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Guidelines for Estimation of Construction Time for Road and Bridge Works

Rajendra Raj Sharma
Sup. Engr. FHSMO,KTM, Department of Roads
razendra@live.com

Introduction

- Construction time estimation is important since:
  - It is a departmental procedural requirement to mention during preparation of estimates.
  - It is necessary for proper project planning, scheduling, cash flow forecasting, contract administration
  - It provides a logical ground for imposing penalty or awarding bonuses.

Introduction

- Until recent times there is no technically justifiable and objective method of project time estimation in the DOR.
- Each project is assigned a certain time for completion based on the experience of the estimator.
- Large discrepancy even among similar projects

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Background

- A committee formed to suggest and recommend the DOR a method of calculating the time for a project
- The committee analyzed various cases of construction projects time in the country and abroad and consulted relevant documents and literatures.
- The committee suggested a method which is briefly described in these presentations for DOR officials for their comments and suggestions.

Working Days vs Calendar days

- Project time is calculated as working days and not calendar days.

- Working days are later converted to calendar days

Working Days vs Calendar days

365 calendar days in a year = **240** Working days + **80** Holidays + **45** Rainy days

80 Holidays = **52** Saturdays + **28** Other Holidays

45 Rainy days = **8**असार(June 15 to July 15) **30**साउन(July 15 to August 15) **7**भदौ(August 15 to Sept 15)

Basic Project Time

- Basic project time(T_0) is calculated for very easy working conditions with very easy access(Basic Conditions) e.g for Terai or Kathmandu based on the project cost
- For other conditions T_0 is multiplied by appropriate coefficients.

Basic Project Time

Work Value, C NRs	Basic Project Time
C<= 30 Millions(तीन करोड)	<240 Working Days or 365 Calendar Days
C>= 1000 Millions(एक अर्व)	Work Out Specially !!!

Basic Project Time(Revised)

Work Value, C NRs	Basic Project Time
C<= 50 Millions(पाँच करोड)	<240 Working Days or 365 Calendar Days
C>= 10000 Millions(दश अर्व)	Work Out Specially !!!

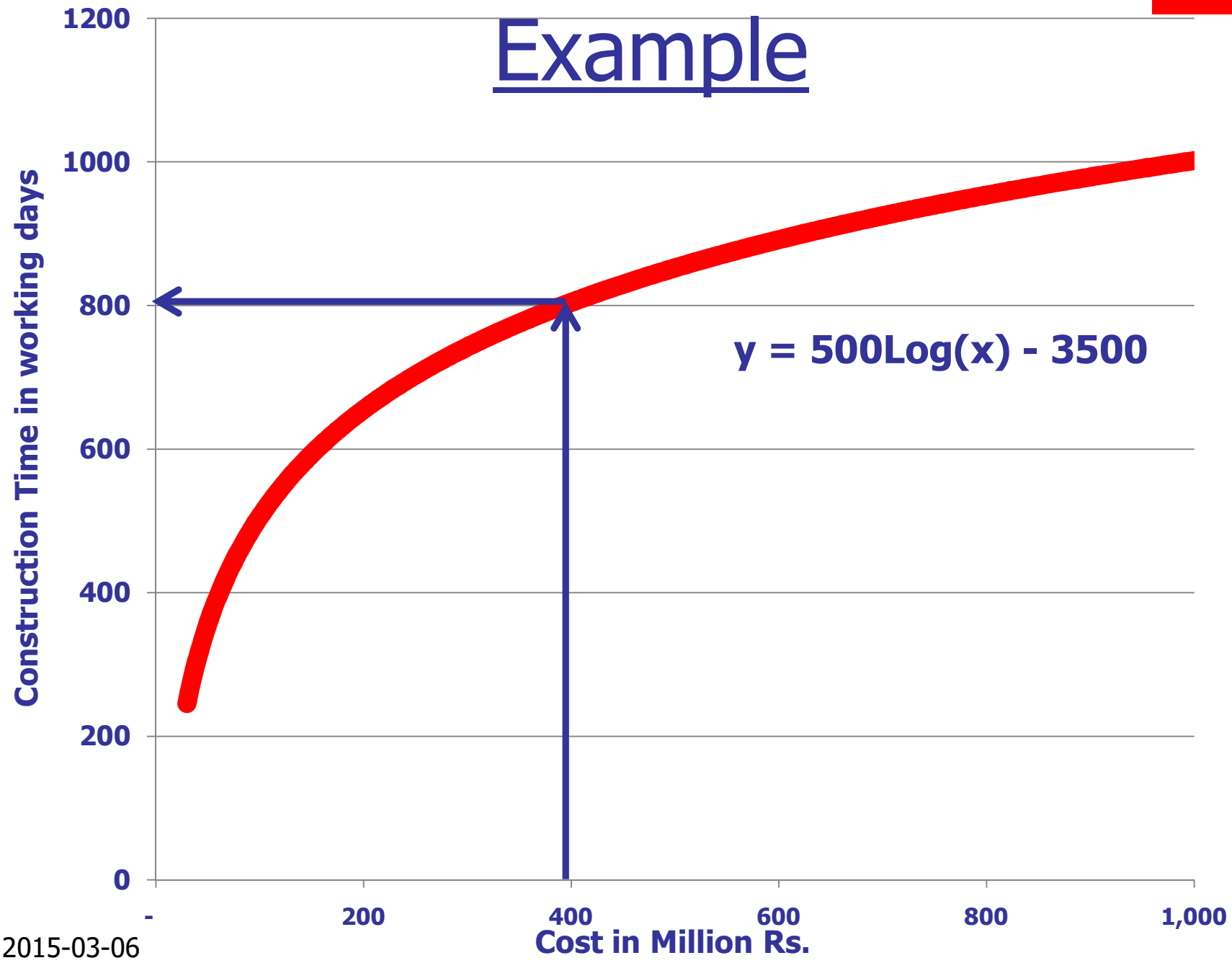
Basic Project Time

Work Value, NRs	Basic Project Time
30Millions<C<1000Millions	$500LogC-3500$ Working Days (where Log-logarithm of base 10)

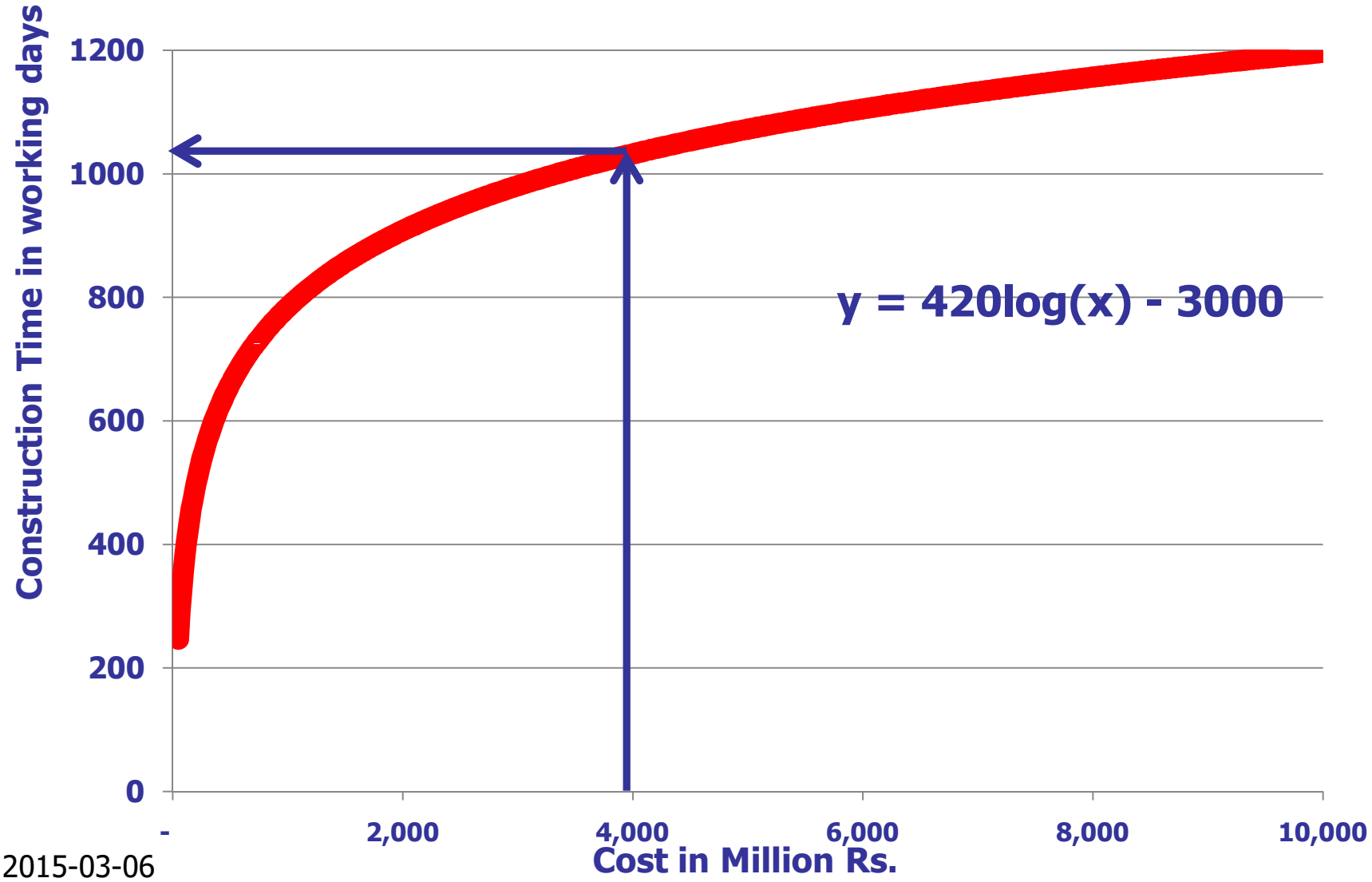
Basic Project Time(Revised)

Work Value, NRs	Basic Project Time
50Millions<C<10000Millions	$420LogC-3000$ Working Days (where Log-logarithm of base 10)

Example


1200
1000
800
600
400
200
0
Construction Time in working days
y = 500Log(x) - 3500
-
200
400
600
800
1,000
Cost in Million Rs.

Example(Revised)



Example

Cost,Rs	Time Working Days	Calendar Months
30,000,000	240	12
50,000,000	360	18
90,000,000	480	24
150,000,000	600	30
270,000,000	720	36
470,000,000	840	42
830,000,000	960	48
1,000,000,000	1000	50

Example(Revised)

Cost,Rs	Time Working Days	Calendar Months
50,000,000	240	12
90,000,000	360	18
180,000,000	480	24
360,000,000	600	30
710,000,000	720	36
1,380,000,000	840	42
2,680,000,000	960	48
10,110,000,000	1200	60

For conditions other than the basic conditions the Basic Project Time T_0 is multiplied by certain coefficients as given on following tables

Terrain or Geography Coefficient K_1

Terrain or Geography	Coefficient
Plain	1.00
Hills	1.05
Mountains	1.10

Terrain or Geography Defined

- Plain-All places <300m AMSL
- Hill-3000m>All places >300m AMSL
- Mountains-All places >3000m AMSL

Work Extension Coefficient K_2

Work Extent	Coefficient
<1km,concentrated works like bridges	1.00
1-25km	1.05
26-50km	1.10
> 50 km	1.15

Work complexity coefficient K_3

Work Complexity	Coefficient
Easy work (involving only up to 3 types of major construction materials for production)	1.0
Complex (involving more than 3 types of major construction materials for production using simple equipments)	1.05
Very complex (special equipments and involving special construction methods)	1.1

Complexity Defined

- Major construction materials include Bitumen, Cement, GI wire, Crushed aggregates, gravels
- Simple equipments mean excavator, grader, roller, bulldozer, loader, pile boring machines upto 750mm dia)
- Complex equipments mean Pile driving equipments (>750mm dia), Truss erection derricks, arch formworks, pile hammers, special erection cranes (>30T), bridge lifting jacks(>30T)

Limitations

- Applicable only for construction projects.
- Only for guidance and does not replace project planning and scheduling
- For projects having cost estimates of Rs. 30(50) million to Rs. 1(10) billion
- Budget availability is assumed.

Example 1

Find the duration of a pre-stressed concrete bridge project with estimated cost of NRs 80,00,00,000 located at Bardiya district of Nepal.

Solution:

- Basic Project Time, T_0=500*Log(800000000)-3500=951 working days
- Geographical coefficient=1
- Work extension coefficient=1
- Work complexity coefficient=1.1
- So actual duration T=951*1*1*1.1=1046.1 days
- So contract duration in calendar days=1046.1/240=4.359 years i.e. 4 years 4 months

Example 1(revised)

Find the duration of a pre-stressed concrete bridge project with estimated cost of NRs 80,00,00,000 located at Bardiya district of Nepal.

Solution:

- Basic Project Time, T_0=420*Log(800000000)-3000=740 working days
- Geographical coefficient=1
- Work extension coefficient=1
- Work complexity coefficient=1.1
- So actual duration T=740*1*1*1.1=814 days
- So contract duration in calendar days=814/240=3.39 years i.e. 3 years 5 months

Example 2

Find the duration of 12 km long road project with estimated cost of NRs 15,00,00,000 located at Solukhumbu district of Nepal.

Solution:

- Basic duration T0=500*log(150000000)-3500=588 working days
- Geographical coefficient =1.15
- Work extension coefficient=1.05
- Work complexity coefficient=1.05
- So actual duration T=588*1.15*1.05*1.05=746 days
- So contract duration in calendar days=713/240=3.106 years i.e. 3 years 1 months

Example 2(Revised)

Find the duration of 12 km long road project with estimated cost of NRs 15,00,00,000 located at Solukhumbu district of Nepal.

Solution:

- Basic duration T0=420*log(150000000)-3000=434 working days
- Geographical coefficient =1.15
- Work extension coefficient=1.05
- Work complexity coefficient=1.05
- So actual duration T=434*1.15*1.05*1.05=550 days
- So contract duration in calendar days=550/240=2.31 years i.e. 2 years 4 months

Conclusions and Recommendations

- For Design and Build projects adequate time should be added to design and other environmental and social clearances.
- For places with adverse climatic conditions working days should be calculated separately.
- For weather sensitive works eg surface dressing, special considerations should be made in calculating working days

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- For subsequent years revisions should be made from time to time (at about 3 years interval)
- Engineering Judgments should always be applied over all kinds of calculations.

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Thank You

Annex:
Why Logarithmic relationship?

$$T_0 = \int dt = \int \frac{dC}{e} = \int \frac{dC}{kC} = \frac{1}{k}\ln(C) + b$$

$$\Rightarrow T_0 = aLogC + b$$

$$\text{where } a = \frac{1}{k}\ln(10)$$

$$\ln - \text{natural} \quad \text{logarithm}$$

$$Log - \text{logarithm with} \quad \text{base} \quad 10$$

Annex

- *C*-Project Cost
- *e*- effort applied(assumption:the bigger the project the more effort is applied i.e. *e* is proportional to *C* or *e=kC*
- *a,b*-constants(for present conditions of road and bridge projects of Nepal *a=500(420), b=-3500 (-3000)*)