unforeseen problems, and ii) enhance the value of the job by improving specifications or adding minor items.

## CALCULATING UNIT RATES FOR A LABOUR INTENSIVE PROJECT

### Example:

A contractor is putting in a bid to gravel a 5 km road of width 6.0m using the labour based approach. The information provided in the Bill of Quantities for the Description item 'Spread and Compact sub base layer' is 30,000 m<sup>2</sup>.

### Calculating Direct project costs

#### 1. Calculate Labour and the "All-in Wage"

In order to mitigate for periods when workers will be idle but still need to be paid we need to use an "All-in wage", which takes into consideration factors such as holidays, leave and allowance for bad weather.

Assuming work is 5 days per week from Monday to Friday

There are 52 weeks in a year. Therefore available working days are 52 weeks x 5 days/week = 260 working days

If we allow 30 days for holidays, annual leave, sick leave, bad weather we remain with 230 actual working days.

Comparing available and actual working days we get  $260/230 = 1.13$  i.e a mark-up of 13% is necessary to adjust the wage rate.

Assuming a daily wage rate of R100, the 'All-in Wage Rate' will be  $R100 \times 1.13 = R113$

Now that we have a more realistic wage rate, let's calculate our labour costs

**2. Choose the appropriate Task Rate**

Available information is that the task rate for spreading material is 50m<sup>2</sup>/day, and assuming that the target construction speed is 100m/day.

Since work is proceeding at 100m/day or 100m\*6m = 600m<sup>2</sup>/days,

**3. Calculate the workforce required**

In order to calculate the required number of workers we divide the total daily output by the output of one person (100m x 6.0m) = 600m<sup>2</sup>/50m<sup>2</sup> = 12 workers

**4. Project Duration**

The project duration will be total quantity divided by daily output = 30,000m<sup>2</sup>/600m<sup>2</sup> = 50 days

**5. Worker-days Required**

The number of worker days is 12 workers x 50 days = 600 wd

**6. Labour Cost**

Cost of labour is 600 wd\* R113 = R67,800

We can insert this labour cost amount for this activity into the direct cost chart.

## Tools

### **Option 1: Cost of tools based on project (Refer to Average tools requirements table )**

Let's make assumptions about the number of workers, the type and quantity of tools they require, the average lifespan of tools and average days of use per month:

- Estimated number of workers = 120 persons
- Estimated average life span of tools = 6 months (Some tools last longer than 6 months whilst others wear out faster than six months).
- Days per month = 21 days

#### **Calculations:**

Worker days in 6 months = 12 workers x 6 months x 21 days/month = 15 120 worker days

Cost of tools per worker day = R68 530/15 120 = R4.53

**Cost of tools per worker day = R4.53**

**Cost of tools for the works = 12 workers x R4.53 x 50 = R2,718** (Estimated costs as at mid 2011)

### **Option 2: Cost of tools based on individual task**

Life span = 6 months

Hand shovel = R100

Rake = R70

Wheelbarrow = R400

Camber board, spirit levels etc = R80\* provisional figure (guesstimate)

Total = R650

Worker days in 6 months = 1 worker x 6 months x 21 days/month = 126

Cost of tools per worker day = R650/126 = R5.19

**Cost of tools per worker day for spreading = R5.19**

The two options yield different average cost of tools for the same activity. Option 1 is recommended as the costing takes into account all the tools requirement to complete a length of road and thus one does not have to guesstimate the element of basic quality control aids such as camber boards, templates, etc.

### Average tools requirements table (120 Workers)

Item	Quantity	Estimated Price per unit (Rands)*	Amount (Rands)
Hoe	30	60	18 000
Pick axe	70	150	10 500
Shovel	100	100	10 000
Mattock	30	60	1 800
Fish line	10	20	200
Wheel barrow	20	400	8000
Camber board	4	200	800
Bush knife	10	50	500
Grass cutter	10	30	300
Rakes	15	70	1 050
Spreader	15	80	1 200
Hand rammer	10	250	2 500
Sledge hammer	5	500	2 500
Crow bars	5	200	1 000
Spirit level	5	230	1 150
Boning rod	4	170	680
Ranging rod	30	120	3 600
Ditch template	4	350	1 400
Line level5	5	70	350
Various small items			3000
<b>Total</b>			<b>68,530</b>

\* Actual prices to be used.

## Plant

In our example the plant requirement for compaction will be: A pedestrian roller and water bowser:

Area compacted per day =  $100\text{m} \times 6\text{m} = 600\text{m}^2$

Hire rate per day (roller and bowser) = R1 000/day

Compaction Unit Rate =  $R1\ 000 / 600\text{m}^2 = R1.67/\text{m}^2$

Cost of compaction =  $1000 \times 5\text{km} \times 6\text{m} \times R1.67/\text{m}^2 = R50,100$

## Transport:

In our example, transport is covered under a different BOQ item for haulage.

## Materials:

In our example there is no material cost as the soil is excavated and brought from a borrow pit. It should be noted that materials that are sourced away from site have a transport cost element that needs to be factored. Additional allowance should be made for materials that cannot be consumed 100% due to factors such as spillages and other wastages.

## INDIRECT COSTS

It is recommended to include indirect costs in the bid as a percentage addition to all items in the BOQ such that each item bears its fair share of the overall costs of carrying out the work. An easier approach is to first compare the total indirect costs to direct costs. Let's assume we found indirect costs to be 15% of total direct costs, then for every unit rate we can calculate 15% of the direct cost to obtain its indirect costs.

## PROFIT MARGIN

Profit allowance is a percentage of the total direct and indirect costs. After factoring direct and indirect costs and profit (10% say) of total costs the total project calculation looks as follows:

DIRECT PROJECT COSTS CHART									Indirect Cost (15%)	Total	Profit (10%)	Total Cost
List of Quantities Taken from the Bill of Quantities				Direct project costs To be calculated for each BOQ item								
Item No	Description	Unit	Quantity	Labour and Tools	Plant	Material	Trans	Total				
	Spread and compact base layer material	m <sup>2</sup>	30,000	70,518	50,100	-	-	120,618	18,092.70	138,710.70	13,871.07	152,581.71
<b>UNIT RATE (Divide total cost by total quantity) = R152 581.71/30 000</b>											5.09 Say 5.10	

## THE UNIT RATES

The client does not have to see how you calculated your unit rate. Divide the total cost per item by total quantity to get a unit rate. The final submission to the client would then look as follows:

BILL OF QUANTITIES					
Item No	Description	Unit	Quantity	RATE	Amount (R)
	Spread and compact base layer material	M <sup>2</sup>	30000	5.10	153,000
<b>TOTAL CONTRACT COST ESTIMATE</b>					153,000
<b>Plus % contingencies e.g. 10% (client to approve before use)</b>					15,300
<b>Final quotation submitted</b>					168,300

## PROJECT COST ESTIMATION FOR PLANNING PURPOSES

As part of the project planning process, Client Bodies are expected to produce annual plans and budgets for succeeding years' projects. Based on experience and empirical data, the table below provides guideline of unit cost indicators for some infrastructure projects, to assist EPWP implementing bodies in budgeting for projects:

EPWP Guideline for Capital Project Costing

Description	Average Unit Cost (Estimated costs as at mid 2011)
<b>Low-Volume Road works</b>	
Gravel Road Rehabilitation	R250,000 – 350,000 per km
Gravel Road Construction	R400,000 – 750,000 per km
Sealed Road Construction	R1,000,000 – 3,000,000 per km
Routine Road Maintenance	R10,000 – 30,000 per km per year
<b>Water and Sanitation</b>	
Water Reticulation Construction (without reservoirs)	R 350,000 – 600,000 per km
Water Reticulation Construction (with reservoirs)	R 550,000 – 1,000,000 per km
Sewer Reticulation Construction	R 300,000 – 500,000 per km
VIP Latrine	R 4,500 per Latrine

Example: If a municipality needs to upgrade a 5km low-volume gravel road to surfacing, then from the table above, the budget needed to upgrade the road will be:

5km x R1.0m to 5km x R3.0m = R5.0m to R15.0m

## References:

1. Extracts from 'Site Supervisor Course for Labour-Based and Community - Managed Upgrading of Urban-Income Settlements'
2. "Management Training for Labour-Based Road Contractors, Book 1, Pricing and Bidding"
3. "Road Maintenance and Regravelling (ROMAR) Using Labour-based Methods Handbook"
4. EPWP Guideline for Capital Project Costing.