GPSC - CIVIL

Construction, Planning and Management

"All Birds find shelter during a rain.
But Eagle avoids rain by flying above
the Clouds."

A.P.J. Abdul Kalam

The content of this book covers all PSC exam syllabus such as MPSC, RPSC, UPPSC, MPPSC, OPSC etc.

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CHAPTER 1:

PROJECT MANAGEMENT

OBJECTIVE OF PROJECT

1. The project should be completed in minimum time period.

2. Project should use available manpower and local resources as far as possible.

3. Project should be completed without delay and minimum investment cost.

ELEMENTS OF PROJECT MANAGEMENT

Three stages of project management are,

1. Planning

- It is the most important technique of the project management.
- Planning means defining the objectives of the project and to identify the different task, material, equipment and etc. that are required for completing the project.

2. Scheduling

- Scheduling is the deciding the phasing rate of activities with the starting and completion dates and the sequential relationship among the various activities in a project such that work can be carried out in an orderly and effective manner.
- In simple words we can say that scheduling that order of all the activities and allocation of resources (like time, space, equipment, material, and manpower) to the activities.

3. Controlling

- The control of large projects, like the control of any management system, involves close monitoring of resources, costs, quality, and budgets. Control

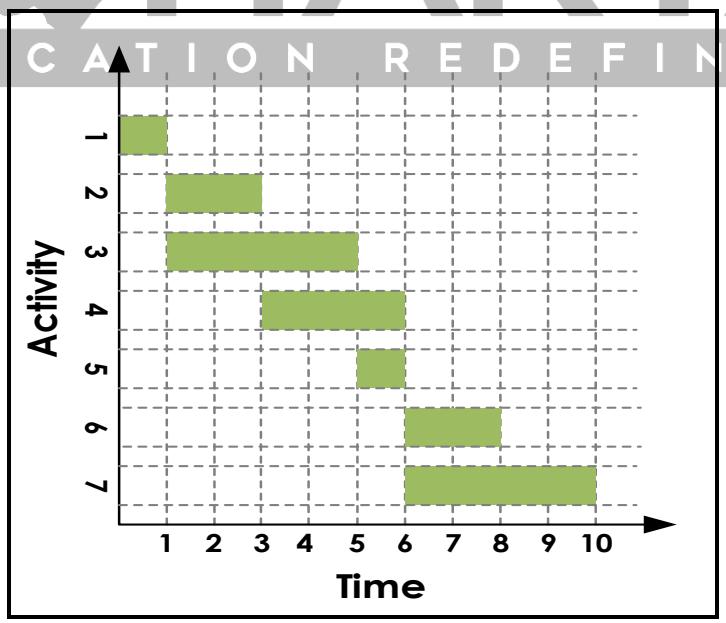
Numerical

Q1. Draw a bar chart for certain project whose activity breakdown is as under,

Activity no.	Duration (weeks)
1	1
2	2
3	4
4	3
5	1
6	2
7	4

Activity 2 and activity 3 can be done concurrently and both must follow activity 1. Activity 2 must precede activity 4. Activity 5 can't begin until both activities 2 and 3 are completed. Activity 6 and 7 can be started only after activities 4 and 5 are complete.

Solution



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Test Series Available..

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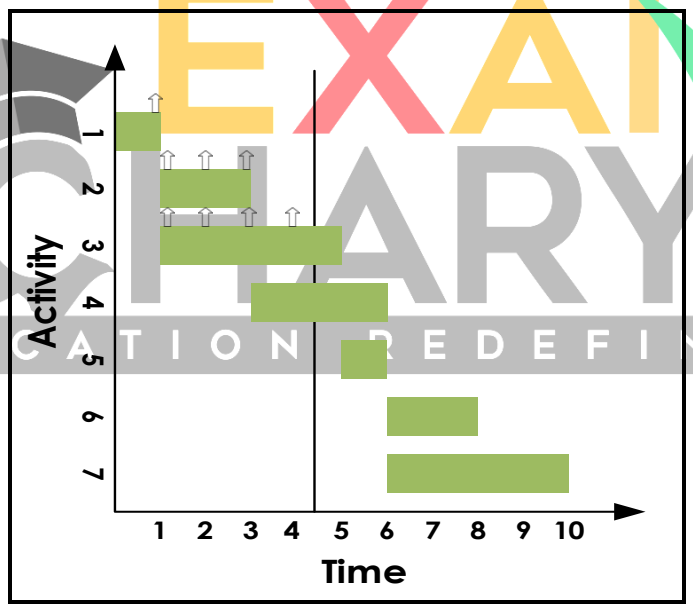
Total full length test : 13

Mock test : 16

Total test : 80

2. Milestone Chart

- The milestone chart is an improvement over the original bar chart.
- In each activity, there are certain key events which mark the completion of certain portion of the main activity. Such key events are called milestone.
- Milestone can be represented by an arrow, square or a circle on the bar of that particular activity.
- Each milestone can be considered to be specific event along the main activity and which chart is called as milestone chart.
- It has been observed that when a particular activity represented by a bar is very long. The details of sub activities will be lacking.
- If, the activity in broken down into number of sub activities or key events, each one of which can be recognized during the progress of that activity, and through which controlling can be achieved.



➢ ***Limitations of Milestone Chart***

- Within an activity, the relationship between two specific milestone is revealed by milestone chart whereas the relationship between and among milestone contained in different activities is not indicated.

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Building Material and Construction

Dream is not that which you see while sleeping it is something that does not let you sleep.

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CHAPTER 2:

FUNDAMENTALS OF NETWORK

INTRODUCTION

Network are used for the purpose of planning, scheduling, and controlling the progress on various components of the projects, especially those projects which are complex in nature. In simple words we can say that network is a flow diagram consisting of activities and events connected logically and sequentially.

Network diagrams are of two types,

1. Activity over arrow,
2. Activity over node.

ACTIVITY OVER ARROW (A-O-A) NETWORK DIAGRAMS

➢ Activity

- A project can be broken down into various jobs in the form of operation and processes necessary for its completion. Each of these operation or processes consuming time or resource is called as an activity.

- Activity are denoted by an arrow. The tail of the arrow signifies the start of activity and the arrowhead its termination.

$$\xrightarrow[\text{Duration (T)}]{\text{Description}}$$

- Generally, the description of activity is written above the arrow, and its duration in the middle underneath.

- Length of arrow has no significance.

Types of Events

1. ***Tail Event***

- An event which marks the beginning of an activity is called tail event or preceding event.
- If a particular event represents the start of a project it is called as initial event.

2. ***Head Event***

- An event which marks the completion of an activity is called head event or succeeding event.
- If a particular event represents the end of a project it is called as end event.

3. ***Dual Role Event***

- If an event acts as the tail event for some activity and as the head event for some other activity or activities, it is called as dual role event.
- In a network diagram all the events other than initial and final events are dual role event.

4. ***Dummy Activity***

- It is a type of activity in the network which neither consumes any time nor resources.
- It is an artificial activity.
- A dummy activity is represented by a dashed arrow and identified by the terminal node or event which it connects.
- Function of dummies are

a. Dummy maintains the logic of network diagram.

b. Dummy keeps the numbering system of the network unique.

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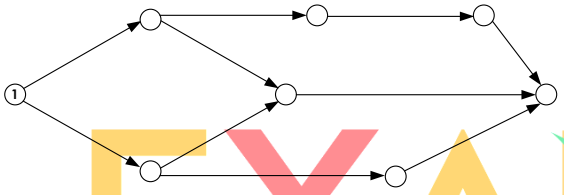
12. Time flow is from left to right i.e. arrows denoting activities should point from left to right. However, if arrow is vertical it may point upward or downward.

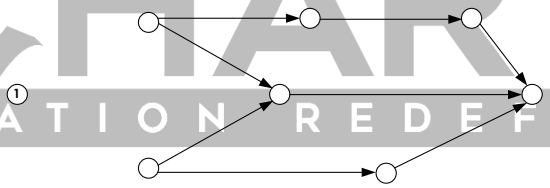
NUMBERING OF EVENTS (FULKERSON'S RULE)

- Activities are usually identified by node numbers i.e. the number of events on either end of the activity arrow.
- Therefore, the events should be numbered in such a way that the logical sequence is maintained.
- Numbering can be done in following steps,

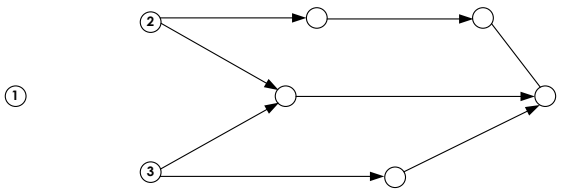
1. Number the initial event as '1',



2. All the arrows coming out of initial event (1) are neglected. This will create one or more new initial events.



3. Number those new initial events as 2 and 3,



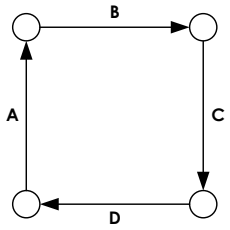
4. Again, neglect all emerging arrows from these newly numbered events which will create a few newer initial events,

5. Follow step 3,

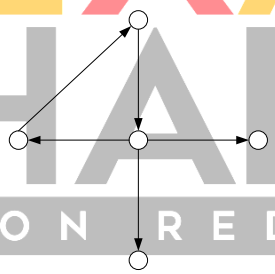
- In skip numbering the events are numbered in the multiples of 10, 20, 30 etc.
- In future if any events are added it can be assigned a number such as 15, 22, 31 etc. which lies in between the number of immediate predecessor event and immediate successor event.

ERROR'S IN NETWORK DIAGRAM

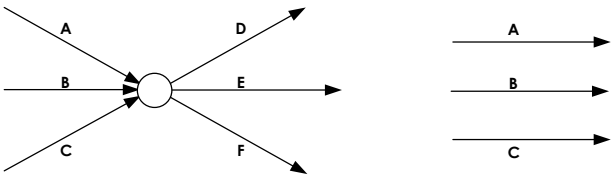
1. **Cyclic or Looping Error**



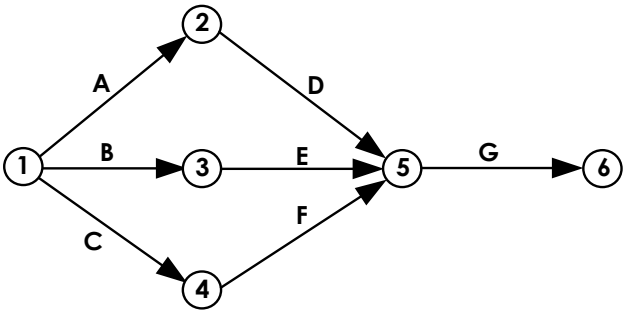
2. **Dangling Error:** Project completed when all its activities are over but following situation can't arise in any case because a network diagram can't have two end points.



3. **Wagon Wheel Error:** This is the most difficult error to be spot and this can be found after examining the entire network diagram in detail. This is a conceptual error, as there may be no event taking place at this point in the following network.



Solution



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Transportation Engineering

END is not the end if fact E.N.D. means
" Effort Never dies"

A.P.J. Abdul Kalam

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information for estimation of time duration. PERT is used in R & D type project such as space industry, defense industry etc. As such projects are of nonrepetitive type or once through type for which correct time estimates can't be made. Further a PERT analysis is event oriented i.e. in this analysis interest is more focused on the events (start or completion of activity) rather than the activity.

In order to take into account, the uncertainties involved in the activity times three kinds of time estimates are made for each activity in PERT.

1. ***Optimistic Time Estimation (t_0):***

   It is the minimum time required for an activity if everything does perfectly well without any problems or adverse conditions developed during the execution of the activity.

2. ***Pessimistic Time Estimate (t_p):***

   It is the maximum time required for an activity if everything goes wrong and abnormal situations prevail.

3. ***Most Likely Time Estimation (t_l or t_m):***

   It is required to complete the activity if normal condition prevail. This time estimate lies between pessimistic and optimistic time estimates.

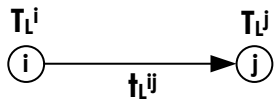
$$t_e = \frac{t_0 + 4t_m + t_p}{6}$$

Note:

- These time may took normal or simple, but they provide useful information about the expected uncertainties in an activity are usually expressed in days, weeks or month and represent the calendar dated and not actual working days.

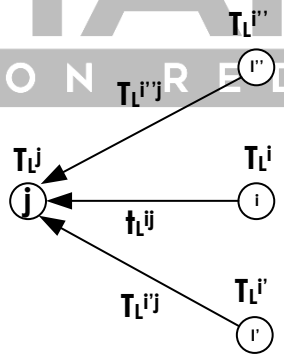
2. Latest Allowable Occurrence Time (T_L):

It is the maximum time of an event by which it may be allowed to occur without affecting the completion time of the project. It is also called Latest allowable time and denote by T_L. It is determined by backward pass method. Almost all the projects are time bound which is known as contractual obligation time or scheduled completion time and is denoted by T. We know that for on time completion of the project T = T_L of the last event in the network. The latest allowable time (T_L) of an event is calculated by subtraction the activity time t_e^{ij} form the latest allowable time of the successor event of the activity (T_L^j).



$$T_L^i = T_L^j - t_e^{ij}$$

If there are more than one successor for an event i, then latest allowable time for event i (T_L) will be minimum of $\left(T_L^j - t_e^{ij}\right)$.



$$T_L^i = \min\left\{\left(T_L^j - t_e^{ij}\right), \left(T_L^{j'} - t_e^{i'j}\right), \left(T_L^{j''} - t_e^{i''j}\right)\right\}$$

Note:
- Latest allowable time for the last or final or end event is taken same as Earliest expected time (T_E) of the last event of the network. If nothing is mentioned in the question. For last event of the Network $T_E = T_L = T_s$.

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3. Negative Slack (S < 0)

A negative slack is obtained when T_L is less than T_E for an event.

It indicates that,

a. This event is behind the schedule by the time period equal to slack of that event. Any further delay in such events cause more delay in the project hence these events are called super critical events.

b. Resource deployed are not adequate enough.

CRITICAL PATH

After the project plan is completed and activity times are known to estimate how long the project will continue we will have to determine the critical path. A critical path is the path in a project network which commencing from the initial event connects the events having zero or minimum slack times and terminates at the end event. Events having zero or minimum slack rimes are called as critical events because any delay in their occurrence will cause delay in project. Therefore, we can say that critical path is the path connecting the critical events of the project. Activities along the critical path are called as critical activities.

Variance of a path or critical path = Sum of variance of activities along that path or critical path.

Standard deviation of a path or critical path = Square root of sum of variance of activities along that path or critical path.

PROBABILITY COMPLETION

Steps

Step 1. The standard deviation σ corresponding to the critical path in the network K is calculated.

$$\sigma = \sqrt{\text{Sum of variance along the critical}} = \sqrt{\sigma_{ij}^2}$$

Numerical

Q1. A project takes 20 days along the critical path and has a standard deviation of 4 days. What is the probability of completing the project within 20 days, 24 days, and 18 days.

Solution

According to the question,

$\sigma = 4$

For 20 days,

$$Z = \frac{T_S - T_E}{\sigma}$$

$$= \frac{20-20}{4}$$

$$= 0$$

$$\therefore P_r = 50\%$$

For 24 days,

$$Z = \frac{T_S - T_E}{\sigma}$$

$$= \frac{24-20}{4}$$

$$= 1$$

$$\therefore P_r = 84.13\%$$

For 18 days,

$$Z = \frac{T_S - T_E}{\sigma}$$

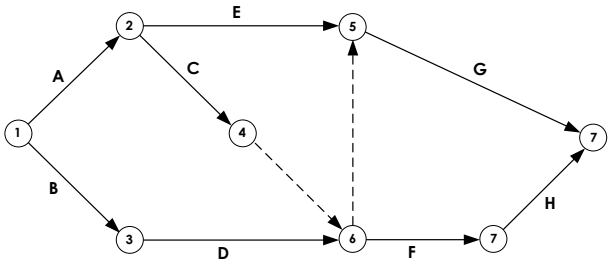
$$= \frac{18-20}{4}$$

$$= -0.5$$

$$\therefore P_r = 30.85\%$$

Answer:

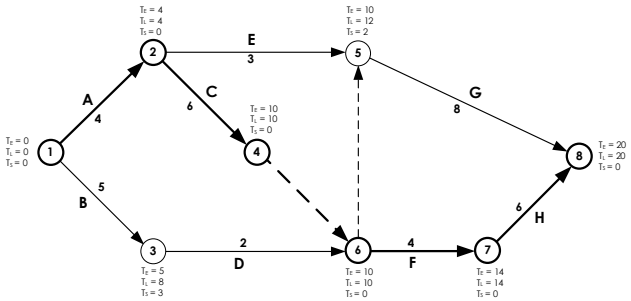
The expected completion time of the project for 94%, 46% and 75% probabilities are 44.68 days, 39.7 days, and 40.0257 days respectively.



Calculation for T_E, σ and σ^2.

Activity	t_o	t_m	t_p	$T_E = \frac{t_o + 4t_m + t_p}{6}$	$\sigma = \frac{t_p - t_o}{6}$	σ^2
A	1	4	7	4	1.00	1.00
B	1	5	9	5	1.33	1.78
C	3	6	9	6	1.00	1.00
D	1	2	3	2	0.33	0.11
E	1	2	9	3	1.33	1.78
F	2	4	6	4	0.67	0.44
G	2	9	10	8	1.33	1.78
H	6	6	6	6	0.00	0.00

Calculation of T_E, T_L and T_S are done in network diagram below.



We can observe that events 1, 2, 4, 6, 7, and 8 are having zero Slack,

∴ Critical path is 1 – 2 – 4 – 6 – 7 – 8 or A – C – F – H.

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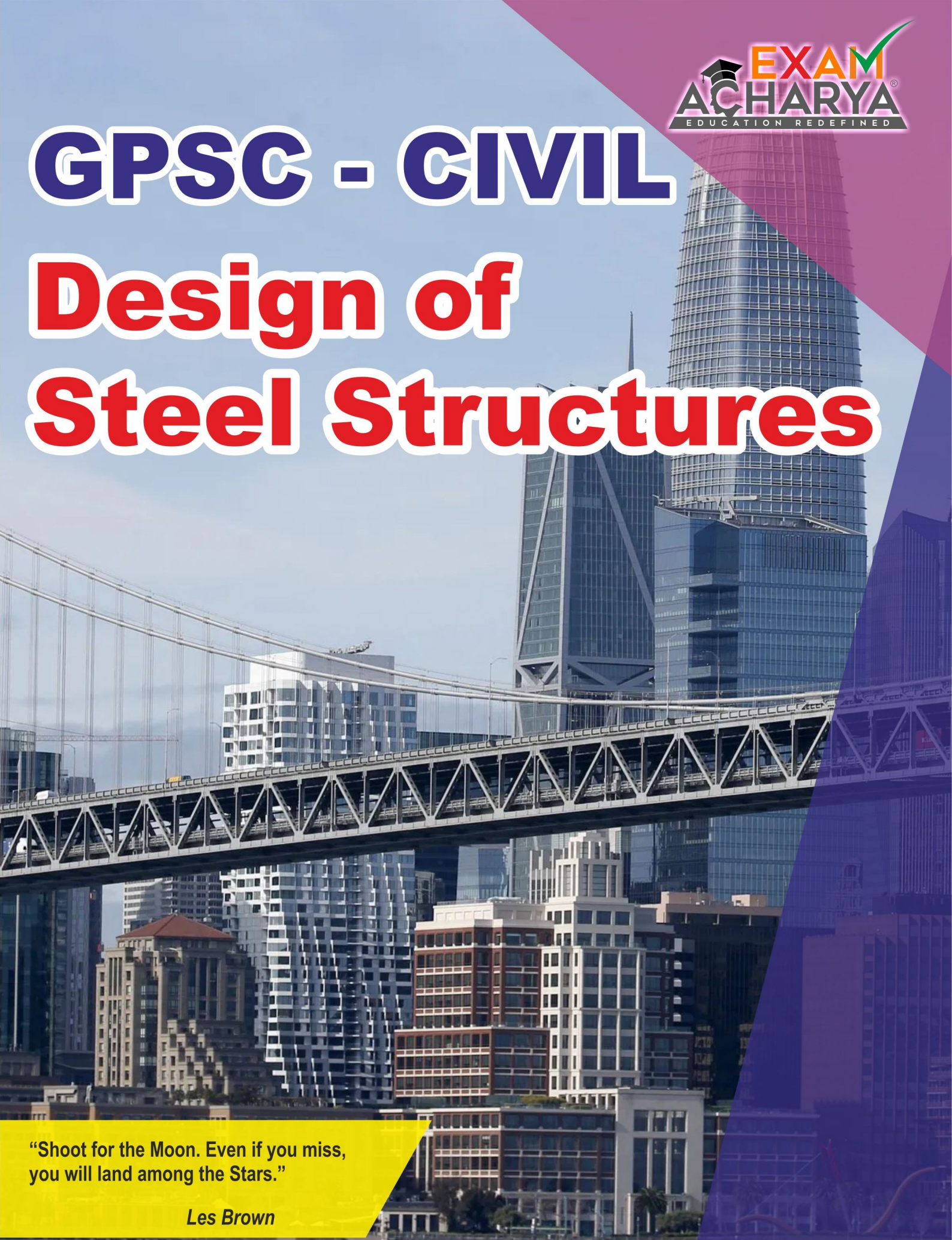
Design of Steel Structures



"Shoot for the Moon. Even if you miss, you will land among the Stars."

Les Brown

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CHAPTER 4:

CRITICAL PATH METHOD

INTRODUCTION

Critical path method, commonly abbreviated as CPM, is closely resembles PERT in many aspects, but it was independently developed. M.R. Walker and J.E. Kelley of Remington Rand were involved in development of CPM for the construction of chemical plants in united states. Both CPM and PERT are the tools used now a days synonymously for planning, scheduling, and controlling various projects, through broad difference exists between them. The major difference between the two techniques is that CPM doesn't incorporate uncertainties in job times i.e. time estimate is deterministic. It assumes that activity times are proportional to the amount of resources allocated to them, and by changing the level of resources the activity times and the project completion time can be varied. CPM is mostly used in construction projects when there is prior experience in handling similar projects from which relationships between resources and job time are available. CPM them evaluates the tradeoff between projects and projects completion time comparison between CPM and PERT.

PERT	CPM
1. Network diagram is event oriented.	**1.** Network diagram is activity oriented
2. It uses probabilistic approach and is suitable for research and development and nonrepetitive project.	**2.** It uses deterministic approach and is suitable for repetitive type of project.
3. 3 time estimates are given for completion of an activity.	**3.** Single times estimate is given for each activity.
4. Follows β distribution.	**4.** Follows normal distribution
5. Cost of project is directly proportional time and hence to minimize the project cost the project completion time is minimized.	**5.** Cost model has to be developed using which minimum cost of the project is found.
6. Critical events are identified by using the concept of slack.	**6.** Critical activities are identified by using concept of float.
7. Critical path will be path joining the critical events.	**7.** Critical path will be the path joining all the critical activities.

1. Earliest Start Time (EST):

It is earliest time by which the activity can commence. It is equal to the earliest event time T_E for the event form which the activity arrow originates. If the activity is denoted by i – j.

$$(\mathbf{EST})_{ij} = \mathbf{T_E^i}$$

Where, T_E^i = Earliest event time for the tail event.

2. Earliest finish time (EFT):

It is earliest time by which the activity can be completed. It is equal to the earliest start time plus the activity duration. If the activity is denoted by i – j.

$$(\mathbf{EFT})_{ij} = (\mathbf{EST}) + \mathbf{t^{ij}}$$

$$(\mathbf{EFT})_{ij} = \mathbf{T_E^i} + \mathbf{t^{ij}}$$

3. Latest start time (LST):

It is the latest (or delayed) time by which activity can be started, without delayed the completion of the project. LST is equal to the latest occurrence time (T_L) for the event at which the activity arrow terminates minus the duration of the activity. For activity i – j.

$$(\mathbf{LST})_{ij} = \mathbf{T_L^j} - \mathbf{t^{ij}}$$

4. Latest finish time (LFT):

It is the latest (or delayed) time which the activity can be finished, without delaying the completion of the project. It is the equal to the latest occurrence time (T_L) of the event at which the activity terminates. For activity i – j.

$$(\mathbf{LFT})_{ij} = \mathbf{T_L^j}$$

$$(\mathbf{LFT})_{ij} = (\mathbf{LST})_{ij} + \mathbf{t^{ij}}$$

$$F_F = F_T - S_j$$

Where,

S_j = slack for event j or slack of head event of activity i – j.

Note
- Free float is the amount of time an activity can be delayed without affecting the commencement of a subsequently activity at its EST but may affect the float of a previous activity.

3. Independent Float (F_{IND}):

It is the amount of the time by which an activity can be delayed when all the preceding activities are completed as late as possible and all succeeding activities started as early as possible. Independent float can also be defined as the excess of minimum available time over the required activity duration.

$$F_{IND} = F_F - S_i$$

Note
- Independent float does not affect the float of preceding and succeeding activities.

4. Interfering Float (F_{INT})

It is defined as difference of total float and free float of an activity. It is also equal to the slack of head event of head activity as shown below.

$$F_{INT} = F_T - F_F$$

SUPER CRITICAL, CRITICAL AND SUBCRITICAL ACTIVITIES

The most important type of float is total float because it is involved with the overall project duration. As discussed before, the total float is the difference between maximum available time and the activity duration, there are three cases.

1. Negative total float ($F_T < 0$):

If the maximum available time for an activity is less the activity time, the total float will have a negative value. Such activities demand special attention because

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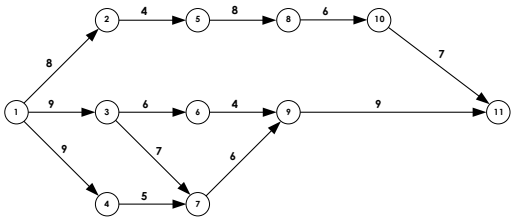
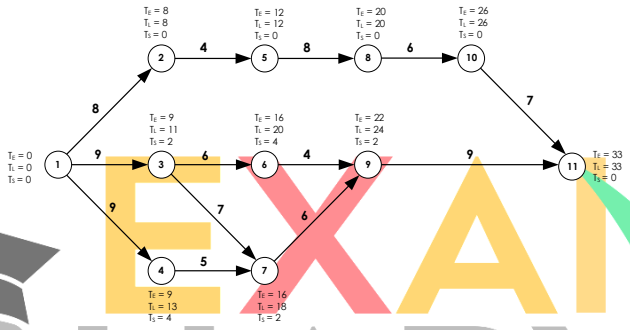
Numerical

Q1. From the following network diagram find the critical path, F_T, F_F, F_{IND}, F_{INT}.



Solution

Calculation of T_E, T_L and T_S are done in network diagram below.



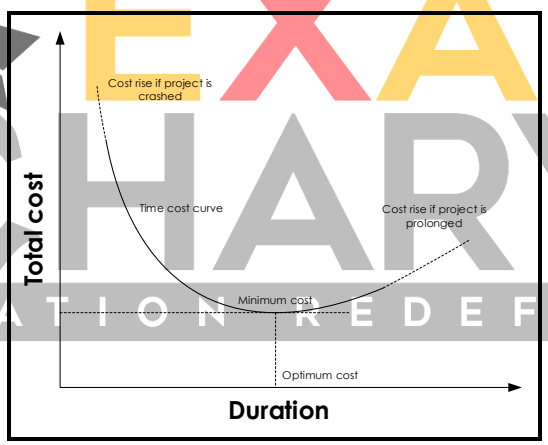
Act	t_{eij}	T_E^i	T_e^j	T_L^i	T_L^i	EST	EFT	LST	LFT	F_T	S_j	F_F	S_i	F_{IND}	F_{INT}
1 - 2	8	0	8	0	8	0	8	0	8	0	0	0	0	0	0
1 - 3	9	0	9	0	11	0	9	2	11	2	2	0	0	0	2
1 - 4	9	0	9	0	13	0	9	4	13	4	4	0	0	0	4
2 - 5	4	8	12	8	12	8	12	8	12	0	0	0	0	0	0
3 - 6	6	9	16	11	20	9	15	14	20	5	4	1	2	-1	4
3 - 7	7	9	16	11	18	9	16	11	18	2	2	0	2	-2	2
4 - 7	5	9	16	13	18	9	14	13	18	4	2	2	4	-2	2
5 - 6	4	12	16	12	20	12	16	16	20	4	4	0	0	0	4
5 - 8	8	12	20	12	20	12	20	12	20	0	0	0	0	0	0
6 - 9	4	16	22	20	24	16	20	20	24	4	2	2	4	-2	2
7 - 9	6	16	22	18	24	16	22	18	24	2	2	0	2	-2	2
9 - 11	9	22	33	24	33	22	31	24	33	2	0	2	2	0	0
8 - 10	6	20	26	20	26	20	26	20	26	0	0	0	0	0	0
10 - 11	7	26	33	26	33	26	33	26	33	0	0	0	0	0	0

CHAPTER 5:

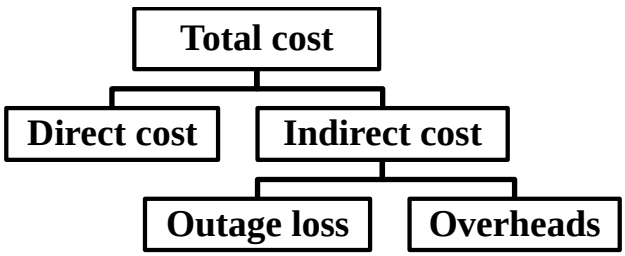
CRASHING

INTRODUCTION

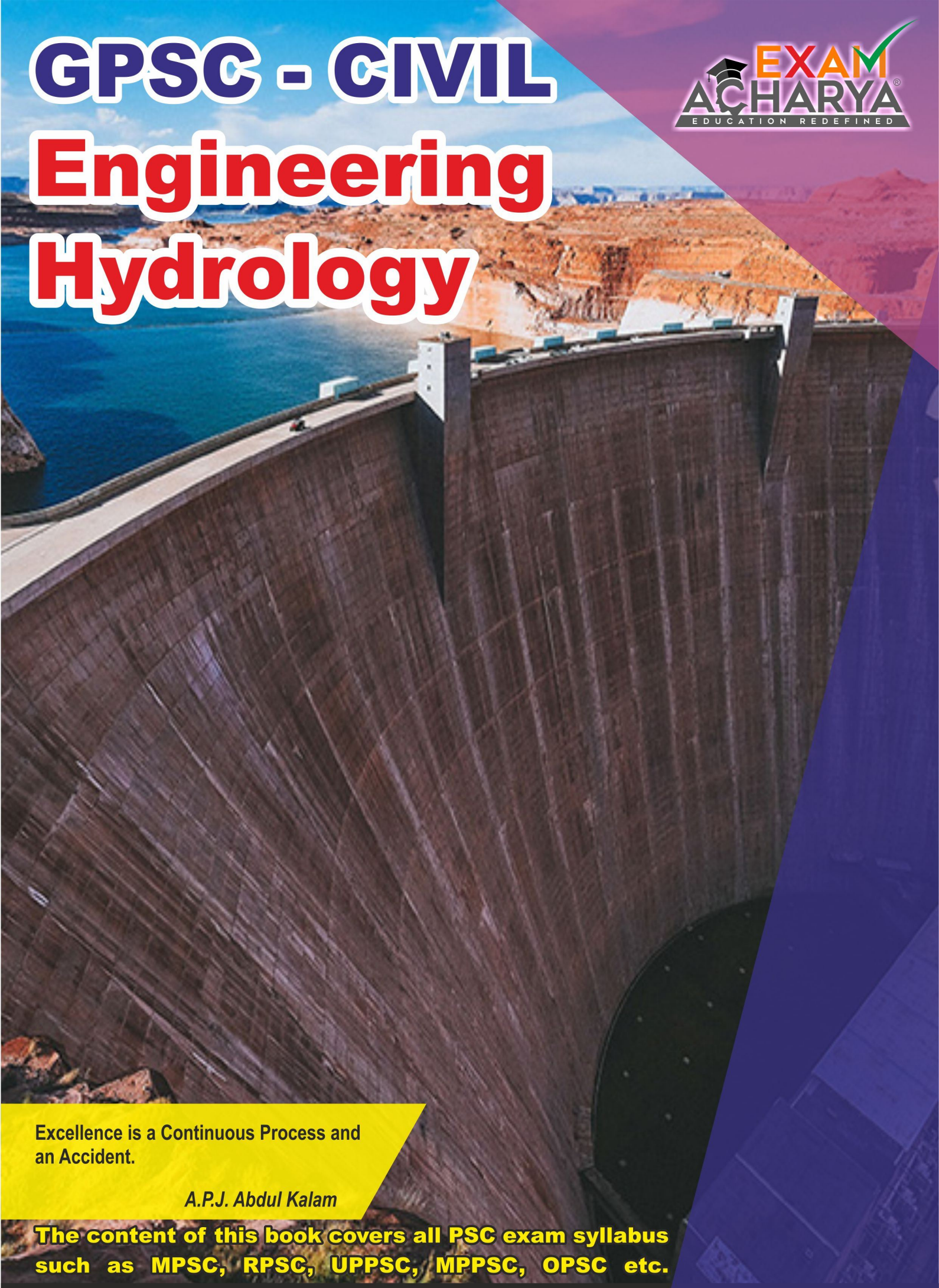
For any project the two important aspects to be considered are, the project time and project cost. Project times are determined by locating the critical and subcritical paths in the project network. It is observed that in construction projects time is related to project cost, bust time relationship to not linear. To find the minimum cost, a cost model or time cost relationship or project cost function, has to be developed. The cost model shows "relationship of the cost" versus "the completion time". Its ordinate represents the cost and abscissa has a time scale as shown in the figure below. Project time corresponding to minimum value of the cost function gives the most optimum duration of the project.



Project cost or total project, in any project cost consists of two separate cost.



GPSC - CIVIL Engineering Hydrology

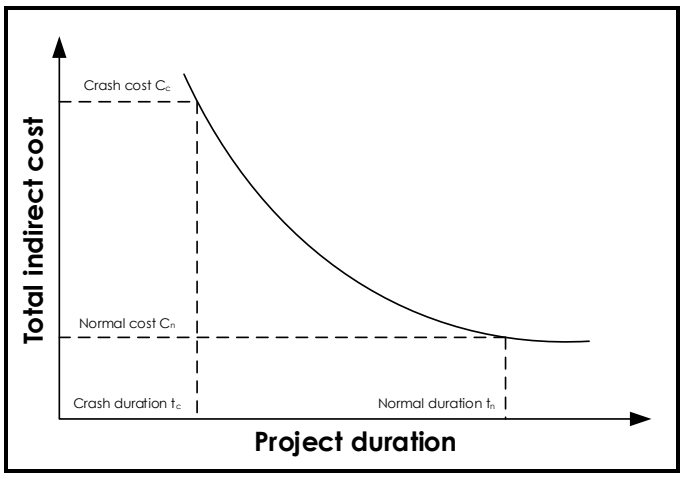


EXAM ACHARYA
EDUCATION REDEFINED

Excellence is a Continuous Process and an Accident.

A.P.J. Abdul Kalam

The content of this book covers all PSC exam syllabus such as MPSC, RPSC, UPPSC, MPPSC, OPSC etc.



NORMAL TIME (t_n)

It is the standard time that an estimator will assign to an activity.

CRASH TIME (t_c)

It is the minimum possible time in which an activity can be completed by assigning extra resources. Or crash time is that time before which an activity can't be completed even by application of infinite number of resources.

NORMAL COST

It is the direct cost of an activity associated with the normal time.

CRASH COST

It is the direct cost of an activity corresponding to the crash time.

OPTIMUM COST AND OPTIMUM DURATION

We know that,

Total project cost = direct cost + indirect cost.

If direct and indirect cost vary with time is shown in fig. below, then total project cost versus time curve have the shape as indicated in the fig. below.

$$\text{Cost slope} = \frac{C_c - C_n}{t_n - t_c} = \frac{\text{crash cost} - \text{normal cost}}{\text{Normal time} - \text{crash time}}$$

Note:
- Crashing potential of an activity = normal time – crash time

Cost slope is helpful in project cost analysis of direct cost. But this curve can also be approximated by a series of connecting straight lines as shown below. Cost slope can be calculated using segmented approach i.e. separately for each segment of straight line. The segmented approach of cost slope is more accurate but requires more calculation. Generally single cost slope is assumed to avoid calculation.

Note:
- Cost slope indicates the increase in direct cost when the activity is reduced by one day.

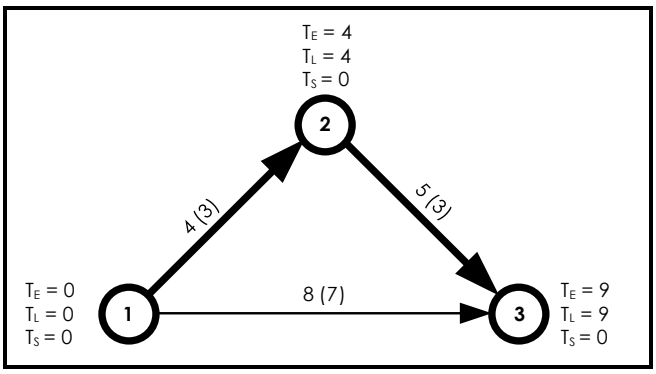
CRASHING

The process of reducing of total project duration along the longest path (time wise) of the network i.e. along the critical path to obtain the optimum project cost and optimum duration is called as crashing. Crashing is a methodology or a procedure to obtain optimum project cost and optimum duration.

Procedure

1. Draw the network diagram.
2. Perform the analysis to determine the critical path.
3. Indicate the critical path along the network diagram or timeline diagram.
4. Find the cost slope of each activity.
5. Start crashing the activity along the critical path having minimum (or least cost slope).
6. Each activity is shortened or crashed until its crashing potential is exhausted or a new critical path is formed.

Network diagram,



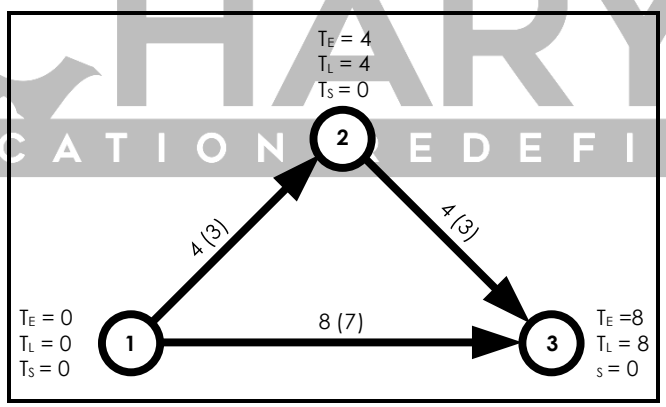
Total duration = 9 weeks

Direct cost = 4000 + 5000 + 8000 = 17000

Indirect cost = 9 × 2000 = 18000

Total cost = 17000 + 18000 = 35000

We have to crash activity 2 – 3 because its cost slope is minimum and is having crashing potential of 2 week. But if we crash activity 2 – 3 by 2 weeks then critical path will change from 1 – 2 – 3 to 1 – 3. So, we don't want to change the critical path. Hence we have to crash activity 2 – 3 by 1 week only.



Total duration = 8 weeks

Direct cost = 17000 + 1000 = 18000

Indirect cost = 8 × 2000 = 16000

Total cost = 18000 + 16000 = 34000

Crash activity 2 – 3 and 1 – 3 by 1 week,

CHAPTER 6:

RESOURCE ALLOCATION

Depending upon situation, the resource allocation can be done by the following two methods.

1. Resource Smoothing
2. Resource levelling

(1) RESOURCE SMOOTHING

Resource smoothing is resorted or done when there is restriction on the duration of project completion time. The resource smoothing is applied in such a way that the total project duration remains the same i.e. there is no change in the total duration of the project. First the periods of minimum demand for resources are determined or located and the activities are shifted according to the availability of float and requirement of resources. Thus the intelligent use of floats can smoothen the demand to the maximum possible extent. This type of resource allocation is known as **resource smoothing.**

Following steps are involved in resource smoothing:

1. The list of resources required for the execution of different activities is prepared and the important activities are identified.
2. The resource profiles are prepared by resource aggregation and cumulative resource requirements for each unit are plotted in the form of histogram.
3. The time periods of peak and low demand are identified and the peaks are lowered and the troughs are filled up.
4. If there is no restraint on the availability of resources, the demand of resources should be made as uniform as possible. This can be done by changing the time of start and finish of non-critical activities in the first instance. These activities have some float. Hence the available float can be used for doing adjustment in the start of finish of the concerned activities.

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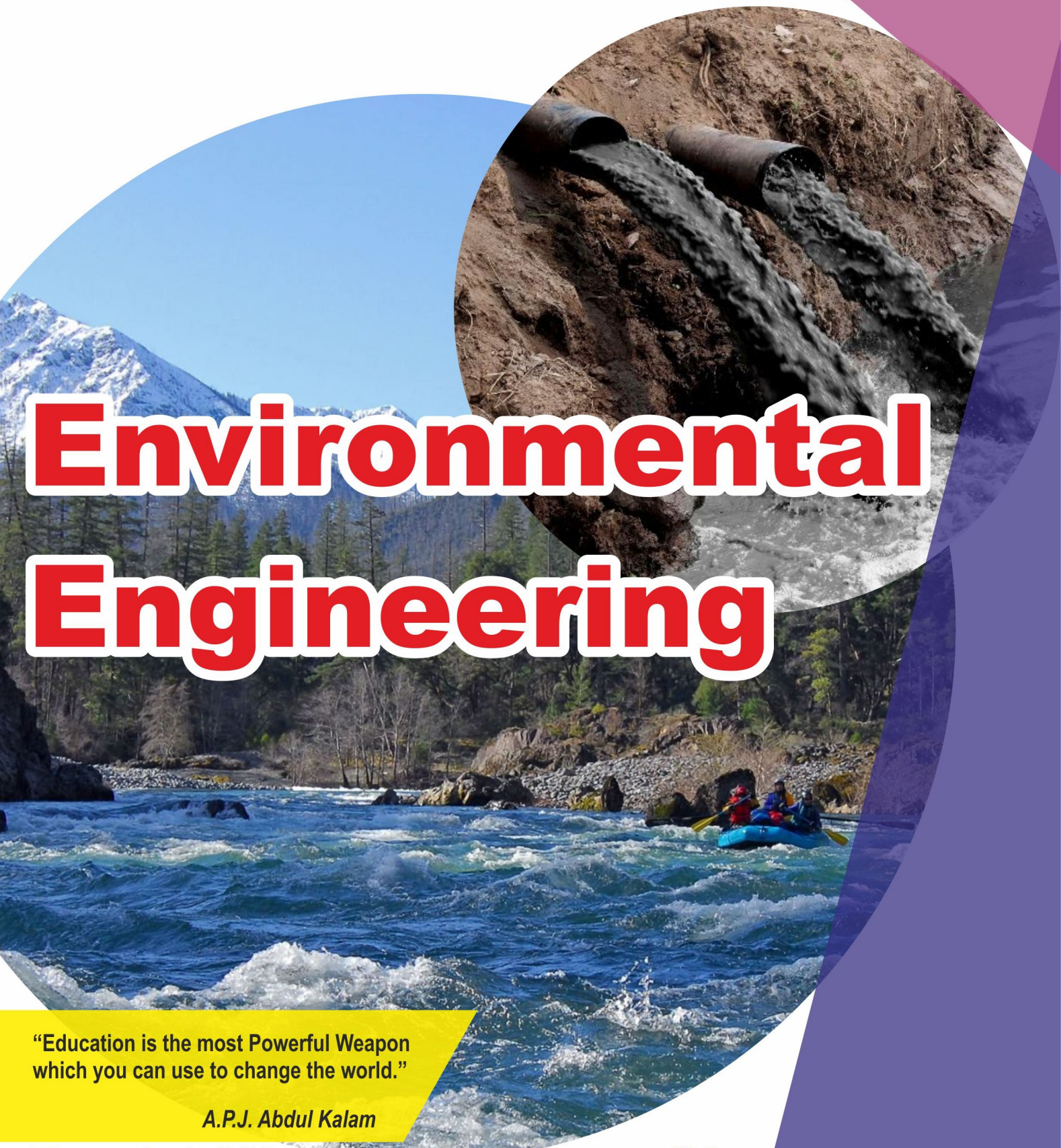

Environmental Engineering

"Education is the most Powerful Weapon which you can use to change the world."

A.P.J. Abdul Kalam

The content of this book covers all PSC exam syllabus such as MPSC, RPSC, UPPSC, MPPSC, OPSC etc.

INTEREST FORMULAE

(1) Simple interest:

$$L = P.\,ni$$

where

l = total interest

P = Principal amount

n = number of years

i = interest rate

If P = 1000 Rs.

n = 5 years

i = 8 %

$\therefore$ l = 1000 x 5 x 0.08

= 400 Rs.

(2) Compound interest:

$$F = P\,(l + i)^n$$

where,

F = future amount (Compound amount)

P = Principal amount

i = interest rate

n = number of years

If P = 1000 Rs.

n = 5 years

i = 8 %

$F = P\,(l + i)^n$

$= 1000(\,1 + 0.08)^5$

= 1469.32 Rs.

Present worth:

$$\mathbf{P = \frac{F}{(l + i)^n}}$$

(3) Single Payment – Compound Amount Factor (SPCAF) :

$$\mathbf{SP\ PWF = \frac{1}{(l + i)^n}}$$

$$\therefore \quad \mathbf{F = \frac{F}{(l + i)^n}}$$

(7) Equal Payment Series – Present Worth Factor (EPS PWF):

$$\text{EPS PWF} = \left[\frac{(1+i)^n - 1}{i(1+i)^n}\right]$$

$$\therefore \quad P = A\left[\frac{(1+i)^n - 1}{i(1+i)^n}\right]$$

How much amount should be deposited in a bank to receive an annual Payment of Rs. 20,000 at the rate of 10 % for next 12 years?

$$\therefore \quad P = 20{,}000\left[\frac{(1+0.10)^{12} - 1}{0.10(1+0.10)^{12}}\right]$$

$$= 20{,}000 \times 6.8137$$

$$= 1{,}36{,}274 \text{ Rs. (Present worth)}$$

(8) Equal Payment Series – Capital Recovery Factor (EPS CRF) :

$$\text{EPS CRF} = \frac{i(1+i)^n}{(1+i)^n - 1}$$

$$\therefore \quad \mathbf{A = P\left[\frac{i(1+i)^n}{(1+i)^n - 1}\right]}$$

Numerical

A loan of Rs. 10,00,000 is to be repaid by a series of 15 equal annual instalments at the rate of interest 12 % calculate the amount of annual instalment.

Solution

$$A = 10{,}00{,}000\left[\frac{0.12(1+0.12)^{15}}{(1+0.12)^{15} - 1}\right]$$

$$= 10{,}00{,}000 \times 0.1468 = 1{,}46{,}800 \text{ Rs. Annual loan instalment.}$$

(2) Grade resistance:

The force opposing movment of machine up a frictionless slope is known as grade resistance. It acts against the total weight of the machine, whether track type or wheel type or wheel type. When a machine moves up an adverse slope the power required to keep it moving increases approximately in proportion to the slope of the road. If a machine moves down a sloping road, the power required to keep it moving is reduced in proportion to the slope of the road. This is known as grade assistance.

The most common method of expressing a slope is by gradient in percent. A 1 % slope is one where the surface rises or drops 1 ft vertically in a horizontal distance of 100 ft. If the slope is 5 % the surface rises or drops 5 ft per 100 ft of horizontal distance. If surface rises, the slope is defined as plus, where as if it drops, the slope is defined as minus. This is a physical property not affected by the type of machine or the condition of the road, but in respect to analysing forces its effect is dependent upon the machine's direction of travel.

(3) Coefficient of traction:

The coefficient of traction is defined as the factor by which the load on a driving tyre or track (i.e. downward force) should be multiplied to determine the maximum possible tractive force between the tyre of track and the surface of road before slipping occurs. Tractive force is the total energy of an engine of a vehicle for pulling a load. Suppose the total pressure between the tyres and road surface is 800 N. In testing the tyres for slippage by applying a driving force to the wheels, it is found that slippage will occur when the tractice force between tyres and the surface is 500 N. Hence, the coefficient of traction will be $A = \frac{500}{800} = 0.625$.

(4) Rimpull

Rimpull is a term that is used to designate the tractive force between the tires of a machine's driving wheels and the surface on which they travel. If the coefficient of traction is sufficiently high there will be no tire slippage, in which case maximum rimpull is a function of the power of the engine and the gear ratios

Hoe	-	excavation of trenches
Power shovel	-	excavation of earth in confined area digging hard rocks
Clam shell	-	Vertical lifting of loose material
Bulldozer	-	Cleaning and scrubbing of worksite
Dargline	-	under water excavation

6. Vibrators:

(i) Needle vibrators (interal vibratior)

Used when depth of concrete is more. Needle is inserted the concrete. Used for mass concrete.

(ii) Surface vibrator : (Screed vibrator)

Suitable for compacting thin members. Used up to depth 250 mm. Suitable for compacting pavements and thin slabs. Vibrator is placed on the surface of the member.

(iii) Form vibrators

Useful for thin walls and columns where reinforcement interfear with internal vibrator. Vibrator is attached to the formwork.

(iv) Vibrating table :

For precast concrete members.

7. Pumps

- To pump dirty water in excavations, **Centrifugal pump** is preferred. It gives low head and high discharge.
- **Reciprocating pumps** are suitable for low discharge and high head. For lifting water in multistory buildings.
- **Piston pums and pneumatic pump** are used for transporting concrete. e.g. in tunnel work.

New Batches are going to start.....

Contact:

7622050066

Test Series Available..

Total weekly test : 35

Total mid subject test : 16

Total full length test : 13

Mock test : 16

Total test : 80

CHAPTER 8:

ESTIMATES AND VALUATION

ESTIMATION

It is the process of calculation of material, total expenditure over material and their respective valuation. Estimation is done to determine the probable cost of construction. A good estimate should have the minimum variation with the actual cost.

Different Types of Estimate

1. Preliminary Estimate / Approximate Estimate / Abstract Estimate

Preliminary estimate is required for initial studies of various aspects of a project to decide the financial position and policy for administrative sanction by the competent authority.

In case of commercial project, irrigation project, power generation plant the probable investment and benefits are roughly calculated in preliminary estimate to decide the necessity of the project.

2. Plinth Area Estimate

It is prepared on the basis of plinth area of building. The rate is detected from the cost of similar building having similar specification, height, and construction in the locality.

Plinth area estimate is calculated by finding the plinth area of the building and multiplying by the plinth area rate. The plinth area should be calculated for the covered area by taking external dimension of the building at the floor level.

Courtyard and other open area should not be included int eh plinth area.

3. Cube Rate Estimate

It is prepared on the basis of the cubical contents of the building. The cube rate is found out from the cost of similar building having similar specifications and construction in the locality.

Plinth area multiplied by the height of structure represents cubic content of building.

EXAM ACHARYA
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GPSC - CIVIL

Fluid Mechanics and Hydraulic Machines

"Success Consists of going from Failure without Loss of Enthusiasm."

Winston Churchill

The content of this book covers all PSC exam syllabus such as MPSC, RPSC, UPPSC, MPPSC, OPSC etc.

Sheets

The detailed estimate is based on two legal forms as following,

i. Measurement sheet:

Used to find the quantity of work.

Sl. no.	Name of particular	Unit	Length	Width	Height or depth	Quantity	Remark

ii. Abstract sheet:

Used to find the cost of work.

Sl. no.	Name of particular	Unit	Quantity	Rate	Total cost	Remark

6. Revised Estimate

Revised estimate is a detailed estimate and is required to be prepared under any of the following circumstances,

i. When the original sanctioned estimate is exceeded or likely to exceed by more than 5 %.

ii. When the expenditure on a work exceeds or likely to exceed by 10 % of original sanctioned amount.

A comparative statement is prepared which includes the reason of variation.

7. Supplementary Estimate

Supplementary estimate is detailed estimate and is required when an additional work comes into account during the execution of sanctioned project.

8. Annual Repair or Maintenance Estimate

Annual repair or annual maintenance estimate is a detailed estimate and is prepared for preparing and maintenance purpose. It includes white washing minor repairs etc. This estimate about 1.5% of total capital cost of structure.

While deciding the service unit from similar construction the following points should be noted.

1. Change in cost of land.
2. Change in price level of different materials.
3. Change in rate of labours.
4. Change in specifications of construction.
5. Percentage method:

Percentage Method

In this method the cost of water supply, drainage, electrification, etc. ancillary works is estimated as some percentage of the total construction cost of building.

Item	Cost – Percentage of total cost
1. Water Supply	4%
2. Drainage	4%
3. Electrical installation	5 to 8%

Typical Bay Method

This method is useful in case of building which have several bays. A bay is a space from centre to centre of two successive columns. A typical interior bay is selected and its total cost is worked out.

Then,

Approximate cost of proposed building = Number of bays x Cost of one bay

Following points are to be noted:

(i) Necessary corrections should be made for end bays due to end walls.

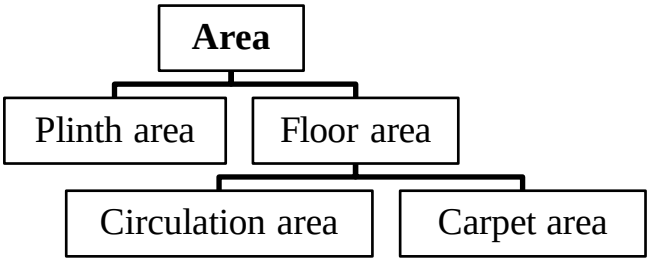
(ii) Sufficient allowance should be made to compensate for the small things that are over – looked.

CONTINGENCIES

The provision of contingencies is made for incidental expenditures incurred during the execution of project. In an estimate a separate amount equals to 3% to 5% of total cost is provided for contingencies.

AREA

The area of building is divided into following parts,



1. Plinth Area

Plinth area is the built up covered area of a building measured at floor level of any storey. Plinth area is calculated by taking the external dimensions of the building at the floor level excluding plinth offsets if any. The open area such as courtyard, balconies, porches (cantilevered) are not included in plinth area.

Note

- Balconies and porches which are supported on columns are included and cantilevered projections are excluded.

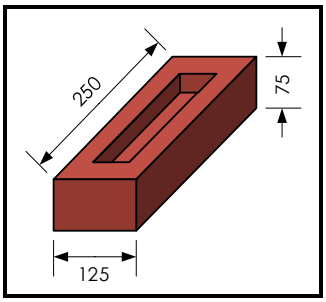
2. Floor Area

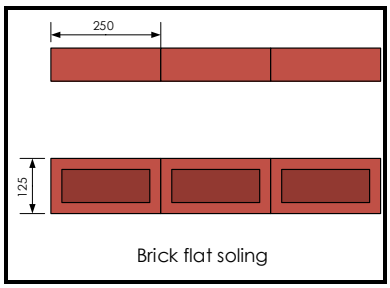
It is the total floor area of any storey between the walls. The thickness of walls, plaster and area of columns is not included in calculation of floor area. It doesn't include cantilevered projections, open areas of staircases.

$$\text{Floor area} = \text{Plinth area} - \text{Area of wall}$$

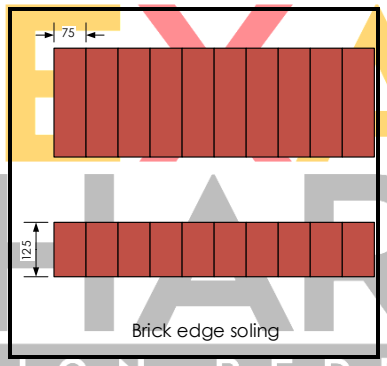
a. Circulation Area

It is the partial area of floor in which movement of users is allowed. Like entrance hall, verandah, staircases, lift cases etc. It is of two types,





No. of bricks in 1 $m^2 = \frac{1}{0.25 \times 0.125} = 32$



No. of bricks in 1 $m^2 = \frac{1}{0.25 \times 0.125} = 54$

2. Concreting

Always measured in **m^3**.

Jeffery concrete or mass concrete or Jali concrete is measured in **m^2** with specified thickness.

3. Brickwork

a. Foundation (**in m^3**)

b. Wall (**in m^2** with specified thickness of wall)

Density of the bar = 7850 kg/m^3

1 quintal = 100 kg

Note

- Pipes used for water supply are used **in running meter**, with specified diameter.

8. Plastering

It is done **in m^2** with specified thickness. General thickness of plastering is 12 mm.

Note

- Dodo work is measured **in m^2** whereas skirting is measured **in running meter** with specified height of 4.5 inches.

9. Electrical Wiring

It is measured **in no. of points**.

10. DPC

Thickness of DPC is 2 – 4 cm, generally it is 2.5 cm. It is measured **in m^2**.

11. Painting or distempering or whitewashing

It is measured **in m^2**.

12. Cornice

It is measured **in running meter**.

Sr. No.	Details of Material/Item	Unit of Measurement
	A. Materials	
1.	Cement	bag
2.	Send, Aggregate, brick bats	cu m
3.	Bricks	Nos.

EXAM ACHARYA
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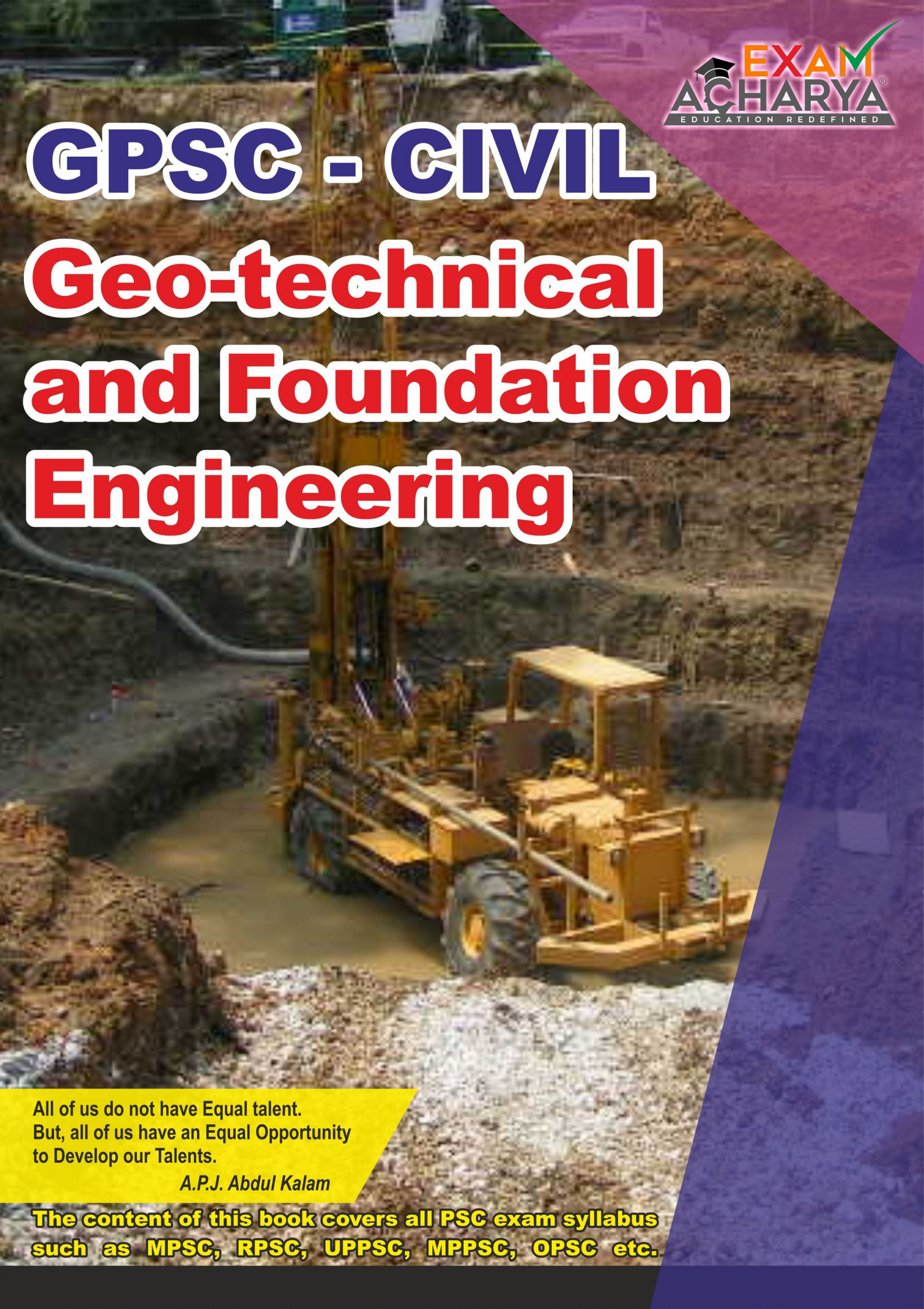
GPSC - CIVIL
Geo-technical and Foundation Engineering



All of us do not have Equal talent.
But, all of us have an Equal Opportunity
to Develop our Talents.

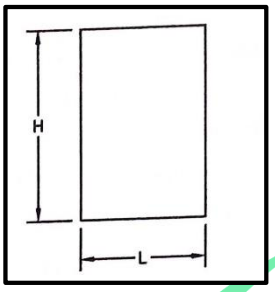
A.P.J. Abdul Kalam

The content of this book covers all PSC exam syllabus such as MPSC, RPSC, UPPSC, MPPSC, OPSC etc.

8.	Demolition of brick wall	cu m
9.	Man hole cover	No
10.	Air vent pipe	M
11.	Iron steps	No

DEDUCTION FOR OPENINGS IN MASONRY

(1) Rectangular Openings

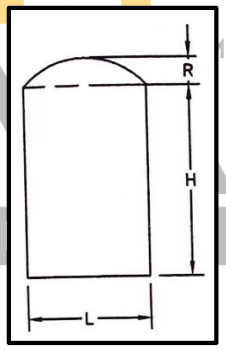


For rectangular opening full deduction is made deduction

= L x H x thickness of wall

(2) Segmental arch Openings

When there is a segmental arch opening over the rectangular opening, deduction in masonry is made for both the rectangular opening and the segmental arch opening.



Area of rectangular part = L x H

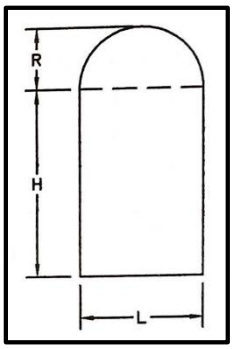
Area of the segmental part = $\frac{2}{3}$ L x R + $\frac{R^3}{2L}$

For getting approximate area of the arch portion, the term $\frac{R^3}{2L}$ may be neglected.

∴ Approximate area of arch portion = $\frac{2}{3}$ L x R

∴ Total deduction [L x H + $\frac{2}{3}$ L x R] x thickness of wall

(3) Semicircular arch opening:

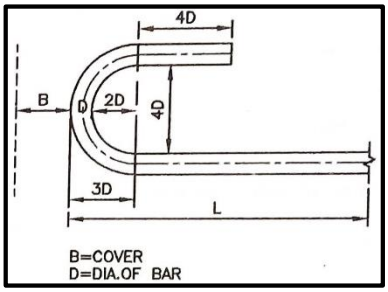


Area of the semicircular portion = $\frac{\pi R^2}{2}$

But, the approximate area of semicircular portion = $\frac{3}{4}$ L x R

∴ Total deduction = $\left(\text{L x H} + \frac{3}{4}\text{ L x R}\right)$ x thickness of wall.

(7) 180° Hook:



B = Cover

D = Dia. of bar

Extra length for one hook = 9D

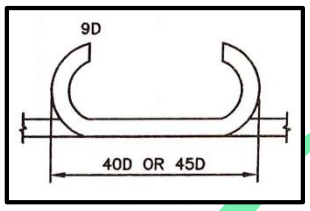
→ if hook is at one end,

Total length of bar = L + 9D

→ If hook is at both ends,

Total length of bar = L + 9D + 9D

(8) Overlap:



For bars in tension,

Extra length = 40 D + 9 D + 9 D

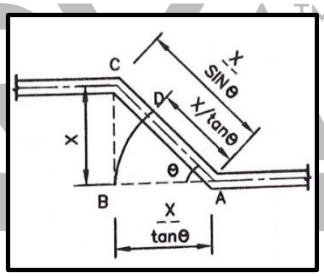
= 58 D (For mild steel bars)

= 68.5 D (For deformed bars)

For bars in compression,

Extra length = 45 D (For mind steel bars)

(9) For bent up bars:



$CD = \frac{X}{\sin\theta} - \frac{X}{\tan\theta}$

$= X\left[\frac{1}{\sin\theta} - \frac{1}{\tan\theta}\right]$

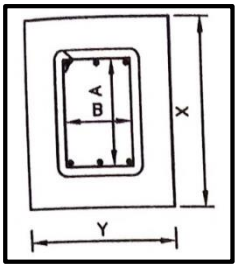
If the bar is bent up at 45°, $\theta = 45°$

$\therefore CD = x[1.414 - 1.0]$

$= 0.414\,x$

$\simeq 0.45\,x$

(10) Lateral ties or vertical stirrups:



Let, X and Y are the outer dimensions of a beam/column

A = X - 2 x cover - 2 x dia. of ring bar

B = Y - 2 x cover - 2 x dia. of ring bar

Length of tow hooks = 2 x 12 D or 0.15 m (Whichever is more)

= 24 D or 0.15 m

∴Total length of ring bar = 2 (A + B) + 24 D

MARKET RATES FOR MATERIALS

Market rates for different civil engineering materials (Jan. 2019) are given in the table below. These rates may vary from place to place and time to time.

Sr, No.	Material	Unit	Rate Rs.
1.	Cement	1 bag (50kg)	300.00
2.	Bricks	1000 Nos.	4000.00
3.	Sand	1 m^3	800.00
4.	Aggregate	1 m^3	1000.00
5.	Slacked lime	1 m^3	1000.00
6.	Brick bats	1 m^3	800.00
7.	White cement	1 kg Or 1 bag	20.00 1000.00
8.	Mild steel bars	1 kg	45.00
9.	HYSD steel bars	1 kg	46.00
10.	25 mm thick kotah stone	1 m^2	350.00
11.	25 mm thick polished kotah stone	1 m^2	400.00
12.	Marble	1 m^2	400.00
13.	Mozaic tiles	1 m^2	200.00
14.	White glazed tiles (150 mm x 150 mm x 6 mm)	10 Nos. (1 box)	150.00
15.	Valsadi teak wook	1 m^3	63000.00
16.	C.P. Wood	1 m^3	50000.00
17.	C.G.I. Sheets (3 m size and 0.8 mm thick)	1 quintal	4000.00
18.	A.C. corrugated sheets (6 mm thick)	1 m^2	200.00
19.	Manglore tiles	1000 Nos.	5000.00
20.	Waterproof powder	1 kg	40.00
21.	Distemper	1 kg	40.00
22.	Oil paint	1 litre	200.00
23.	Turpentine	1 litre	50.00
24.	Varnish	1 litre	65.00
25.	12 mm thick plywood sheet	1 m^2	350.00
26.	Lime for white washing	1 kg	5.00
27.	Asphalt	1 kg	25.00
28.	Plaster of Paris bag (25 kg)	1 bag	200.00
29.	Stones (undressed)	1 m^3	500.00

New Batches are going to start.....

Contact:

7622050066

Test Series Available..

Total weekly test : 35

Total mid subject test : 16

Total full length test : 13

Mock test : 16

Total test : 80

➢ **Materials for 1 : 6 brick work**

quantity of brick work = 10 m^3	For 1 bag of cement
proportion 1 : 6	Weight = 50 kg
volume of dry mortar = 3.3 m^3	Volume = 0.035m^3
1 : 6 = 7	
C : S	

∴ Cement = $\frac{1}{7}$ x 3.3 = 0.4714 m^3 = $\frac{0.4714}{0.035}$ = 13.47 bags

Sand = $\frac{6}{7}$ x 3.3 = 2.83 m^3

[B] Concrete Work:

For 1 m^3 of wet compacted concrete, dry volume is take about 52% more.

∴ 1 m^3 of wet concrete = 1.52 m^3 of dry concrete.

➢ **quantity of materials for 1 : 1.5 : 3 cement concrete:**

Volume of wet concrete = 1 m^3	M 15 → 6.4 bags
Volume of dry concrete = 1.52 m^3	M 20 → 7.89 bags
Proportion = 1 : 1.5 : 3 = 5.5	

∴ Cement = $\frac{1}{5.5}$ x 1.52 = 0.2763 m^3 = $\frac{0.2763}{0.035}$ = 7.89 say 8 bags

Send = $\frac{1.5}{5.5}$ x 1.52 = 0.414 m^3

Aggregate = $\frac{3}{5.5}$ x 1.52 = 0.829m^3

[c] Plastering

For filling up joints and for uneven surface, 30% more mortar is required.

To get the dry volume of mortar, wet volume may be further increased by 25%.

(i) Materials for 100 m^3 area and 12 mm thick plaster (1 : 4) :

Volume of wet mortar = Area x thickness

= 100 x 0.012

➢ ***Task Work (Out Turn Work) :***

The capacity of doing work by an artisan or skilled labour (in 8 hours shift) is knows as task work.

(i) Labour : excavation in ordinary soil = 3.0 m^3

excavation in hard soil = 2.0 m^3

excavation in rock = 1.0 m^3

(ii) Mason : Brick masonry in plinth and foundation = 1.25 m^3

Brick masonry in superstructure = 1.0 m^3

PCC = 5.0 m^3

RCC = 3.0 m^3

12 mm thick plaster = 10.0 m^2

EXAM ACHARYA
EDUCATION REDEFINED

GPSC - CIVIL

Reinforced Cement Concrete

Education's purpose is to
replace an empty mind with an open one.

Malcolm Forbes

The content of this book covers all PSC exam syllabus such as MPSC, RPSC, UPPSC, MPPSC, OPSC etc.

MATERIALS REQUIRED FOR DIFFERENT WORKS

Sr. No.	Particulars of Items	For	Quantity
1.	Bricks in brick masonry (size 20 x 10 x 10 cm)	1 cu.m	500 nos.
2.	Dry mortar for brick masonry	1 cu.m	0.33 cu.m.
3.	Dry mortar for rubble stone masonry	1 cu.m	0.40 cu.m
4.	Stone for rubble stone masonry	1 cu.m	1.25 cu.m
5.	Dry mortar for cement concrete (PCC and RCC)	1 cu.m	1.52 cu.m
6.	Brick bats for BBCC or BBLC	1 cu.m	1.0 cu.m
7.	Materials for cement concrete 1:1:5:3 (M-20) Cement Sand aggregates	1 m^3	 8 bags 0.414 m^3 0.828 m^3
8.	Materials for P.C.C. 1:4:8(M-10) Cement Sand aggregates	m^3	 3.4 bags 0.47 m^3 0.94 m^3
9.	Bricks for 10 cm thick partition wall	10 m^2	500 nos.
10.	Dry mortar for 12 mm thick plaster	100 m^2	2.0 m^3
11.	Lime for while washing one coat	100 m^2	10 kg
12.	Dry distemper for 1st coat	100 m^2	6 kg
	for 2nd coat	100 m^2	5 kg
13.	Snow –cem for 1st coat	100 m^2	30 kg
	for 2nd coat	100 m^2	20 kg
14.	Ready made paint for painting one coat	100 m^2	10 litres
15.	Bitumen or asphalt for painting on D.P.C. or on roof 1st coat 2nd coat	1 m^2	 1.5 kg 1.0 kg
16.	Galvanized iron sheets for roof	100 m^2	128 m^2
17.	A.C. corrugated sheets for roof	100 m^2	115 m^2

- **Reinforcement requirement for various elements:**

(1) Slab (@ 1 % of c/s area)
(2) Beam (@ 1.5 % of c/s area)
(3) Column (@ 2.0 % of c/s area)
(4) Footing slab (@ 1 % of c/s area)

For multi-story frame structures

Up to 5 story - @ 1.75 kg per sq.ft of built up area
6 to 15 story - @ 4.75 kg per sq. ft of built Up area

WEIGHT OF M.S. SHEET & PLATES

M.S. Sheet		M.S. Plate	
Thickness in mm	**Weight in kg/ m^2**	**Thickness in mm**	**Wight in kg/ m^2**
0.40	3.15	5	39.25
0.50	3.90	6	47.10
0.63	4.95	8	62.80
0.80	6.30	10	78.50
0.90	7.05	12	94.20
1.00	7.85	14	109.90
1.12	8.80	16	125.60
1.25	9.80	18	141.30
1.40	11.00	20	157.00
1.60	12.55	22	172.70
1.80	14.15	25	196.25
2.0	15.70	28	219.80
2.24	17.60	32	251.20
2.50	19.60	36	282.60
2.80	22.00	40	314.00
3.15	24.75	45	353.25
3.55	27.85	50	392.50
4.00	31.40	56	439.60
		63	494.55

→ Wight of M.S. sheet/plate (kg/ m^2)

= thickness (mm) x 7.85

e.g. for 1.40 mm sheet, weight = 1.4 x .85 = 11 kg/ m^2

for 25 mm plate, weight = 25 x 7.85 = 196.25 kg/ m^2

→ Weight of chequered plate

= wt. of M.S. plate (same thickness) x 1.05

→ % cost of various Materials and Labour (For Load bearing Residential building)

Now,

Quantity of earthwork = A x L

= $(Bd + Sd^2)$ x L

When, B = width of road

d = depth

S = Side slope

➢ **Earthwork for Roads in hilly areas:**

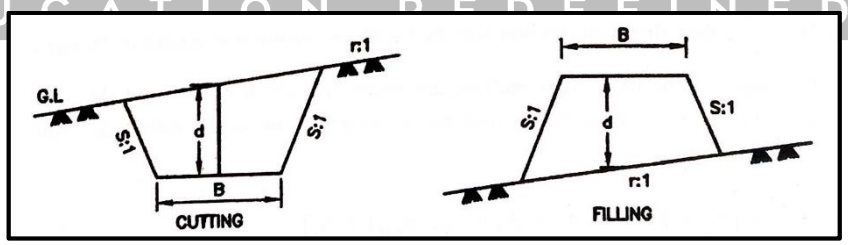
→ **One level section:**

In this case the ground is plane and the ground has no slope perpendicular to the length of road. Calculation of earthwork of such type of roads has been discussed in the previous article.

→ **Two level section:**

When the road has a slope in longitudinal direction as well as in the transverse direction, the cross section of such road is called two level section.

→ **Two-level section (Full cutting or full filling) :**



Cross-sectional area of two-level section,

$$A = \left[\frac{S\,(B/2)^2 + r^2\ .Bd + r^2\ \ Sd^2}{r^2\ -S^2}\right]$$

Where, B = formation width of road

d = depth or height at mid of section

S:1 = Side slopes of c/s = H:V

Then, the quantity of earthwork may be calculated by using the following formulae :

→ **Trapezoidal formula :**

$$V = \frac{D}{2} \times [A_0 + 2 (\mathbf{A_1 + A_2 + A_3 + \ldots\ldots A_{n-1}}) + \mathbf{A_n}]$$

Where,

D = distance between two sections

A_0 = Area of first section

A_n = Area of last section

→ **Prismoidal formula:**

$$V = \frac{D}{3} \times [A_0 + 4A_1 + 2A_2 + 4A_3 + 2A_4 + \ldots\ldots + 2\,A_{n-2} + 4\,A_{n-1} + A_n]$$

$$= \frac{D}{3} \times [A_0 + A_n + 4\,(A_1 + 4A_3 + A_5 + \ldots\ldots + A_{n-1}) + 2\,(A_2 + A_4 + A_6 + \ldots. A_{n-2})]$$

→ For prismoidal formula, it is necessary to have an odd number of sectional area.

→ If there is an even number of sections, the end strip should be treated separately and the volume of the remaining strips should be calculated by prismoidal formula.

Area of curved surface:

$$A_1 = \pi r l$$

Area of base circle

$$A_2 = \pi r^2$$

∴ **Total surface area of the cone:**

A = Area of curved surface + Area of base circle

= $A_1 + A_2$

= $\pi r l + \pi r^2$

= $\pi r [l + r]$

[C] Frustum of Cone

Volume of entire cone

$$V = \frac{1}{3} \pi R^2 (H + h)$$

Volume of the tip cone

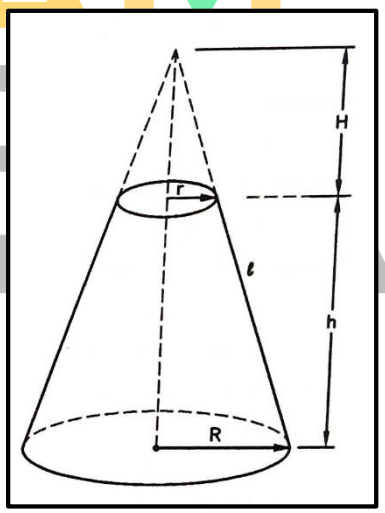
$$V = \frac{1}{3} \pi r^2 H$$

∴ **Volume of the Frustum**

$$V = \frac{1}{3} \pi R^2 (H + h) - \frac{1}{3} \pi r^2 H$$

Simplifying it,

$$V = - \frac{\pi h}{3} [R^2 + Rr + r^2]$$



Frustum of cone

Lateral surface area of frustum of cone:

$A = \pi (R + r) l$ $\quad$ l = Slant height

$A = \pi (R + r) \sqrt{(R - r)^2 + h^2}$ $\quad$ $= \sqrt{(R - r)^2 + h^2}$

EXAM ACHARYA

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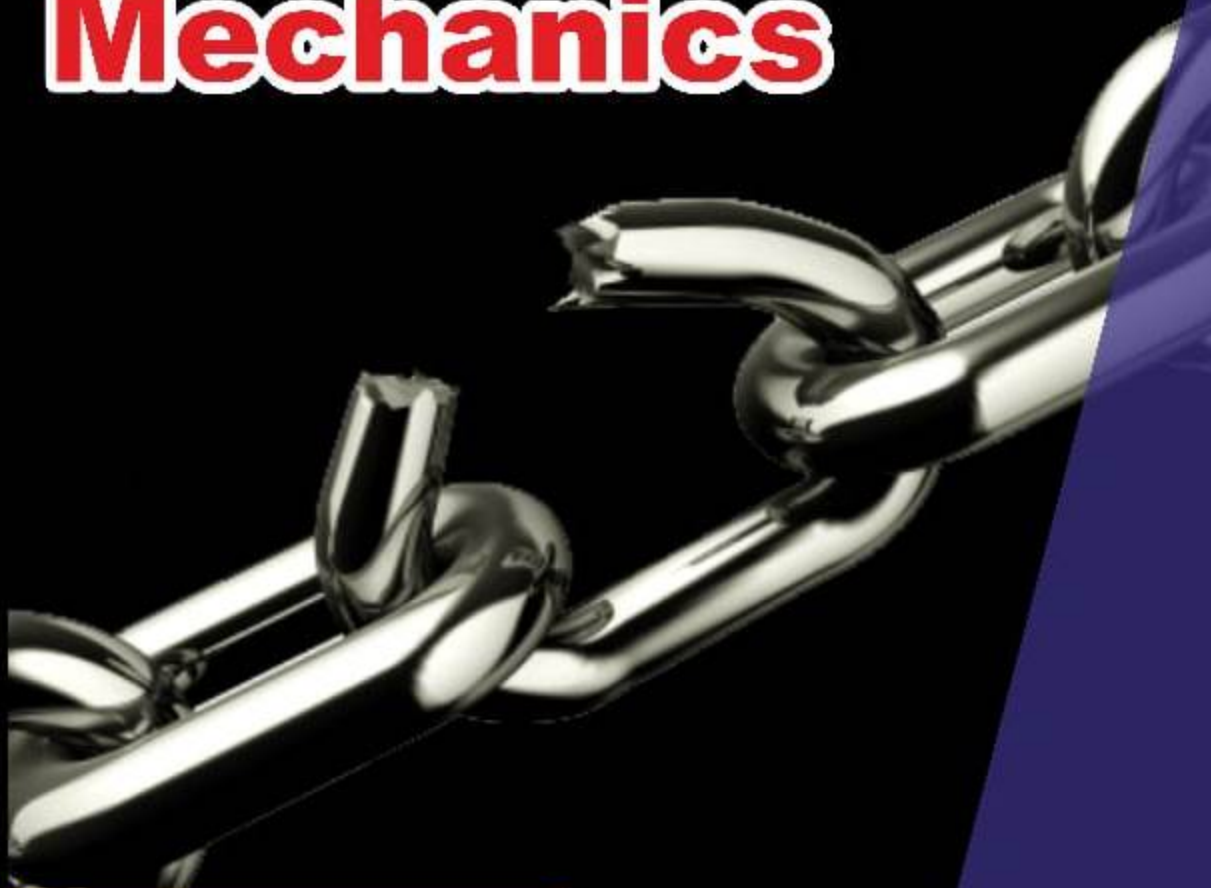
Solid Mechanics



"Education is the most Powerful Weapon which you can use to change the world."

A.P.J. Abdul Kalam

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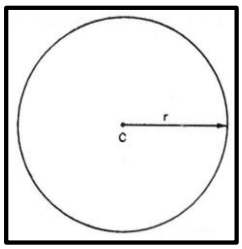
GPSC - CIVIL

Solid Mechanics

[E] Circle-Segment and Sector

1. **Circle:**



Circle

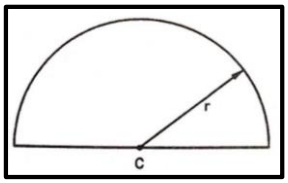
Area, $\mathbf{A = \pi r^2}$

2. **Sector of a circle:**

(i) Semi-circle:

Area,

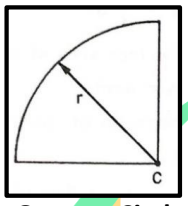
$$\mathbf{A = \frac{\pi r^2}{2}}$$



Semi Circle

(ii) Quarter-circle:

Area, $\mathbf{A = \frac{\pi r^2}{4}}$



Quarter Circle

(iii) Any sector:

Area,

A = $\frac{\theta\pi}{360}$ $\mathbf{r^2}$ …. Where **θ** in degree **Are length =rθ**

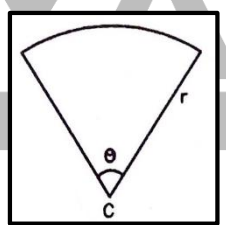
A = $\frac{\theta}{2}$ x $\mathbf{r^2}$ …. Where **θ** in radian

OR

$$\mathbf{A = \frac{C_s}{2\pi r}\ \pi r^2}$$

Where,

$\mathbf{C_s}$ = are length of sector



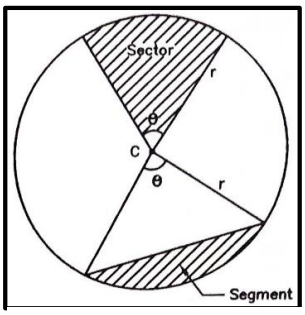
Any Sector

3. **Segment of a circle:**

Area of segment

A = $\frac{1}{2}$ x (θ - sin θ) x $\mathbf{r^2}$ …. When θ is in radians

A = $\left[\frac{\theta}{360} \text{ x } \pi - \frac{\sin\theta}{2}\right]$ $\mathbf{r^2}$…. When θ is in degrees



Sector and Segment

Example-1 : Find area of ellipse with

a = 5 cm b= 3 cm.

Soultion:

Area of ellipse

A = **πab**

= **π** x 5 x 3

= **47.12 cm^2**

- **Area by trapezoidal rule:**

$$\mathbf{A = \frac{d}{2}[(h_0 + h_{n)]+2\ x\ (h_1 + h_2 + h_3 + \ldots\ldots h_{n-1})]}$$

where,

d = common distance

$\mathbf{h_0, h_1, h_2}$ …… ordinates at equal interval

- **Area by Simpson's rule :**

$$\mathbf{A = \frac{d}{3}[(h_0 + h_{n)]+4\ (h_1 + h_3 + \ldots\ldots h_{n-1}) + 2\ (h_2 + h_4 + \cdots . h_{n-2})]}$$

→ Simpson's rule is applicable only when the number of ordinates are **odd.**

→ Boundary between two ordinates are assumed to be parabolic arcs.

USEFUL INFORMATION

Length, Area, Volume

1m	=	3.28ft.
1 m^2	=	3.28 x 3.28 = 10.75 Sq.ft.
1 m^3	=	3.28 x 3.28 x 3.28 = 35.28 cu.ft

Area	**1 brass**	=	**100 Sq.ft.**
		=	$\frac{100}{10.75}$ **= 9.3** m^2
Volume	**1 brass**	=	**100 cu.ft.**
		=	$\frac{100}{35.28}$ **= 2.83** m^3

Density of Materials

Material	Density
Cement	1430 kg/ m^3
Sand	1500 kg/ m^3
Aggregate	1600 kg/ m^3
Steel	7850 kg/ m^3
Water	1000 kg/ m^3 (10 kN/ m^3)
Soil	1600-1800 kg/ m^3
RCC	2500 kg/ m^3 (25 kN/ m^3)
PCC	2400 kg/ m^3
Brick Masonry	1800 kg/ m^3
Wood	800 to 1600 kg/ m^3

Nominal Mixes for Concrete:

Grade of Concrete	Cement :Sand : Aggregate
M 7.5	1 : 4 : 8
M 10	1 : 3 : 6
M 15	1 : 2 : 4
M 20	1 : 1.5 : 3 (minimum grade for RCC)
M 25	1 : 1 : 2

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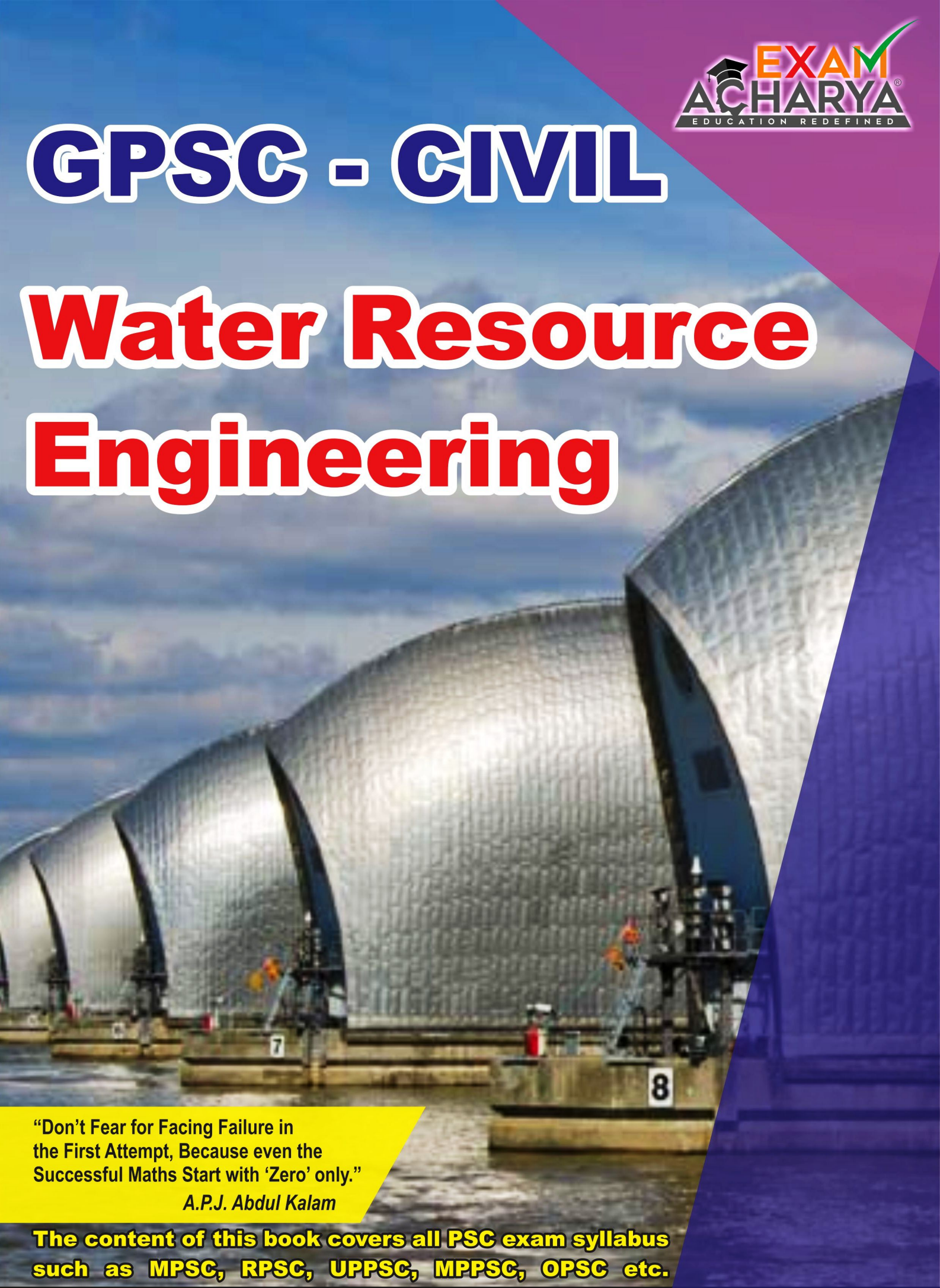
Water Resource Engineering



"Don't Fear for Facing Failure in the First Attempt, Because even the Successful Maths Start with 'Zero' only."

A.P.J. Abdul Kalam

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5. Salvage value:

Salvage value is the value of property at the end of its utility period without being dismantled.

Note:
- The cost of land is not included in calculation of scrap of salvage value. The salvage value and scrap value of the property can be positive, negative or zero. RCC structure always fetch a zero or negative scrap or salvage value.

6. Market value:

It is the value of property which can be obtained at any particular time from the open market if the property is put for sale.

7. Book value:

It is the value shown in account book after deduction necessary depreciation. The book value at a particular year original cost minus amount of depreciation up to the previous year.

Note:
- At the end of utility period of the property book value will be only scrap value.

8. Obsolescence:

The value of property becomes less by becoming out of dated in style, structure design, architectural aspect etc. is termed as obsolescence. The reason behind obsolescence may be progress in art, introduction of new architectural design and planning ideas etc.

Note:
- Obsolescence doesn't mean that a building is inferior in point of view of functions and physical strength.

9. Annuity:

It is the annual periodic payments for repayments of the capital amount invested by a party. These annual payments are either paid at the end of the year or at the beginning of the year, usually for a specified number of year.

by way of annual instalment. The amount of annual instalment of the sinking fund may be found out by the formula,

$$\mathbf{L = \frac{Si}{(1+i)^n - 1}}$$

Where,

S = Total amount of sinking found to be accumulated,

n = Number of years to accumulate the sinking fund,

i = Rate of interest in decimal,

l = Annual instalment required.

12. Depreciation:

Depreciation is the gradual exhaust of the usefulness of a property. This may be defined as the decrease or loss in the value of property due to its use and structural wear and tear.

Methods of Depreciation:

i. Straight line method:

It is very less accurate method in which a constant amount is workout by which a property is depreciated on annual basis.

$$\mathbf{D = \frac{C \pm (\mp S)}{n}}$$

Where,

D = Annual depreciation,

C = Construction or original cost,

S = Scrap value,

n = NO. of years (Design life).

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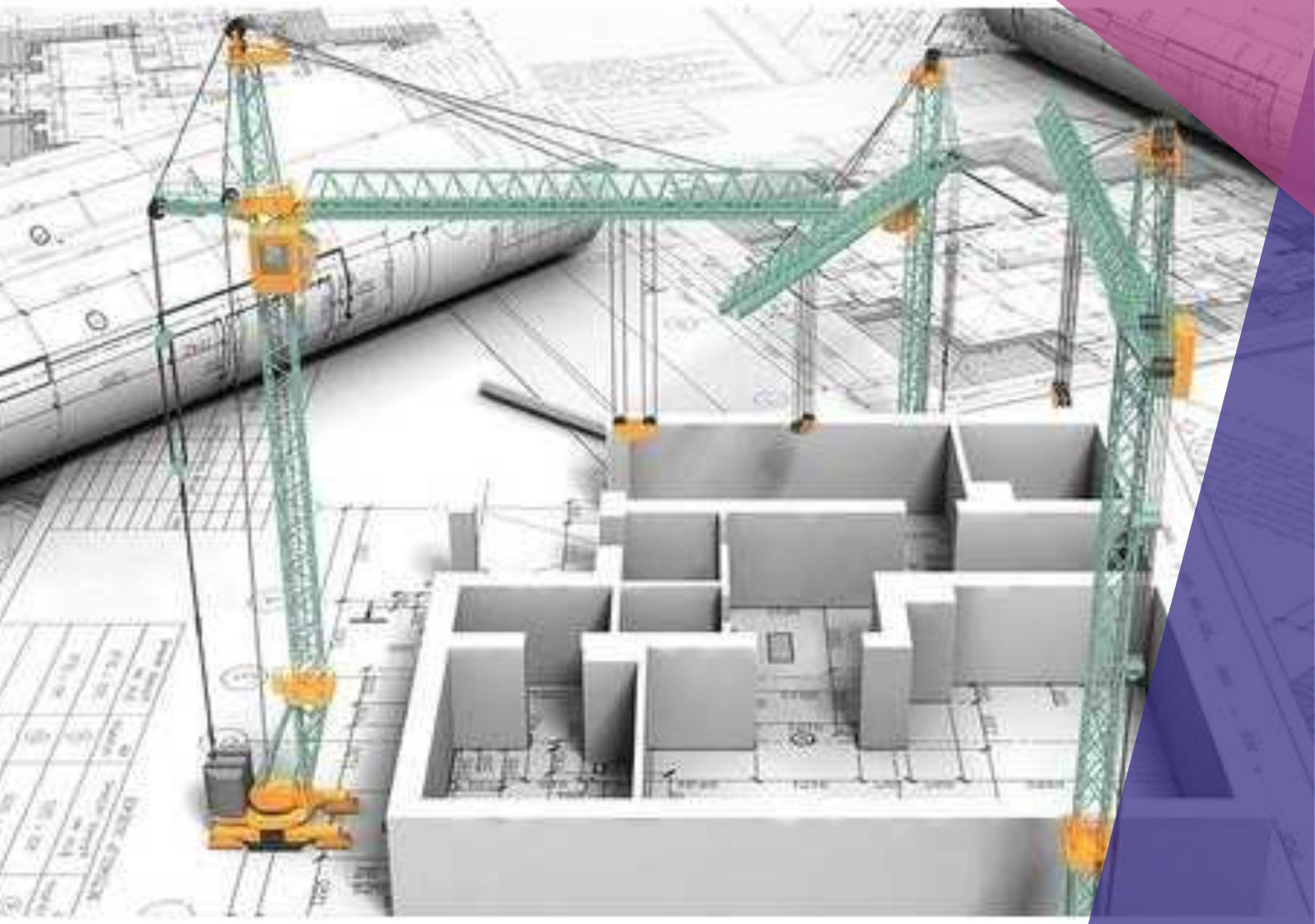

Structural Analysis

"All of us do not have Equal Talent.
But, all of us have an Equal Opportunity
to Develop our Talents."
A.P.J. Abdul Kalam

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New Batches are going to start.....

Contact:

7622050066

Test Series Available..

Total weekly test : 35

Total mid subject test : 16

Total full length test : 13

Mock test : 16

Total test : 80

About 60 – 70% by total valuation is considered under the amount to be paid against mortgage.

14. Lease:

When the owner gives the physical position his property to another person for a fix time period and fix annual payment.

It is divided into two parts,

i. Building Lease:

When some load is given on possession and building is to be constructed by used it is known as building lease. It doesn't include repairing and maintenance cost.

ii. Occupational Lease:

When some building is given on possession and user is supposed to use the building only, it is known as occupational lease. In this lease the total repairing and maintenance cost is bare by the owner only.

ENGINEERING ECONOMY

Prime Cost

It is the original cost of article and it include any transportation commission incurred with article.

Capital Cost

Capital cost is the total expenditure including fabrication of article, its transportation, marketing cot, dealers commission and workmanship etc.

Present Worth

It is the value of the money at initial time (t = 0).

Annual interest rate = $\frac{\frac{350}{3.5}\times 12}{1000} \times 100 = 120\%$

TYPE OF INTEREST

1. Simple Interest

When the total interest earned is directly proportional to the principal involved interest rate and the no. of interest periods for which the principal is invested, the interest is called simple interest.

$$\mathbf{I=Pni}$$

Where,

I = Total interest earned,

P = Principal investment,

n = No. of interest period (for annual it is no. of years)

i = Rate of simple interest.

2. Compound Interest

Whenever the interest for any interest period is based on the remaining principal amount plus any accumulated interest charge up to the beginning of that period, the interest is said to be compound. Compound interest is much more common in practice than simple interest.

$$\mathbf{F = P(1+i)^n}$$

If,

i = Annual interest rate,

P = present worth of money,

F = Future worth of money.

LIME CONCRETING

Requirement of dry lime concrete to make 1 m^3 of wet lime concrete = 1.54 m^3,

Note
- Increase 50 – 55 % for dry concrete.

CEMENT CONCRETING

Requirement of dry cement concrete to make 1 m^3 of wet cement concrete = 1.52m^3,

Note:
- Increase 50 – 55 % for dry concrete.

CEMENT, FINE AGGREGATE, COARSE AGGREGATE RATIO FOR DIFFERENT GRADE OF CONCRETE

Grate	Cement	Fine aggregate	Coarse aggregate
M – 5	1	5	10
M – 7.5	1	4	8
M – 10	1	3	6
M – 15	1	2	4
M – 20	1	1.5	3
M – 25	1	1	2
≥ M – 30	Mix design		

CEMENT MORTAR

Requirement of dry mortar for 1 m^3 of wet cement mortar = 1.25 m^3

Brickwork

Cement mortar required for 1 m^3 of brick work = 0.35 m^3.

Rubble Stone Masonry

Cement mortar required for 1 m^3 of rubble stone masonry = 0.42 m^3.

Plastering

For 12 mm and 6 mm thick plastering in wall for 100 sq. m.,

- Add 30% for filling the depression joints etc.,
- For dry volume of mortar increase the volume of wet mortar by 25%.

For 12 mm Thick Plastering

Volume of wet mortar $= 0.012 \times 100\ m^3 = 1.2\ m^3$,

For filling add 30% $= 1.2\left(1 + \frac{30}{100}\right) m^3$

$= 1.56\ m^3$

For dry volume add 25% $= 1.56\left(1 + \frac{25}{100}\right) m^3$

$= 1.95\ m^3 \approx 2\ m^3$

For 6 mm Thick Plastering

Volume of wet mortar $= 0.006 \times 100\ m^3 = 0.6\ m^3$,

For filling add 30% $= 0.6\left(1 + \frac{30}{100}\right) m^3$

$= 0.78\ m^3$

For dry volume add 25% $= 0.78\left(1 + \frac{25}{100}\right) m^3$

$= 0.975\ m^3 \approx 1\ m^3$

For 20 mm thick plastering in wall for 100 sq. m.,

- Add 20% for filling the depression joints etc.,

For filling add 10% $= 2.5\left(1+\frac{10}{100}\right)\text{m}^3$

$= 2.75\ \text{m}^3$

For dry volume add 50% $= 2.75\left(1+\frac{50}{100}\right)\text{m}^3$

$= 4.125\ \text{m}^3$

For 40 mm Thick Floor

Volume of wet mortar $= 0.04 \times 100\ \text{m}^3 = 4\ \text{m}^3$,

For filling add 10% $= 4\left(1+\frac{10}{100}\right)\text{m}^3$

$= 4.4\ \text{m}^3$

For dry volume add 50% $= 4.4\left(1+\frac{50}{100}\right)\text{m}^3$

$= 6.6\ \text{m}^3$

For 75 mm Thick Floor

Volume of wet mortar $= 0.075 \times 100\ \text{m}^3 = 7.5\ \text{m}^3$,

For filling add 10% $= 7.5\left(1+\frac{10}{100}\right)\text{m}^3$

$= 8.25\ \text{m}^3$

For dry volume add 50% $= 8.25\left(1+\frac{50}{100}\right)\text{m}^3$

$= 12.375\ \text{m}^3$

Analysis of Rate

The determination of rate per unit of a particular item of a work from the cost of quantities of materials, cost of labors and other miscellaneous expenses requires for its completion is known as the analysis of rates.

Note

- Generally, a reasonable profit to contractors equals to 10% of total cost of item is also included in analysis of rate.
- Rate of materials are usually taken as the rates delivered at the site of work and include first cost (Prime cost), cost of transportation, dealers commission and taxes etc.

GPSC - CIVIL

Surveying

EXAM ACHARYA
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The best Brains of the Nation may be found on the last Benches of the Classroom.

A.P.J. Abdul Kalam

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Other

Providing and fixing plywood shuttering for sides and soffit of beam including necessary steel or wooden balli scaffoldings	200 per sqm
Three coats of lime wash with glue and gum complete including preparation of surface wastage of material	35 per sqm
Wastage of material	2.5% of respective item
Overhead and profit	20%
Labor cess	1%

Solution

Item	Coefficient	Rate	Total cost	Remark
Cement	410 kg	255/- per bag	$(8.2 \times 255)\left(1+\frac{2.5}{100}\right) = 2143.27$	No. of bag $= \frac{410}{50}$ nos. $= 8.2$ nos.
Sand	0.41 cum	1300/- per cum	$(0.41 \times 1300)\left(1+\frac{2.5}{100}\right) = 546.32$	
20 mm graded aggregate	0.82 cum	3500/- per cum	$(0.82 \times 1300)\left(1+\frac{2.5}{100}\right) = 2941.75$	
Mason	0.6 day	450/- per day	$(0.6 \times 450) = 270$	
Bhisty	0.8 day	415 per day	$(0.8 \times 415) = 332$	
Beldar	2.3 day	375 per day	$(2.3 \times 375) = 862.5$	
Concrete mixer with driver	0.1 day	3000 per day	$(0.1 \times 3000) = 300$	
Vibrator with driver	0.1 day	1000 per day	$(0.1 \times 1000) = 100$	

Q2. Analyze the rate which will cost in construction of 1 m^3 M-20 concrete work.

Solution:

Quantity of cement required for 10 m^3 concrete $= \frac{10\times\left(1+\frac{52}{100}\right)\times 1}{1+1.5+3}\ m^3$

$= 2.763\ m^3$

$= 2.763 \times 1440\ kg$

$= 3978.72\ kg$

$= \frac{3978.72}{50}\ bag$

$= 79.57 \approx 80\ bag$

Quantity of sand required for 10 m^3 concrete $= \frac{10\times\left(1+\frac{52}{100}\right)\times 1.5}{1+1.5+3}\ m^3$

$= 4.14\ m^3$

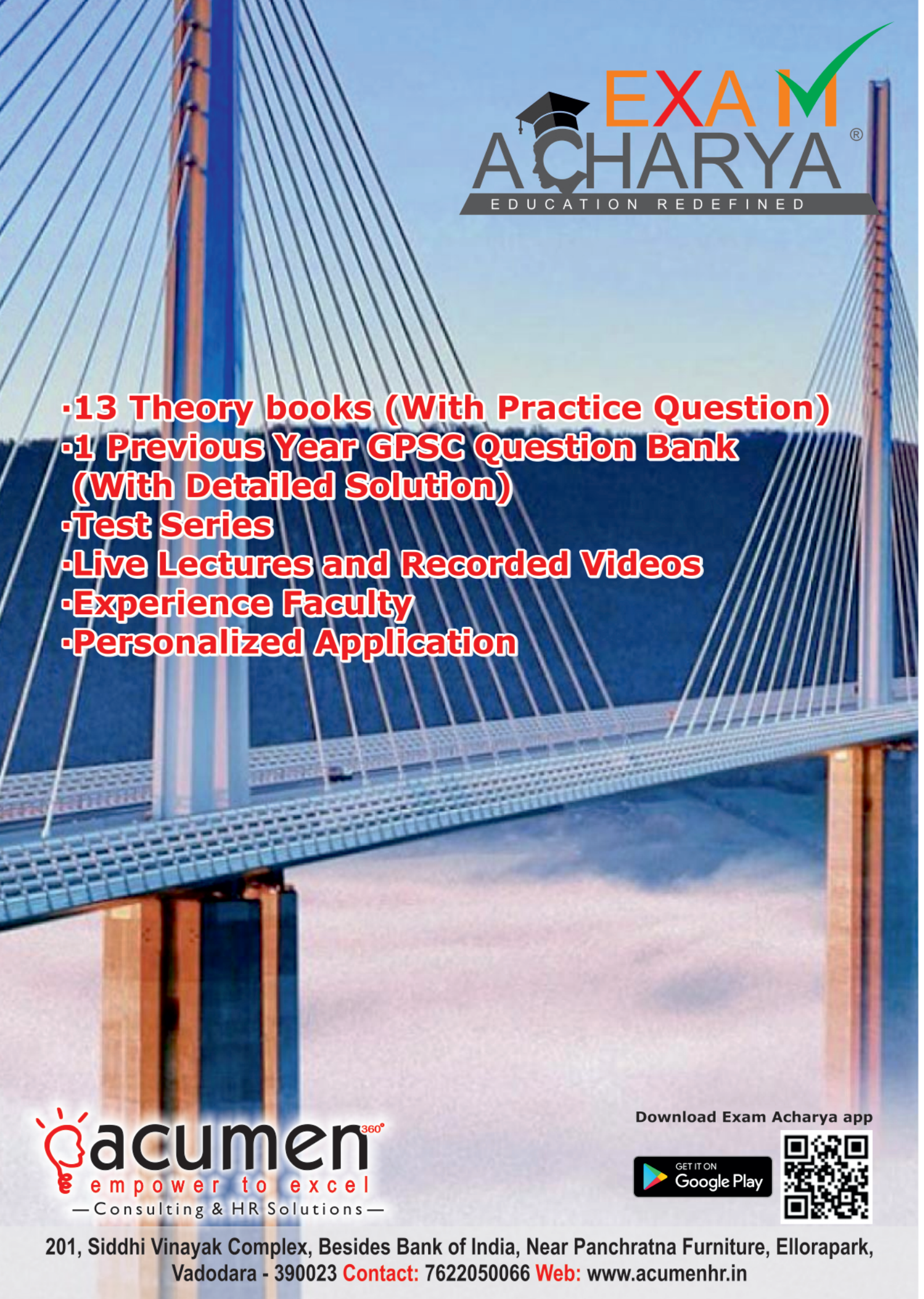
Quantity of aggregate required for 10 m^3 concrete $= \frac{10\times\left(1+\frac{52}{100}\right)\times 1}{1+1.5+3}\ m^3$

$= 8.28\ m^3$

Item	Coefficient	Rate	Total cost
Cement	80 bag	300/- per bag	$(80 \times 255) = 24000$
Sand	4.14 cum	750/- per cum	$(4.14 \times 750) = 3105$
20 mm graded aggregate	8.28 cum	1000/- per cum	$(8.28 \times 1000) = 8280$
Mason	6 day	450/- per day	$(6 \times 450) = 2700$
Bhisty	8 day	415 per day	$(8 \times 415) = 3320$
Beldar	23 day	375 per day	$(23 \times 375) = 8625$
Transportation	–	–	1000
Total			**51030**
Water and electric charges @ 5%			$51030 \times \frac{5}{100} = 2551.5$
Contingencies @5%			$51030 \times \frac{5}{100} = 2551.5$
Overhead charges @5%			$51030 \times \frac{5}{100} = 2551.5$
Contractor profit @10%			$51030 \times \frac{10}{100} = 5103$
Total cost of 10^3 concrete			63787.5
Total cost of 1 m^3 concrete			$\frac{63787.5}{10} = 6378.75$

Answer:

The total cost for 1 m^3 concrete is 63787.5 Rs.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