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APPENDIX A

EXAMINATION PAPERS

بِسْمِ اللّٰهِ الرَّحْمٰنِ الرَّحِیْمِ

Mansoura University
Final Exam

Faculty of Engineering
CONSTRUCTION PROJECT MANAGEMENT

Civil Department.
Degree of B.Sc.

11 May 1989, 9.00 - 11.00 am

Question 1 (25% of max. credit)

- a) What are the client's main uses of a construction schedule?
- b) The construction of a long reinforced concrete retaining wall involves the following three sequential activities: steelfixing, formwork erection and concreting. The wall is divided into 15 equal sections. The manhours required and the team size for each section are given in the following table:

Activity	Manhours/section	Team size/section
Steelfixing (S)	576	4
Formwork erection (F)	1440	6
Concreting (C)	576	6

Prepare a line of balance schedule for the contract using a target rate of build of one section per week and each team working at their natural rate. Assume a minimum buffer time of three days between activities and six 8-hour days per week.

What is the overall duration of the contract and when will the first team of carpenters leave the site?

Question 2 (35% of max. credit)

The programme of a small contract is given in the table below. Each activity requires the continuous use of a mechanical excavator throughout its duration. What will be the minimum contract duration if no more than two excavators can be made available for the work and if it is assumed that having started an activity it must be completed without a break?

Activity	Duration (weeks)	Depends upon
A	1	--
B	2	A
C	2	A
D	3	A
E	4	B
F	5	C
G	4	D
H	1	C,E
I	3	G
J	1	F,H,I

P.T.O.

Question 3 (15% of max. credit)

- a) Give three examples of secondary objectives which could arise on a construction project and would exert a major influence over contract strategy decisions.
- b) What are the circumstances that favour the use of turnkey contracts?
- c) Compare the following types of contract from the point of view of flexibility for design change and variations:
 - Lump sum
 - Admeasurement
 - Cost-reimbursable
- d) Comment on the following statement: "The existence of a realistic cost estimate against which tenders can be compared is a vital factor in the quality of decision made by the Engineer with respect to selection of the best bid."
- e) Suggest a regime for evaluation of bids when the contractors are invited to specify their preferred contract duration.

Question 4 (15% of max. credit)

- a) Briefly discuss the factors that minimize the contractor's negative cash flow required to execute a construction contract.
- b) Compare the following two schemes of cash flows estimated at today's price pertaining to buying and operating an item of construction equipment. Consider investment rate = 12% per annum.

	scheme 1	scheme 2
Initial plant cost (LE)	21500	15000
Annual maintenance cost (LE)	1500	1750
Life (years)	6	3

Question 5 (25% of max. credit)

- a) Discuss, with the help of a simple diagram, the activity time-cost relationship.
- b) What are the main categories of sources of risks and uncertainties for construction contracts? Give two examples for each category.
- c) Draw the contract time-cost envelope. Discuss the relationship between the envelope and the contract actual cost-to-date and budgeted cost-to-date curves.

Examiner:
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Civil Department.
B.Sc. Degree.

17 May 1990, 9.00 - 11.00 am

Question 1 (30% of max. credit)

Consider the construction of a reinforced concrete culvert together with the grading of the approaches to the culvert on either side. The culvert consists of a base slab carrying side walls, two apron slabs carrying wing walls and a roof. The list of activities to be considered in the plan of the works together with their durations is as follows:

Activity	Duration (weeks)
Construct base slab	4
Construct north apron slab	4
Construct south apron slab	4
Construct north section of side walls	7
Construct south section of side walls	7
Construct north wing walls	6
Construct south wing walls	7
Construct north section of roof	14
Construct south section of roof	14
Grade north approaches	15
Grade south approaches	10

The following information is extracted from the contract method statement :

- Aprons will be constructed after construction of the base slab and before grading of the approaches
- Side walls, wing walls and roof slabs will be constructed in the north side and then in the south side; to economize with formwork
- Wing walls will be constructed after side walls.

Prepare the complete plan of the works and the corresponding activity schedule using the precedence method.

Question 2 (25% of max. credit)

a) How can the Engineer evaluate a claim where compensable and nonexcusable delays overlap on the contract primary critical paths?

b) Consider the following small contract:

Activity	Predecessor	Duration (days)
A	-	8
B	A	12
C	-	5
D	C	10
E	-	7
F	C,E	15
G	B,D	8
H	F	2

The following work changes and delays were recorded:

No.	Category	Description	Effective dates	Delay time	Activities affected
1	Contractor	Equipment not on site	1-2	2	E
2	Client	Redesign work in activity D (same quantities of work)	6-12	7	D
3	Client	Design change (20% extra work)	-	3	F
4	Contractor	Late supply of materials	9-13	5	B
5	Client	Late supply of drawings	10-12	3	F
6	Client	Late inspection	25	1	B
7	Contractor	Equipment breakdown	25-26	2	F

Draw the as-built schedule and determine how each party is responsible for the contract delayed completion.

Question 3 (15% of max. credit)

- a) Outline the decisions taken by the project manager during the development of a contract strategy for the execution of a specific project.
- b) Explain why a consideration of Incentives, Flexibility and Risk Sharing is vital when choosing a type of contract for civil engineering work.
- c) Comment on the following statement: " The interests of all parties to a construction contract will be best served if the contractor is required to carry only those risks that he can reasonably be expected to foresee at the time of bidding. "

Question 4 (25% of max. credit)

- a) Compare and contrast the use of a Performance Bond with that of Retention Money in terms of the effect on the contractor's cash flow.
- b) Two alternatives for placing concrete are available for a contractor in his work: through a concrete pump and using labour gangs. The capital cost of the pump is LE 75000. Annual operating cost of the pump amounts to LE 4500. The choice of the pump will reduce annual labour cost from LE 27000 to LE 5500. What will be the minimum period for the pump to be used so that the choice of this alternative is justified? Assume investment rate is 12% per annum.

Question 5 (15% of max. credit)

- a) In the light of the contract time/cost relationship give a reason why minimum material content does not necessarily result in minimum cost.
- b) In the process of producing a cost estimate for bidding purpose, the contractor should identify the risks he is going to carry and give responses to deal with them. Give your views, as a contractor, on the possible responses to the following risks:
 - Client's indecisions or delays
 - Troubles encountered with different public services
 - Late supply of materials
 - Equipment breakdown.

- c) Determine the duration and the direct cost rate of the following activity:

Excavate and cart to a tip: the material to be excavated is estimated to be 3360 m³. Use an excavator with an output of 1200 m³/week loading 3 lorries. A small bulldozer will be needed at the tip to spread excavated material. Two banksmen will be used to guide the operators. Use the following weekly rates:

rate of one excavator	=	LE 1000/week
rate of one bulldozer	=	LE 750/week
rate of one lorry	=	LE 450/week
rate of one driver	=	LE 120/week
rate of one banksman	=	LE 100/week.

Question 6 (10% of max. credit)

- a) A cost control report of a certain contract gives the following figures as percentages of the contract at-completion budgeted cost:

BCWP = 25%, BCWS = 47%, ACWP = 72%, and DCWP = 53%.

Calculate cost, schedule and expenditure variances and comment on the status of the contract.

- b) The application of a cost control system to a certain contract gives an adverse materials variance. Give three suggestions to the site manager in order to improve the situation.

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Mansoura University
Final Exam

Faculty of Engineering
CONSTRUCTION PROJECT MANAGEMENT

Civil Department.
B.Sc. Degree.

11 May 1971, 9.00 - 11.00 am

Question 1: (75% of max. credit)

Consider construction of the following rectangular reservoir. The structure has mass concrete external walls and central dividing wall, a reinforced concrete floor slab and precast concrete roof beams and slabs supported on reinforced concrete columns. A period of two weeks is to pass away between the concreting of adjacent bays of external walls. The lower part of the excavation is in hard rock which is overlain by clay. External walls and central wall are founded directly on the rock.

The set of activities to be considered in the plan of the works together with their durations and budgeted costs are given in Table 1. The cost of each activity is assumed to be uniformly distributed over its duration and will be paid without delay. The contract of the works is let on a lump sum basis where the full revenue will be received on contract completion.

- a) Draw the contract time-scaled diagram and mark the critical path. Determine contract completion time. Tabulate ES, EF, LS, LF, TF and FF of the activities. (30%)
- b) Determine the scheduled timings of the activities so that the weekly cost of the contract will not exceed LE 30 000. (15%)
- c) With the activities on their scheduled timings, calculate financial charges for the cash expended in the contract. Assume investment rate = 12% per annum. Consider 1 month = 4 weeks approximately. (15%)
- d) At the end of week 12 of the contract, where cumulative actual cost is LE 160 000, the current progress is recorded as shown in Table 2. Calculate cost and schedule variances and comment on the progress of the contract. (15%)

Table 1

Activity	Duration (weeks)	Budgeted cost (LE'000s)
A Establish site	4	52
B Prepare formwork	10	60
C Excavate soft	2	18
D Excavate rock	6	54
E Concrete external walls	15	150
F Concrete floor & column footings	4	24
G Concrete columns	3	27
H Concrete central wall	2	16
I Erect roof beams	1	24
J Erect roof slabs	3	57
K Build surrounding embankments	2	22
L Clean & sterilise reservoir	1	8
M Clear site	2	18

Table 2

Activity	Date started (week ending)	Projected completion (week ending)
A	0	4
B	4	16
C	4	7
D	7	13

Question 2: (15% of max. credit)

- a) Give two examples of project organizational structures which can be used to achieve "fast-track" contracting.
- b) How can the Engineer evaluate the contractors applying for pre-qualifying for a certain project?
- c) Compare and contrast the use of a Performance Bond with that of Retention Money in terms of the protection given to the client.
- d) Comment on the following statement: " Adequate design and carefully prepared specification are not, by themselves, enough to produce the desired quality of work. "

Question 3: (15% of max. credit)

The durations and direct costs for the activities involved in a small contract under both normal and crash conditions are given in Table 3.

Table 3

Activity	Predecessor	Normal		Crash	
		Duration (weeks)	Cost (LE)	Duration (Weeks)	Cost (LE)
10	--	4	400	2	500
20	--	8	800	5	980
30	--	3	600	2	700
40	10	10	500	6	600
50	10,20	8	800	6	950
60	20,30	7	700	4	1000

Calculate the minimum direct cost of the work if the overall duration for the contract is to be 13 weeks.

Question 4: (15% of max. credit)

- a) How can the project manager set a realistic duration for a contract?
- b) Briefly explain how a contract cost is translated into a tender price.
- c) What are the risks to both client and contractor arising from loading of rates in bills of quantities?

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Faculty of Engineering
CONSTRUCTION PROJECT MANAGEMENT

Civil Department.
B.Sc. Degree.

9 May 1992, 9.00 - 11.00 am

Question 1: (60% of max. credit)

Table 1 gives the activities involved in a pipeline contract. The normal duration, normal cost, crashability and cost slope of the activities are also listed. The indirect costs for the contract amounts to LE 120/day. The contractor will supply the required materials and he will pay liquidated damages of LE 100/day for delays by his own fault. The contract provides for time extension and cost recompense for extra work caused by the owner. The contract duration should be 102 days.

- a) Calculate the minimum cost of the works corresponding to the given contract duration.
- b) Assume now that the project is under construction according to the activity schedule determined in (a) above. Determine the effect on both contract duration and cost of the following delay and work change:
 - delay of 24 days in pipe delivery (activity C.)
 - the Engineer had ordered the contractor to provide an additional 50% of concrete anchor blocks because of bad ground encountered. This will increase duration of activity K by 50%.

Table 1

Activity	Predecessors	Normal duration (days)	Normal cost (LE)	Crash-ability (days)	Cost slope
A Preparation time	-	10	200	-	-
B Move on to site	A	20	200	-	-
C Obtain pipes	A	40	1800	-	-
D Obtain valves	A	28	500	8	10
E Locate pipeline	B	8	150	-	-
F Cut specials	C	10	100	4	40
G Excavate trench	E	30	3000	20	180
H Prepare valve chambers	C, G	20	2800	12	50
I Layout joint pipes	C, G	24	1000	10	65
J Fit valves	D, F, H	10	200	4	80
K Concrete anchors	I	8	520	1	80
L Backfill	J, K	6	420	1	60
M Finish valve chambers	J, K	6	200	3	40
N Test pipeline	J, K	6	150	2	70
O Clean up site	L, N	4	300	-	-
P Leave site	M, O	2	180	-	-

P.T.O.

Question 2: (25% of max. credit)

The following Table gives data required to schedule a small contract of 6 similar units. A minimum buffer of 6 days should be assumed.

Sequence of activities	Unit duration (days)	Slope of LOB
X	11	1/11
Y	13	1/13
Z	11	1/11

- Draw the contract LOB. State the overall duration of the contract.
- Give a suggestion as to how the overall duration of the contract could be reduced.
- Assume that the materials required for activity X (units 4 : 6) have not been delivered to site until day 50. What is the effect of this delay on contract completion time.

Question 3: (15% of max. credit)

- What are the main roles of the construction contract documents?
- List three services offered by the management contractor that can not be performed by the Engineer.
- Give your views, as an estimator for a highway project, on the possible responses which should be developed to deal with the following risks:
 - bad weather conditions
 - site remoteness
 - shortage of skilled labour.
- What are the main advantages of using the method-related charges for pricing bills of quantities.

Question 4: (20% of max. credit)

A steel tower contract comprises the following three sequential activities:

Activity	Duration (months)	Cost (LE)
Design	6	25000
Fabricate	12	150000
Erect	6	100000

Which one of the following two contracts is more attractive to the contractor:

- a cost-plus contract, or
- a contract with the following payment arrangements: 20% of revenue is paid as an advanced payment, 10% when materials are delivered to work, 20% when fabrications are delivered to site and 50% on completion,

given that the profit margin is 10% and the discount rate is 16% per year. Consider the net cash flow in every six-month period.

Examiner:
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Faculty of Engineering
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B.Sc. Degree.

6 May 1993, 9.00 - 11.00 am

Question 1 (55% of max. credit)

Table 1 gives the activities involved in the first phase of the construction of an earth dam. The duration, predecessor(s) and budgeted cost of each activity are also listed. The project has a physical constraint; that is the river must be diverted during January (time of low flow.)

- a) Choose a suitable date (week no. and month no.) for the start of the contract, neglecting holidays. Justify your choice. (17%)
- b) Assume that the project starts on the date chosen in (a) above but the contractor encounters unexpected ground conditions during construction. This increases the duration required to drive the diversion tunnel (activities B and D) by 25%. How can the contractor deal with this situation to achieve minimum increase in contract cost. (8%)
- c) Assuming that the budget of each activity is uniformly distributed over its duration, draw the contract time-cost envelope on a 4-week base. Given that actual cumulative cost at end of week 4 is LE 33600 and at end of week 8 is LE 85000, draw the cost-to-date curve and comment on the progress of the contract. (30%)

Table 1

Activity	Duration (weeks)	Predecessors	Budgeted cost (LE)
A Establish site	6	-	50400
B Drive diversion tunnel east	12	A	84420
C Concrete diversion tunnel east	14	B	44520
D Drive diversion tunnel west	6	A	20940
E Concrete diversion tunnel west	8	D	25440
F Excavate forebay	3	A	15000
G Concrete forebay	6	F	12000
H Divert river	0	C,E,G	0

Question 2 (25% of max. credit)

Consider the construction of a rectangular reservoir which is part of a large treatment works. The structure has mass concrete external walls, a central dividing brick wall, a reinforced concrete floor slab and precast concrete roof beams and slabs supported on reinforced concrete columns. The lower part of the excavation is in hard rock which is overlain by clay.

Compile a list of all costs (direct and indirect) which must be included in the contractor's estimate, indicating how they will be calculated (fixed, time-related or quantity-proportional) using the operational estimating method.

Question 3 (20% of max. credit)

Table 2 gives the work items of a certain contract together with their estimated quantities and total direct costs. Contract indirect cost and markup is LE 140000.

Table 2

Work item	Estimated quantities	Unit	Total direct cost (LE'000s)
Common excavation	500000	m ³	475
Rock excavation	200000	m ³	2400
Structures	--	Sum	400

- a) Develop a balanced bid.
- b) If you, as a contractor, have a reason to think that rock excavation quantities are considerably less than estimated while common excavation is higher, develop an unbalanced bid to maximize profit.

Question 4 (20% of max. credit)

- a) Define the role of the Project Manager and his team.
- b) Explain what is meant by the two terms: "Tender Price" and "Contract Price". Briefly explain why the values of these two terms are likely to be different.
- c) Explain the purpose of pre-qualification and outline what it involves.
- d) Give an advantage and a disadvantage for each of the "open tendering" and "selective tendering".
- e) Compare the Admeasurement contract and pure Cost-Reimbursable contract from the point of view of evaluation of change by client.

Examiner:
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CONSTRUCTION PROJECT MANAGEMENT

Civil Department.
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9 June 1994, 9.00 - 11.00 am

Question 1 (75% of max. credit)

The activities involved in the construction of one kilometre of a pipeline are given in table below. The duration and direct cost of the activities are also listed. Each of the given activities will be done using a separate gang. All of them being sequential except for excavate trench and string pipe, which are done concurrently. The project consists of three similar kilometres. The contract site overhead amounts to LE 77.777/day and is distributed among the activities according to their relative direct costs.

Activity	Duration (days)	Direct cost (LE)
LC Locate and Clear	1	400
ET Excavate Trench	5	3000
SP String Pipe	2	600
LP Lay Pipe	6	1800
PT Pressure Test	1	200
BF BackFill	2	1000

a) Prepare the complete plan of the works and the corresponding activity schedule using the precedence method. Mark the critical path. (30%)

b) Assume now that the project is being constructed according to the ES timings determined in (a) above. At the end of day 10, the following information is obtained from the project site:

- activities LC were completed on schedule.
- duration of the first part of activity ET was prolonged by 1 day but that of the second part will be the same as the original duration.
- activities SP were completed although the early start of the third part had been delayed by 3 days.
- remaining duration of the first part of activity LP is 3 days.
- the first part of activity PT will not start until beginning of day 16.
- actual cumulative cost is LE 9570.

Update your network and mark the critical path. Calculate schedule and cost performance ratios and comment on the progress of the contract. (45%)

Question 2 (15% of max. credit)

The use of a cost-based contract has a fundamental effect on the relationship between the client and the contractor when compared with a price-based contract. Explain as fully as you can why this is the case.

Question 3 (15% of max. credit)

A decision has to be made with regard to the installation of an automatic control equipment on a batching plant for the construction of a large power station. The capital cost of the equipment is LE 21000 and its installation will have the effect of reducing annual labour costs from an estimated LE 9600 to LE 3000. Maintenance of the automatic plant is expected to amount to LE 420 per year more than the manually controlled plant. Salvage value of the automatic equipment, if installed, will be LE 2000 irrespective of the length of time it is in use. What is the minimum contract period that will justify the use of the automatic equipment. Consider a minimum attractive rate of return of 10%.

Question 4 (15% of max. credit)

- a) Discuss the role of the resident project representative to provide quality assurance on a construction project.
- b) Suggest a principle for allocation of risks within a construction contract.
- c) Explain how to calculate the amount of the head office overhead of a construction company that should be allocated to a specific contract.

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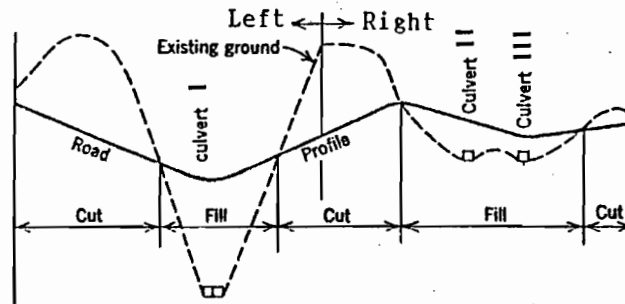
Faculty of Engineering
CONSTRUCTION PROJECT MANAGEMENT

Civil Department.
B.Sc. Degree.

2 June 1995, 9.00 - 11.00 am

Question 1 (60% of max. credit)

Consider the construction of a new road with concrete pavement, shown in Figure below in longitudinal section. The complete plan of the project is given in Table below where durations are given in days.



Activity	Description	Duration	Predecessors
A	Move onto site and set up	10	-
B	Build and cure culvert I	40	A
C	Build culvert II	14	A
D	Build culvert III	14	C
E	Cure culvert II	10	C
F	Cure culvert III	10	D
G	Dig and clear right	8	A
H	Dig and clear left	10	G
I	Move dirt right (part 1)	15	G
J	Move dirt right (part 2)	5	E,F,I
K	Move dirt left	27	B,H
L	Place sub-base right	4	J
M	Pave right	5	L
N	Cure pavement right	10	M
O	Shoulders right	2	N
P	Place sub-base left	4	K
Q	Pave left	5	P
R	Cure pavement left	10	Q
S	Shoulders left	2	O,R
T	Seed embankment	4	N,R
U	Guardrail on curves	3	N,R
V	Move out and open road	3	S,T,U

- Prepare the complete activity schedule using the precedence method. Mark the critical path.
- Determine the scheduled timings of the following activities so that the activities of each group will be done consecutively using one crew :
 - Move dirt activities I, J, and K.
 - Place sub-base activities L and P.
 - Pave activities M and Q.
 - Shoulders activities O and S.
 What would be the minimum possible project duration?
- At end of day 35, the update report showed that all work was on time except culvert III which required 9 days for completion before curing. What is the total delay if the same crews given in (b) above were to be used? What remedial actions can be used to retrieve the position?

Question 2 (15% of max. credit)

- a) Briefly describe the main stages, and list fully the end products of each stage, in the tendering process for a civil engineering construction contract.
- b) Compare lump sum, admeasurement and cost-plus contracts from the following points of view :
- early start to construction
 - claims resolution.

Question 3 (25% of max. credit)

A contractor has been awarded a contract for the construction of an industrial building together with procurement and installation of the required plant. Consider the following details:

Contract period = 40 weeks where construction period = 35 weeks. Plant will be delivered to site at end of the construction period. The contract has the following payment arrangements : 10% of revenue is paid as an advance payment, 40% at mid contract period and 50% on completion. The markup is 10%. Contractor's expenses during construction are expected to follow an early start S-curve. Cost of the plant is 50% of total cost while cost of installation is 5.55%. No delay is expected between the contract revenue and its income and between the contract cost and its expense.

- a) Draw cumulative cash flow curves for both cost and revenue and the corresponding net cash flow curve.
- b) Briefly explain (without calculations) how to calculate financial charges of this contract.
- c) Suggest how the contractor can reduce the negative cash flow during construction of this project.

Question 4 (15% of max. credit)

- a) Why should the estimator visit the site of the works before producing the cost estimate?
- b) Discuss the procedures which might be followed with respect to adding time contingency allowances into construction networks.
- c) Comment on the following statement: "If the contractor adds a cost contingency allowance into his tender price he will lose the tender."

Examiner:
Dr. ADEL I. ELDOSOUKY

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

Mansoura University
Final ExamFaculty of Engineering
CONSTRUCTION PROJECT MANAGEMENTCivil Department.
B.Sc. Degree.

21 May 1996, 9.00 - 11.00 am

Question 1 (30% of max. credit)

Draw a LOB diagram for the construction of 12 units in 38 days. Each unit is represented by the plan given in table below. Assume that optimum crew size for each activity is equal to one and buffer time between the activities is equal to zero. Consider the case of minimum number of crews.

Activity	Predecessors	Duration (days)
A	-	8
B	A	12
C	A	2
D	C	2
E	B	3
F	D,E	1
G	F	3

Question 2 (15% of max. credit)

Some of the activities involved in a construction contract together with their budgeted cost are given in table below. At end of week 12 of the contract, the update report shows that the construction is being performed exactly as the planned schedule given in the table. The corresponding cost control report shows a cumulative actual cost of LE 160000. Calculate the cost performance ratio and comment on the progress of the contract.

Activity	Budgeted cost (LE)	Planned schedule (wks)	
		ES	EF
I	52000	0	4
J	60000	4	16
K	18000	4	7
L	54000	7	13

Question 3 (20% of max. credit)

- What are the main duties of the Engineer in a conventional construction contract?
- When should the client consider use of the management contract?
- Briefly explain how each of the following charges be paid to the contractor in a cost plus contract:
 - Site overheads,
 - Head office overheads and
 - Risk allowance.
- Discuss effect of type of construction contract on the amount of financial charges of the contract.

Question 4 (20% of max. credit)

a) Complete the following sentences:

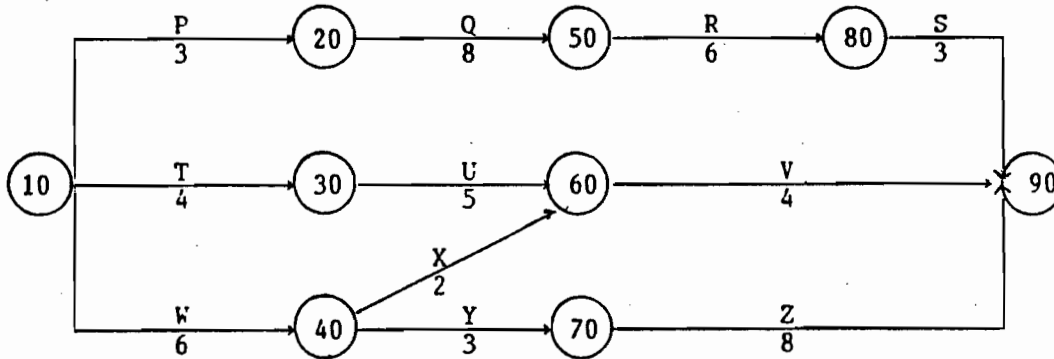
1. The contractor may decide to subcontract an item of work in order to —
2. The best source to get labour production rates is —
3. Preparation of a contract method statement aims at determining —
4. The risk of unforeseen ground conditions should be carried by the client because —
5. If the contract duration is less than the optimum, the contractor can —
6. Loading of rates in BOQ is risky for the client when —

b) Compare the operational estimating method with the unit rate estimating method from the following points of view:

- when to use
- basic data required
- cash flow prediction.

Question 5 (30% of max. credit)

A bridge pier foundation is to be constructed in a cofferdam. The work is planned according to the network shown below. Each activity requires the continuous use of a derrick crane. Because of space restrictions, only two such cranes can be made available for the work. What is the minimum contract duration assuming that once an activity is started it must be completed without a break?



Examiner:
Dr. ADEL I. ELDOSOUKY

APPENDIX B
MODEL ANSWERS TO EXAMINATIONS

EXAM OF MAY 89

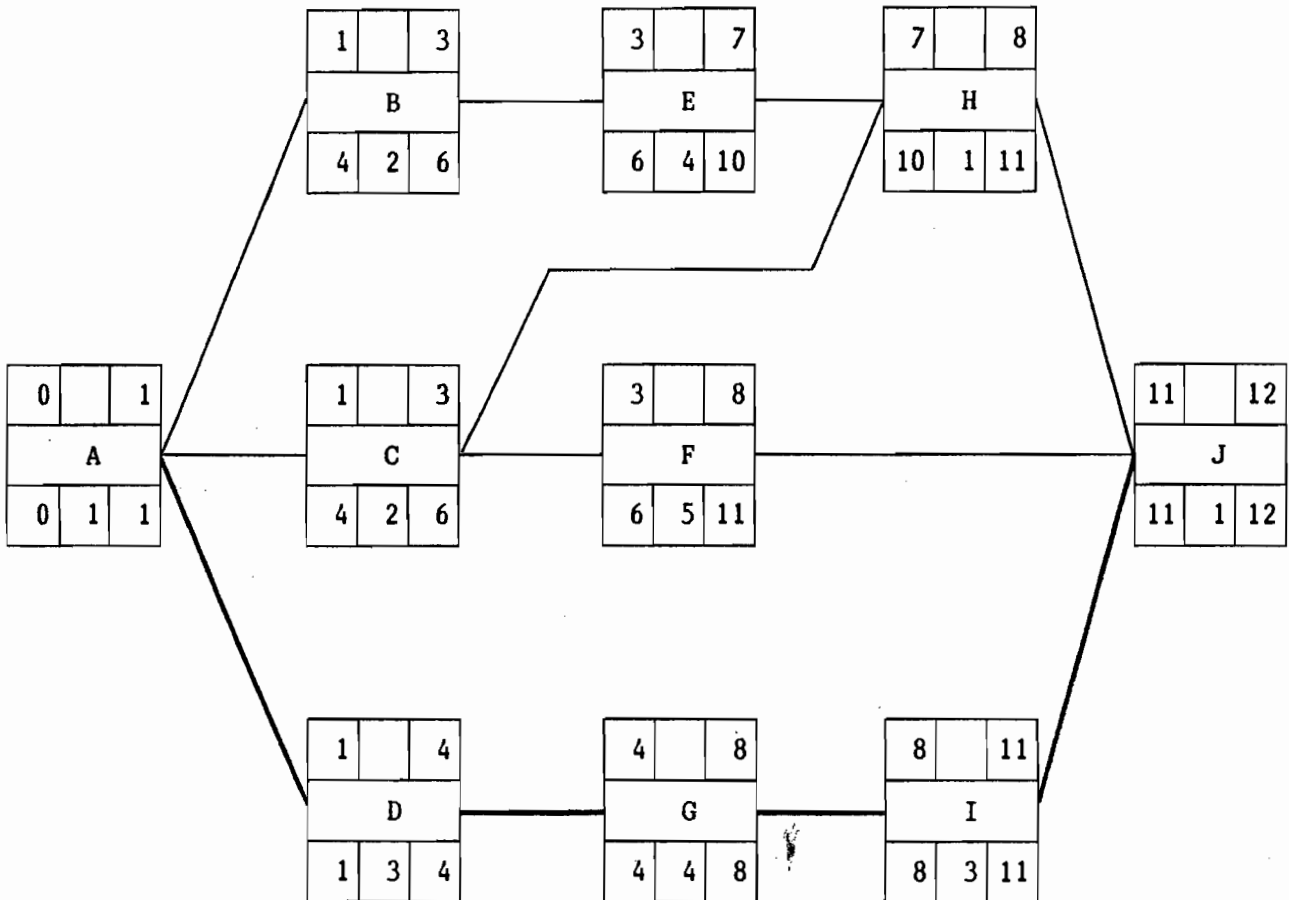
Solution 1

a) The Client's main uses of a construction schedule:

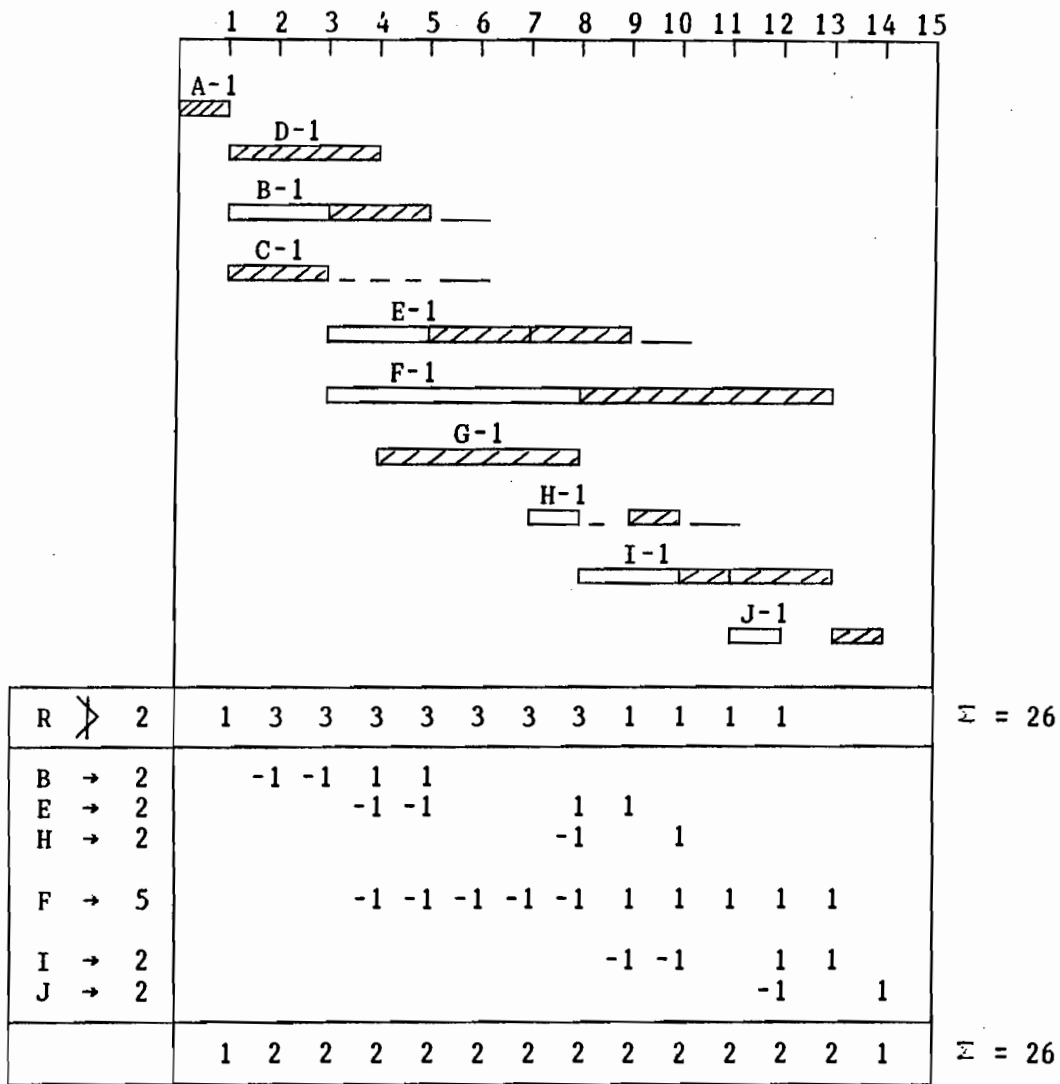
- to give a timely notice of the likely consequences of change and indecisions
- to prepare in advance cash required for the execution of the project
- to be used as a basis for analysis of contractor's claims
- a detailed schedule is an evidence that the percentage completion is accurate.

b) See Example 2.20, page 72.

Solution 2



Precedence Network, Early start completion time = 12 weeks



Completion time that satisfies resource constraint is 14 weeks.

Solution 3

a) Examples of secondary objectives :

- allocation of risks between client and contractor
- training of client's staff
- transfer of technology
- involvement of contractor in design and/or client in contract management
- use of labour-intensive construction.

b) Circumstances that favour use of turnkey contracts :

- repetitive or standard design
- when the contractor has special skills and expertise
- when the design is affected by method of construction.

c) From the point of view of flexibility for design change:

Lump sum contract is Very limited
 Admeasurement contract is Limited
 Cost-reimbursable contract is Extensive.

d) Selection of the lowest bidder is not always accurate because the lowest bidder may submit unrealistic bid: without providing proper resources or ignoring risk. Therefore, the Engineer must prepare a realistic cost estimate so that he may discover the unrealistic bids.

e) When the contractors are invited to submit their preferred contract duration, the client can use the Net Present Value to compare bids. He should choose a suitable discount rate. The bid with the lowest NPV is the best.

Solution 4

a) Factors that minimize the contractor's negative cash flow required to execute a construction contract:

- loading early rates of B.O.Q.
- achieving highest productivity on site
- reducing delay of payments by the client
- delivering material just before submission of monthly certificates
- increasing advanced payment and reducing retention money.

b) The lives of cash flows should be equal

For the second scheme:

initial cost	15000	15000						
maintenance		1750	1750	1750	1750	1750	1750	1750

Scheme 1

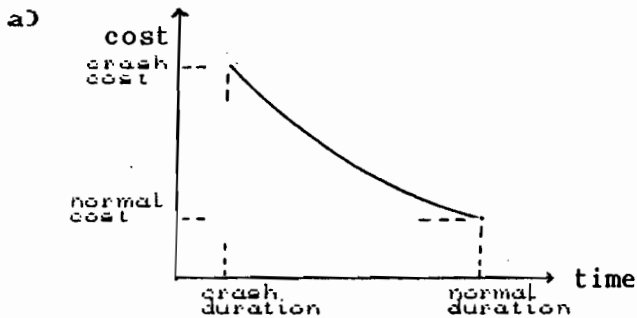
$$N.P.V. = 21500 + 1500 \left[\frac{(1.12)^6 - 1}{0.12 (1.12)^6} \right] = \text{LE } 27\,667$$

Scheme 2

$$N.P.V. = \left\{ 15000 + 1750 \left[\frac{(1.12)^3 - 1}{0.12 (1.12)^3} \right] \right\} \left\{ 1 + \frac{1}{(1.12)^3} \right\} = \text{LE } 32\,871$$

Then, choose scheme 1.

Solution 5



- The normal cost is the minimum direct cost. The corresponding duration is the normal duration.
- The crash duration is the min. practical duration. The corresponding cost is the crash cost.
- The points between the above two points can be represented by a curve or a straight line approx.

b) Main categories of sources of risks and uncertainties for construction contracts are:

1. Administrative: late hire of wayleaves
maintaining flow of traffic during construction
2. Construction: ground problems
weather variations
3. Logistics: shortage or late supply of different resources
site remoteness problems
4. Physical: driving a tunnel from one end
diverting a river at time of low flow
5. Design: incompleteness
design change
6. Financial: late payment of revenue to contractor
inflation
7. Management: site congestion
errors in B.O.Q.
8. Political: changes of laws
complex regulations
9. Contractual: appropriateness of type of contract
liability to subcontractors
10. Disasters: floods
fire.

c) Draw Figure 6.2 given in page 161, then :

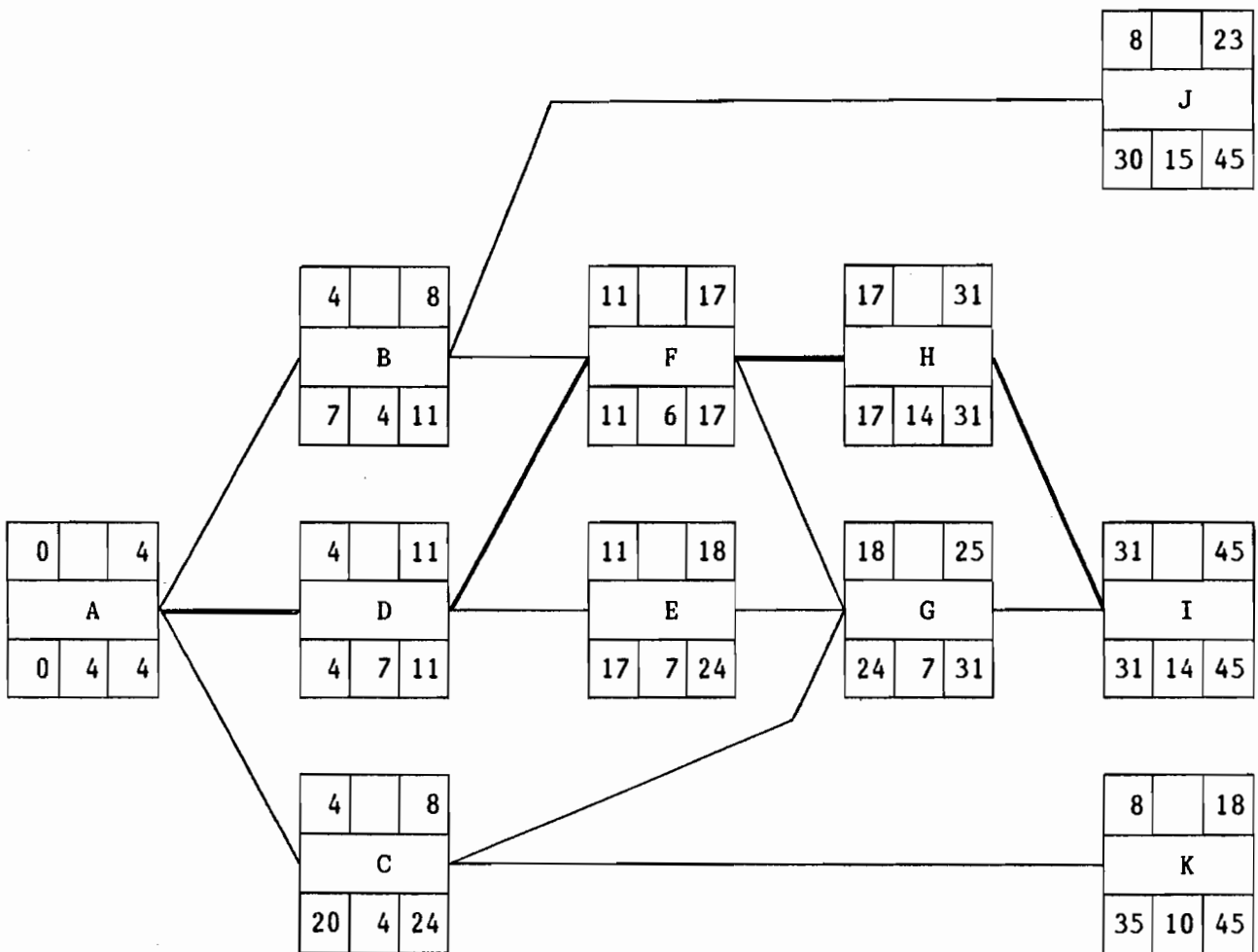
The budgeted cost-to-date curve must lie within the envelope. If the actual cost-to-date curve is above the budgeted cost-to-date curve, this means that there is cost overrun and vice-versa. This is an approach for construction cost control.

EXAM OF MAY 90

Solution 1

Plan of the culvert construction

Activity	Predecessors	Duration
A Construct base slab	-	4
B Construct north apron slab	A	4
C Construct south apron slab	A	4
D Construct north section of side walls	A	7
E Construct south section of side walls	D	7
F Construct north wing walls	B,D	6
G Construct south wing walls	C,E,F	7
H Construct north section of roof	F	14
I Construct south section of roof	G,H	14
J Grade north approaches	B	15
K Grade south approaches	C	10

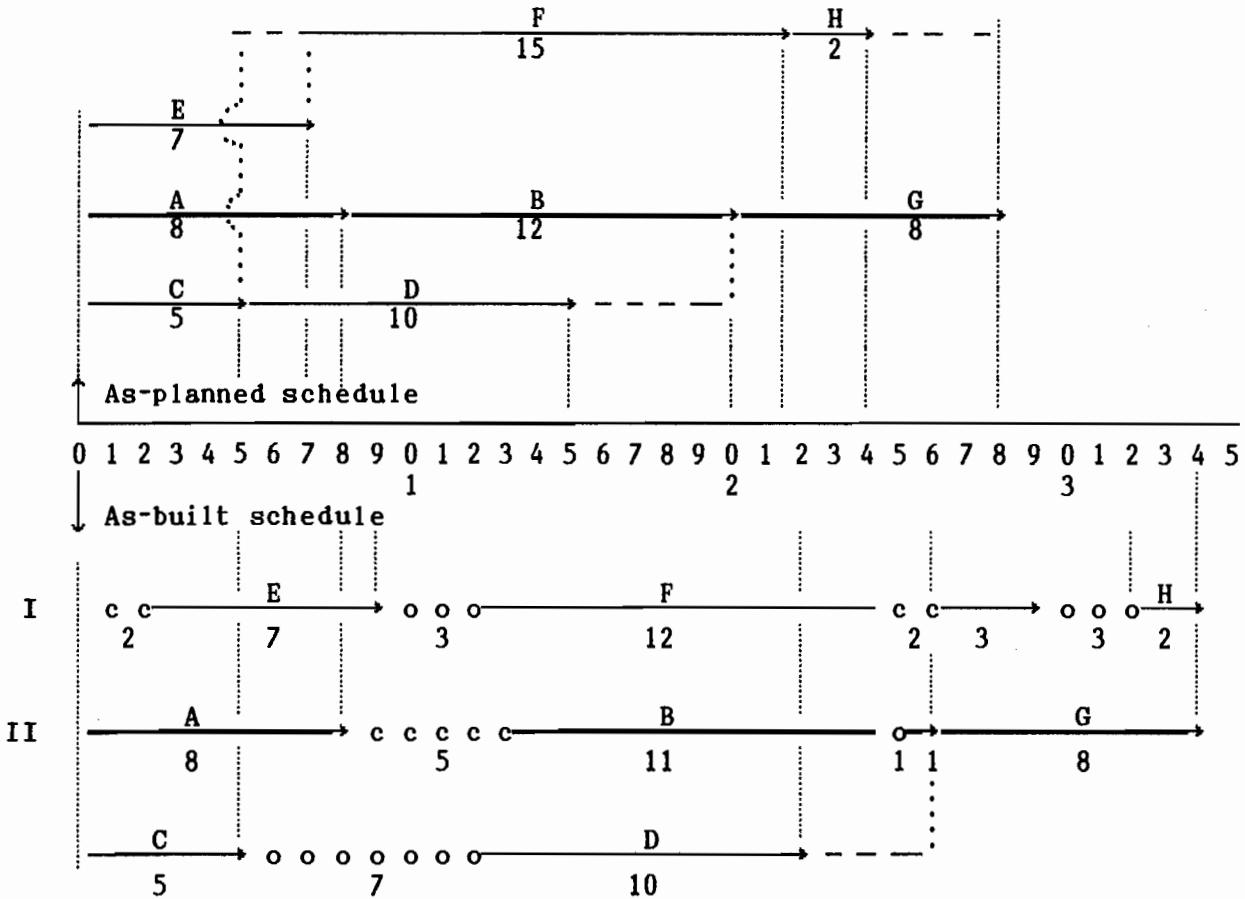


Activity schedule

Solution 2

a) For the part of the delay which is in overlap:

- the Engineer gives the contractor a time extension to complete the works,
- the client pays to the contractor overheads and
- the contractor pays to the client liquidated damages.



Net working duration on path I = 24 days
 Net working duration on path II = 28 days
 Then Primary critical path is II.

Total delay = 6 days
 The contractor should be given a time extension and overheads for one day.
 He will pay liquidated damages for 5 days.

Solution 3

a) Decisions taken by the project manager:

1. Project objectives and constraints:
 - primary objectives
 - secondary objectives
 - constraints
2. Organization of the project
 - size of work packages
 - suitable no. of design teams
 - to what extent construction is separated from design
3. Type of contract:
 - mechanism for payment for contractor
 - selection of type of contract
4. Administration of contract
 - conditions of contract (general & special)
 - contract documents
5. Tendering procedure
 - necessity of pre-qualification
 - method of tender analysis
 - method of appointing contractors

b) Incentives is required to give the contractor a chance for better performance

Flexibility is required because in most civil engineering works there will be design changes

Risk sharing should be considered because there are many risks in civil works and the contractor is going to include a risk contingency in his estimate to cover risks he has been asked to carry.

c) This is because it is better for the client to pay for what happens rather than for what the contractor thought might happen in these risks. This situation is the best for the construction industry.

Solution 4

a) Performance bond is 5% of tender price and is given in the form of a letter of guarantee from an approved surety on the beginning of the contract. The contractor may pay 0.5% for this letter. An advanced payment usually covers this payment.

Retention money is 5% of each monthly payment to the contractor. The sum of the retained money will be paid at the end of the contract. This usually strains the contractor's cash flow. Reduction of this amount is favourable to the contractor.

b)

	Pump	Labour
Capital cost	75000	-
operating cost	10000	27000

Use EUAC to compare alternatives

- EUAC of labour = 27000

- EUAC of the pump = 10000 + 75000 × CR, where $CR = \frac{r(1+r)^n}{(1+r)^n - 1}$

for r = 12 %	n	CR	EUAC
	3	0.416	41220
	4	0.329	34673
	5	0.277	30794
	6	0.243	28227
	7	0.219	26426 ←

We calculate n where EUAC of the two alternatives are equal:

then n = 6.66 years, i.e. there should be a volume of work for 6.66 years for the pump so that it could be considered a better alternative to using labour.

Solution 5

a) Minimum material content may need more time for construction. This increases contract duration and its indirect cost. Therefore, a structure of minimum material content does not necessarily result in minimum cost.

b) - Client's indecision:
the contractor should supply an activity schedule to warn the client and to be an evidence for the delay.

- Troubles encountered with different public services:
the contractor should use existing maps or new tools to discover location of services. If not, he should make trial pits.

- Late supply of materials:
the contractor should secure advanced delivery dates and alternative suppliers.

- Equipment breakdown:
the contractor should supply the site with a complete workshop for maintenance of equipment.

c) $Q = 3360 \text{ m}^3$, output = $1200 \text{ m}^3 / \text{week}$
Duration = $3360 / 1200 = 3 \text{ weeks}$

Cost of plant = $(1000 + 750 + 3 \times 450) \times 3 = \text{LE } 9300$
 Cost of labour = $(5 \times 120 + 2 \times 100) \times 3 = \text{LE } 2400$
 Total cost = $\text{LE } 11700$
 Direct cost rate = $11700 / 3360 = \text{LE } 3.48 / \text{m}^3$

Solution 6

a) $CV = BCWP - ACWP = 25 - 72 = - 47 \%$
 $SV = BCWP - BCWS = 25 - 47 = - 22 \%$
 $EV = BCWP - DCWP = 25 - 53 = - 28 \%$

The contract is behind schedule with over cost. The contractor is responsible for 28 % over cost and the remainder (19%) is due to inflation.

b) Suggestion to reduce material wastage:

- equipment should be used for handling material
- a material engineer should be used to check receipt of the correct materials and to secure proper storing
- a well trained storekeeper should be used
- the storage space should be adequate.

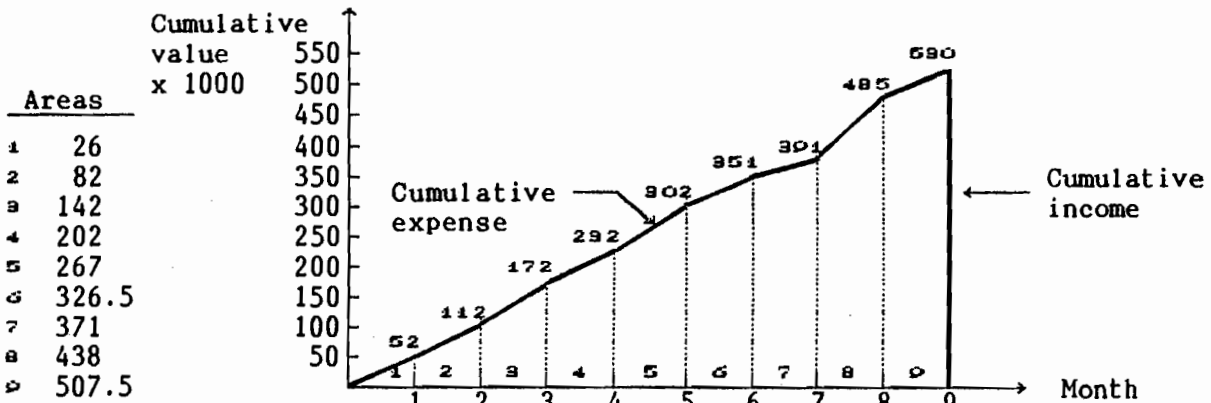
Activity schedule: Contract completion time = 36 weeks

Activity	ES	EF	LS	LF	TF	FF
A	0	4	0	4	0	0
B	4	14	4	14	0	0
C	4	6	6	8	2	0
D	6	12	8	14	2	2
E	14	29	14	29	0	0
F	14	18	22	26	8	0
G	18	21	26	29	8	8
H	14	16	27	29	13	13
I	29	30	29	30	0	0
J	30	33	30	33	0	0
K	29	31	32	34	3	3
L	33	34	33	34	0	0
M	34	36	34	36	0	0

b) See figure above for calculation of weekly cost. Activity K will be shifted one week so that the weekly cost of the contract will not exceed LE 30 000. The scheduled timings of the activities will be as follows:

Activity	SS	SF
A	0	4
B	4	14
C	4	6
D	6	12
E	14	29
F	14	18
G	18	21
H	14	16
I	29	30
J	30	33
K	30	32
L	33	34
M	34	36

c) See figure above for calculation of cumulative monthly cost. Costs are paid without delay. Revenue is received on completion. Draw cash flow curves:



Area between expense & income curves = 2362000 LE. Month

$$\text{Financial charges} = \frac{2362000}{12} \times 0.12 = \text{LE } 23620$$

d)

Act	Budget/wk	Weeks												
		1	2	3	4	5	6	7	8	9	10	11	12	
A	13	████████████████												
B	5					██								
C	6					██████████████								
D	9								████████████████████████████████					
Σ		13	13	13	13	11	11	11	14	14	14	14	14	= 155

ACWP = LE 160 000
 BCWS = LE 172 000
 BCWP = LE 155 000

SV = BCWP - BCWS = 155000 - 172000 = - 17000 → behind schedule
 CV = BCWP - ACWP = 155000 - 160000 = - 5000 → cost overrun

Solution 2

a) Fast-track contracting means less construction time where construction can proceed while design is being completed.

Examples of organizational structures: Management contracting
 Turnkey contract

b) This is a case of bid evaluation with subjective variables.

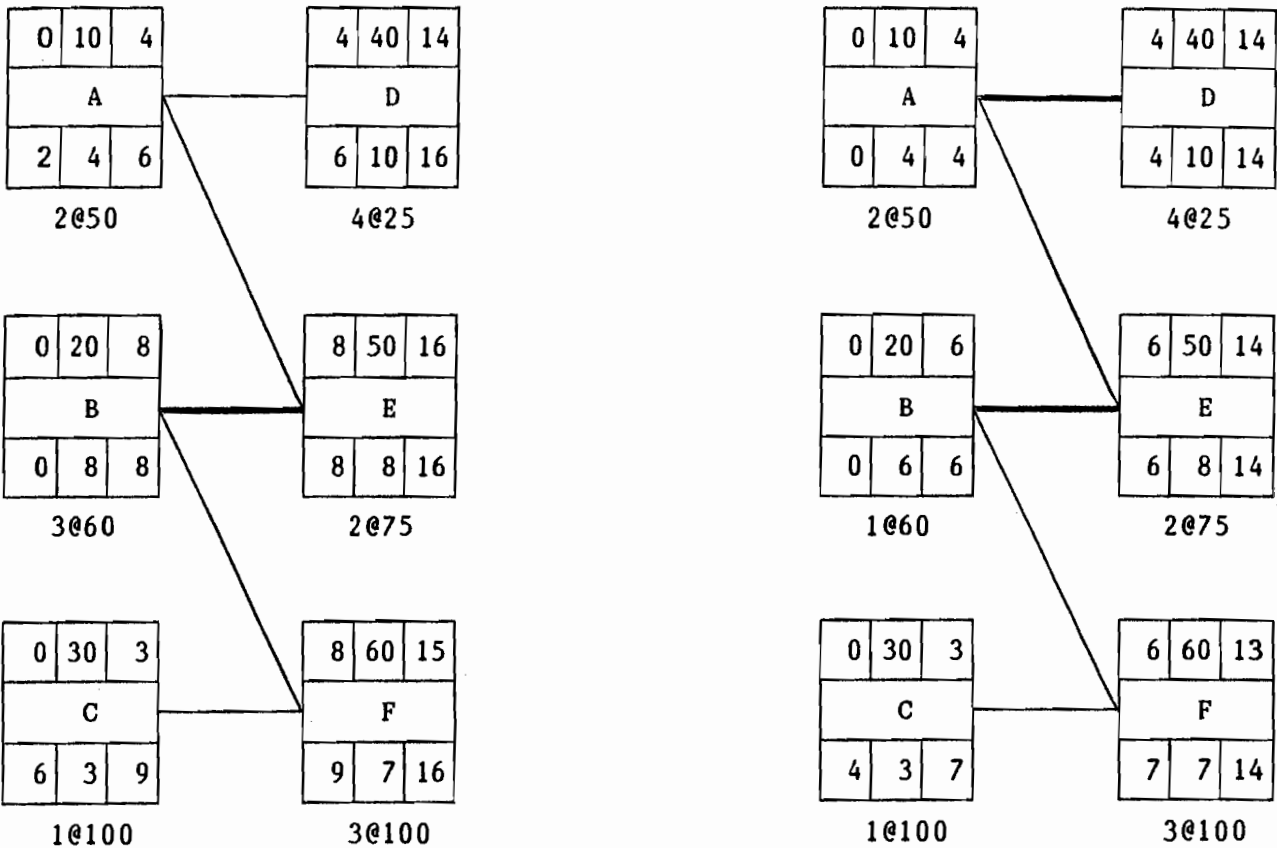
The factors which are of interest are listed and given weights according to their relevant importance to the project. Then each contractor is given a score against each factor.

c) Retention money gives the client protection during the contract period against defective work. It ensures that the contractor has an incentive to do minor items of work.

Performance bond gives the client protection during the maintenance period against any defect in the work completed. It also covers bankruptcy, delay and quality of work.

d) This statement is true. Adequate design and carefully prepared specification are the first step for quality assurance of the project. The desired quality of work is then obtained by continuous field inspection by the Resident Project Representative.

Solution 3



Critical path: BE
then crash B by 2

Normal cost = LE 3800
Crash cost = 3800 + 2(60) + 1(85) = LE 4005

Critical paths: AD & BE
then crash B & D each by 1

Solution 4

a) A realistic duration for a contract can be set as follows:

- determine contract optimum duration corresponding to the least cost
- add to the optimum duration an allowance for the risks which the contractor is going to carry. The summation will represent a realistic duration for the contract.

b) A contract cost is translated into a tender price by adding the mark-up. This includes:

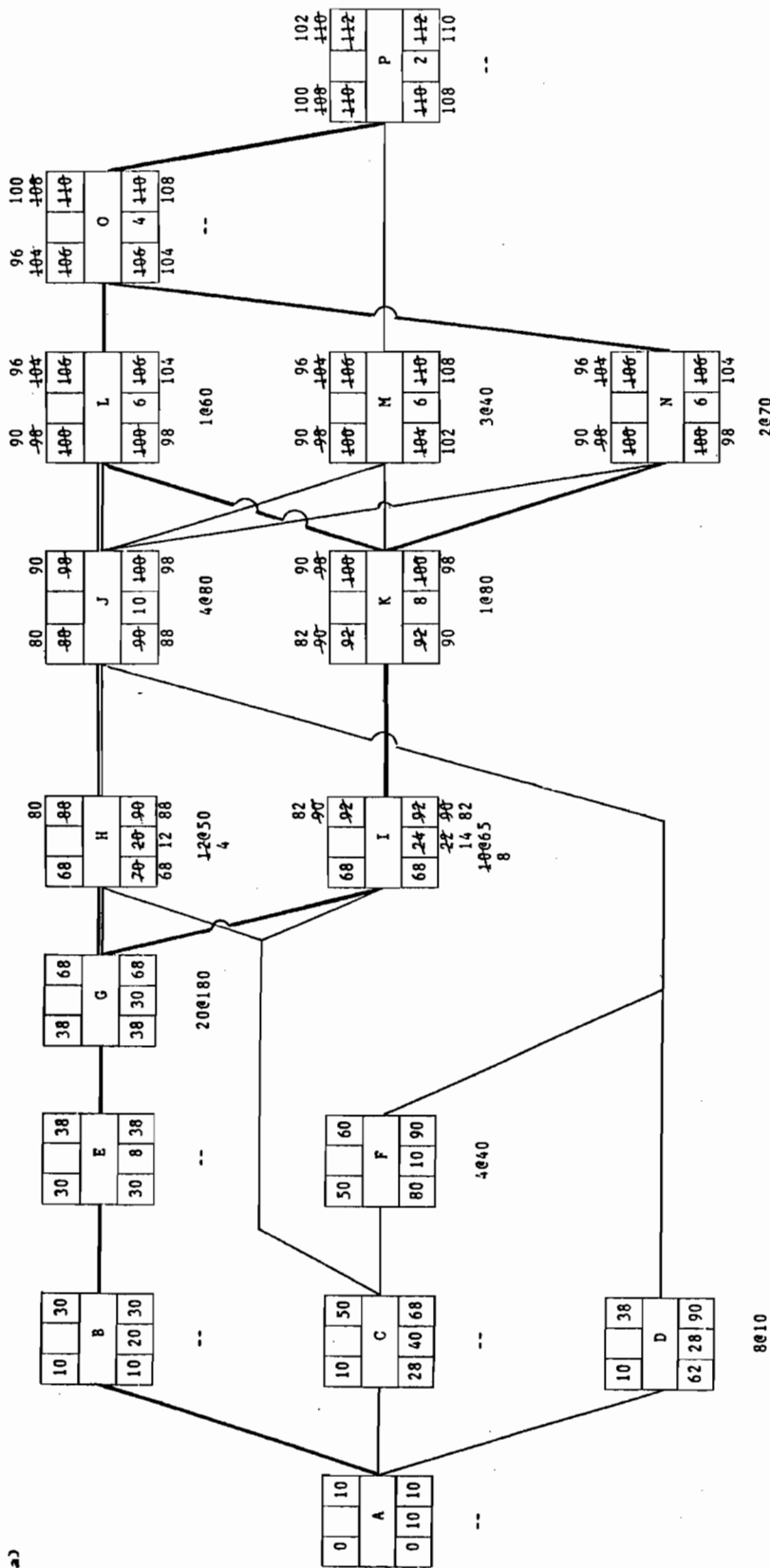
1. a risk allowance (cost contingency)
2. financial charges for the cash expended in the contract
3. contractor's profit according to the market conditions.

c) Loading of rates is risky for both parties because actual quantities of work are usually more or less than those included in B.O.Q.

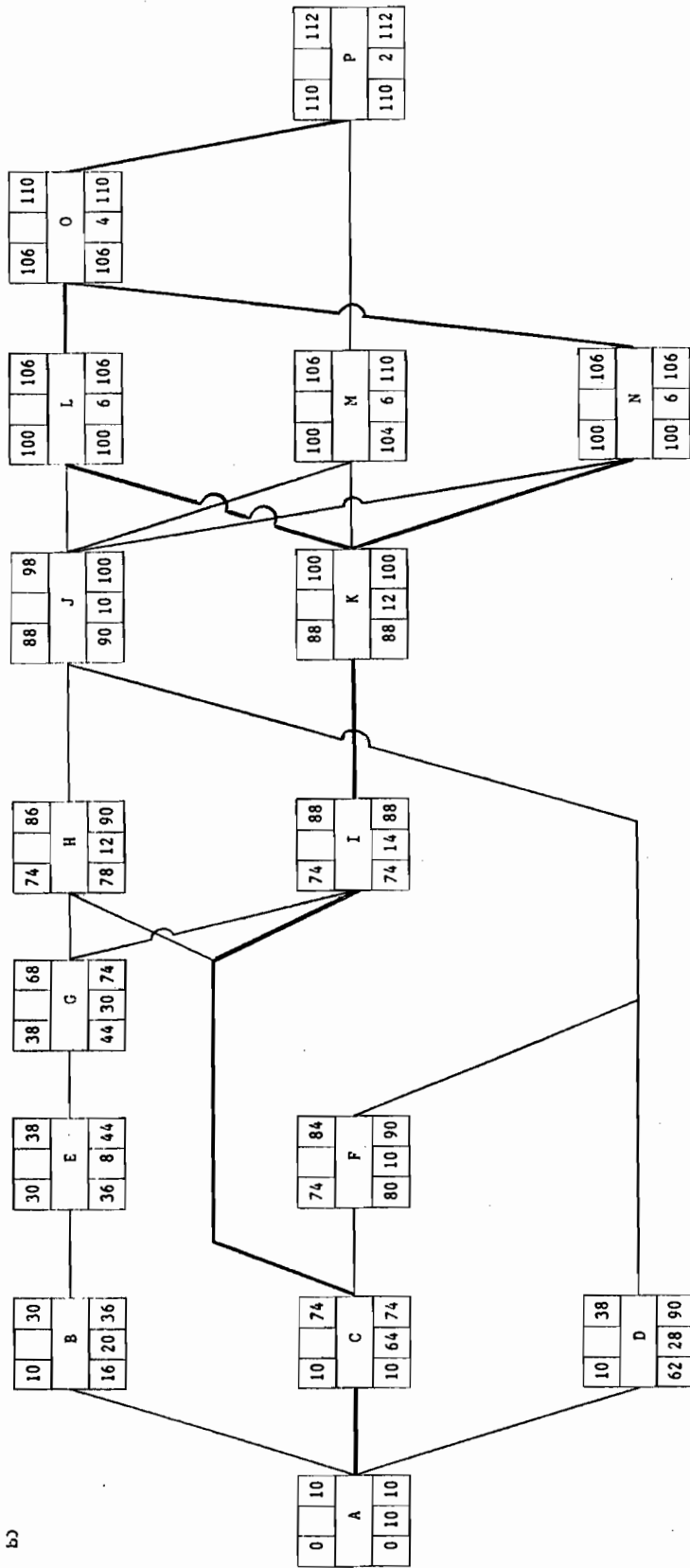
If a quantity with higher rate is increased, the contractor will gain more profit and this is a risk to the client. If a quantity with lower rate is increased, the contractor's profit will be eroded and this is a risk to the contractor.

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Solution 1



- Critical paths ABEGIKLOP either crash G 180
ABEGIKNOP I 65
K 80
L & N 130
→ Crash I by 2 days, cost increase = 130.
- Critical paths ABEGHJLOP either crash G 180
ABEGIKLOP H & I 115
ABEGIKNOP H & K 130
J & I 145
J & K 160
L & N 130
→ Crash H & I by 8 days, cost increase = 920.
- Contract duration = 102 days, minimum cost = 11720 + (130 + 920) + 102 (120) = LE 25 010.



b)

- Total delay = 112 - 102 = 10 days

- Critical paths ACIKLOP
ACIKNOP

Delayed activities are C & K, they are on the same critical path.

- Contractor responsibility = 6 days

He will pay liquidated damages = 6 (100) = LE 600

- Owner responsibility = 4 days

He will pay 260 + 4 (120) = LE 740.

Solution 2

See Example 2.22, page 76.

Solution 3

a) Main roles of the contract documents are:

- quality assurance of the works
- basis for payment to the contractor
- basis for choice of contractors

b) Services offered by the management contractor and not by the Engineer:

- cost control
- advise on construction economics
- contract scheduling

c) - For bad weather conditions:

the contractor should make a good progress during the dry season and add a time contingency to the programme of work.

- For site remoteness problems:

the contractor should provide facilities to transport labour and staff and to feed them on camp.

- For shortage of skilled labour:

the contractor should assume reduced labour output to satisfy unskilled labour and provide facilities for training them.

d) Advantages of using method-related charges:

- systematic method for evaluating of work changes and claims
- reduction of financial charges and effect of inflation
- no need for loading of rates.

Solution 4

Discount factor = 8 % every 6-month period

Cost-plus contract

Period	Cost	Revenue	Net cash flow	Dis. factor	NPV
0	0	0	0	0	0
1	-25000	27500	2500	0.9259	2314
2	-75000	82500	7500	0.8573	6430
3	-75000	82500	7500	0.7938	5954
4	-100000	110000	10000	0.7350	<u>7350</u>

$\Sigma = 22047$

Other contract

Period	Cost	Revenue	Net cash flow	Dis. factor	NPV
0	0	60500	60500	0	60500
1	-25000	30250	5250	0.9259	4861
2	-75000	0	-75000	0.8573	-64298
3	-75000	60500	-14500	0.7938	-11510
4	-100000	151250	51250	0.7350	<u>37669</u>

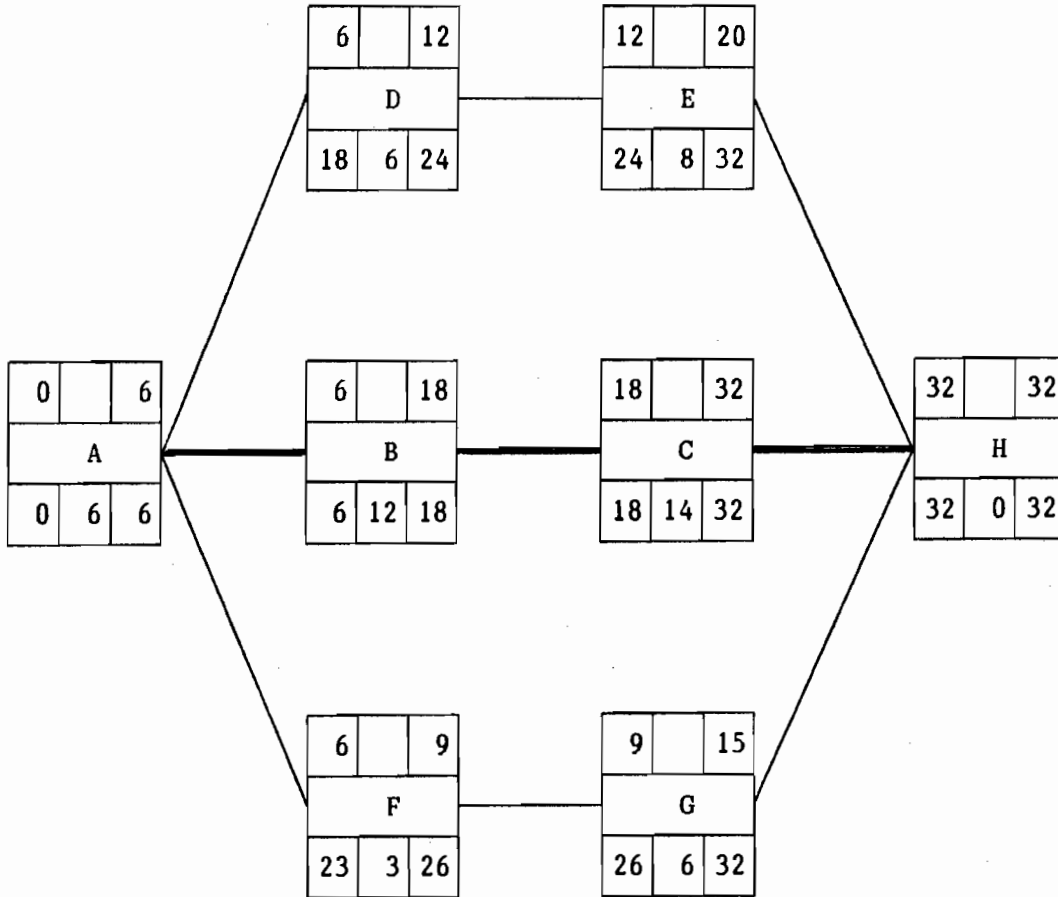
$$\Sigma = 27222$$

Then based on NPV, the second contract is more attractive to the contractor

EXAM OF MAY 93

Solution 1

a)



Project completion = 32 weeks

Then week 32 = week no. 1 in the year.

Start date = 52 - 32 = week no. 20 in the previous year
= end of week 3 of May.



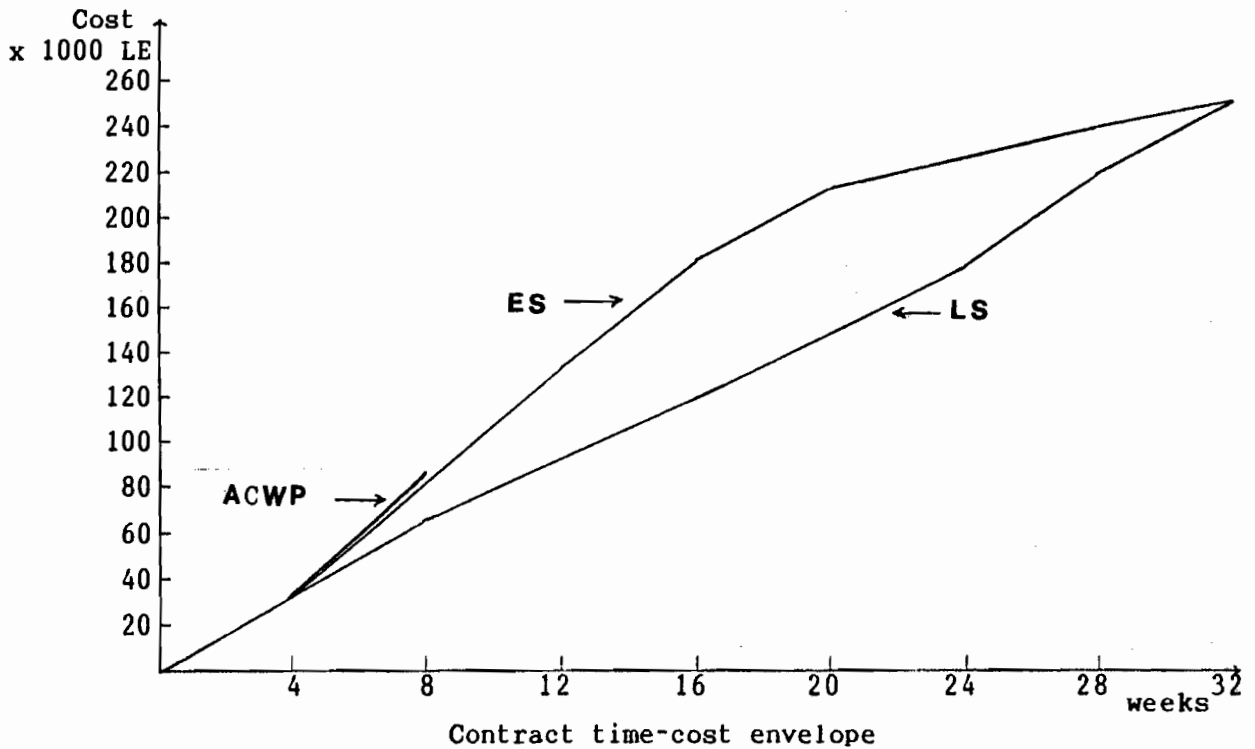
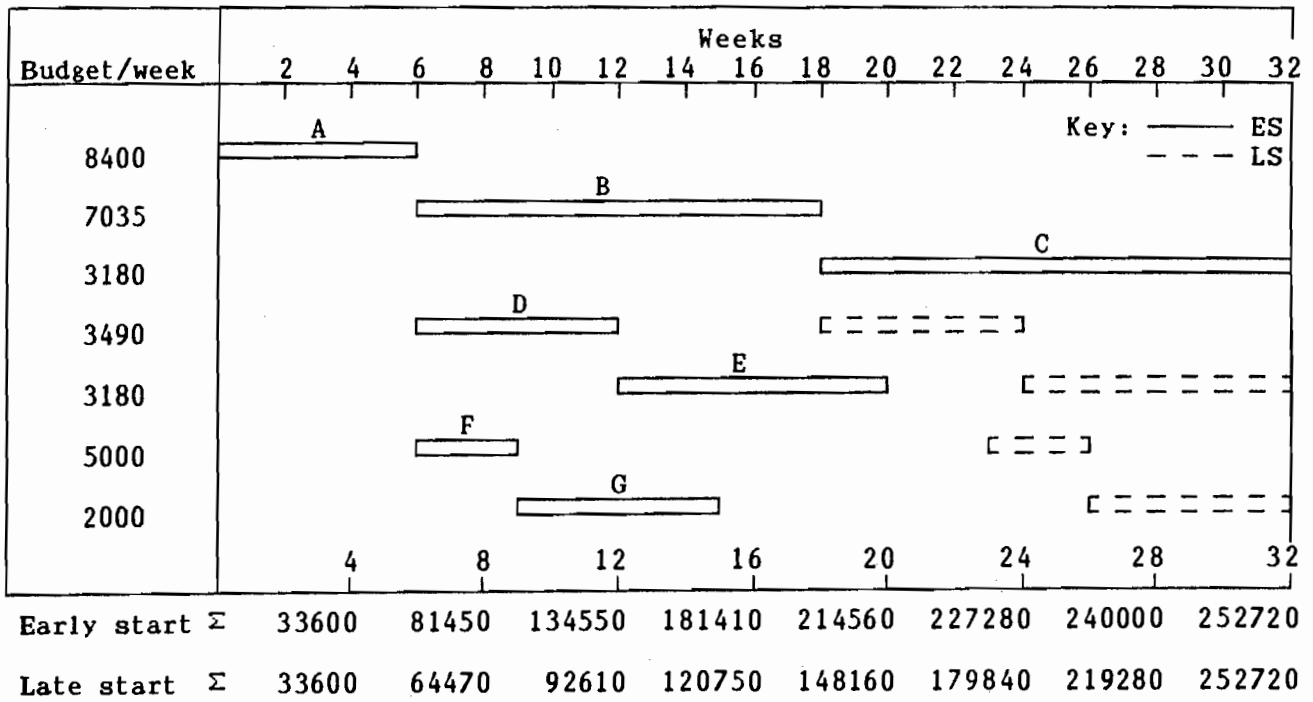
The four weeks of January can be used as a time contingency to cover any risk variables which may delay the construction of this phase of the project.

- b) The contractor should use the four weeks of January as a time allowance, so increase of duration of activity B by 3 weeks must be recovered by crashing activity C by the same amount. On the other hand, increase of activity D by 1.5 weeks can be recovered by the float available for the activity. This will not affect project duration.

So, minimum increase in contract cost can be achieved by crashing activity C by 3 weeks.

- c) To draw the contract time-cost envelope, two S - curves should be derived: the first with the activities on their early start timings and the second with the activities on their late start timings.

Calculations for deriving S - curves



Progress of the contract

Up to week 4 the contract runs according to the target schedule, but between week 4 and week 8, it gives over cost. The contractor should take corrective actions to reduce this overrun.

Solution 2

See Example 5.3, page 136.

Solution 3

a) The indirect cost & markup is distributed equally between bid items according to their direct costs.

Balanced bid

Item	Quantity	Unit	Total direct cost	Direct cost rate	Indirect cost rate	Total rate
C. excavation	500000	m ^a	475000	0.95	0.0406	0.991
R. excavation	200000	m	2400000	12.00	0.5129	12.513
Structures	--	Sum	400000	--	--	--

b) If rock is less than expected while common excavation is higher, the contractor can load the rate of common excavation by the part of indirect cost & markup of the rock excavation. So, new loaded rates will be:

Unbalanced bid

Item	Quantity	Unit	Total direct cost	Direct cost rate	Indirect cost rate	Total rate
C. excavation	500000	m ^a	475000	0.95	0.246	1.196
R. excavation	200000	m	2400000	12.00	--	12.000
Structures	--	Sum	400000	--	--	--

Solution 4

a) The role of PM team:

- choice of contract strategy
- choice of consultants
- solve problems with local authorities and inhabitants
- project commissioning
- project coordination
- realization of the project defined at sanction
- prediction of project cash flow.

b) Tender price = price chosen by the contractor to bid on a certain project

Contract price = total final price of the project.

They are different because of the many variables affecting the project such as change of quantities, risks, and inflation.

c) Prequalification aims at evaluation of contractors before tender.

The evaluation process involves contractors' reputation, company turnover, experience with previous similar projects and quality of staff. The client has the right to discuss with other clients who worked with the contractor in the past.

d) Open tendering:

advantage: no agreement between contractors

disadvantage: long list of bidders

Selective tendering:

advantage: short list of chosen competitive contractors

disadvantage: a interested company may be neglected.

e) Admeasurement contract: prices (which include unknown indirect cost and markup) are used to evaluate change. The evaluation process is therefore difficult.

Cost-reimbursable contract: is easier than admeasurement contract because actual costs are paid to the contractor.

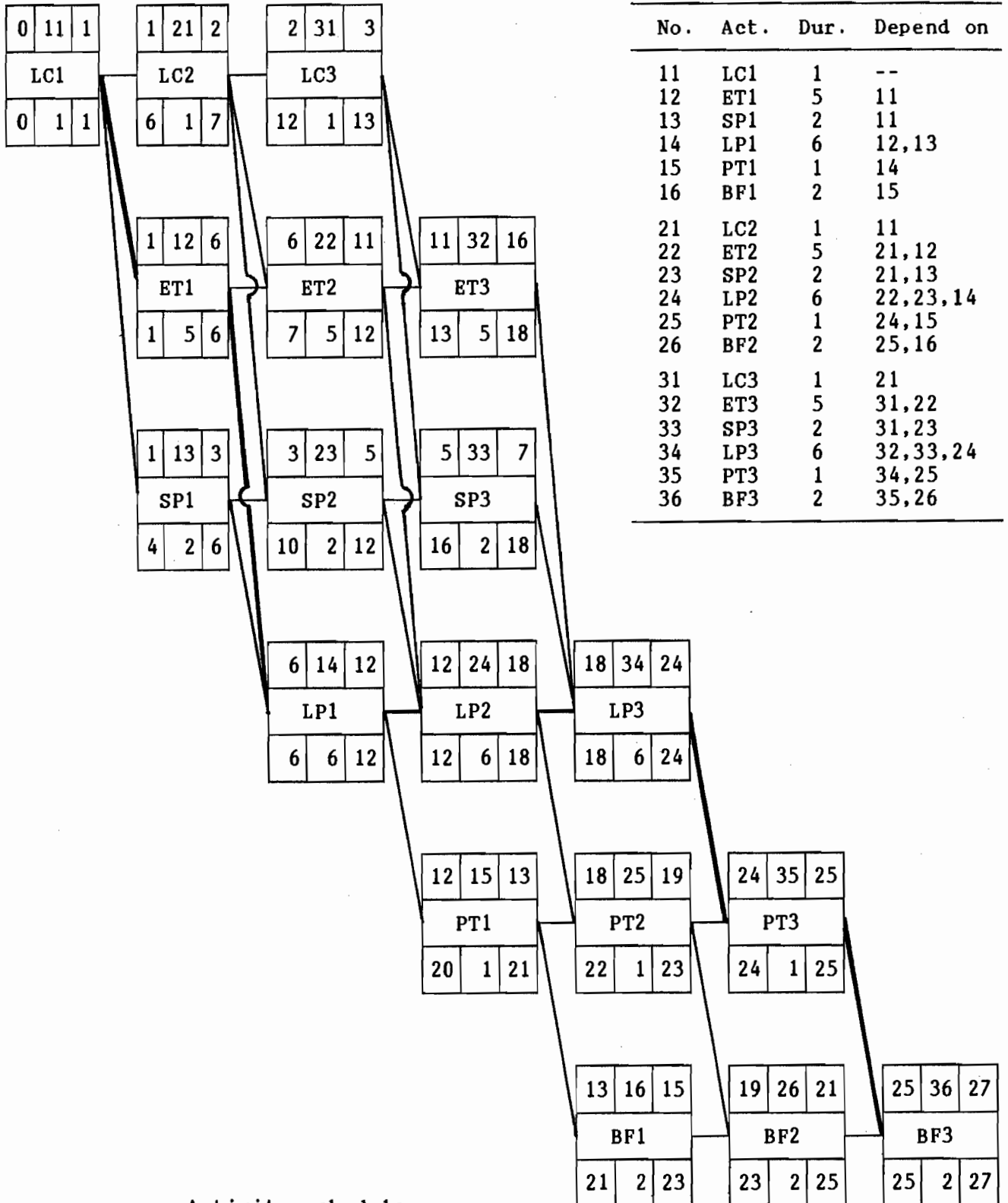
EXAM OF JUNE 94

Solution 1

a)

Plan of the works

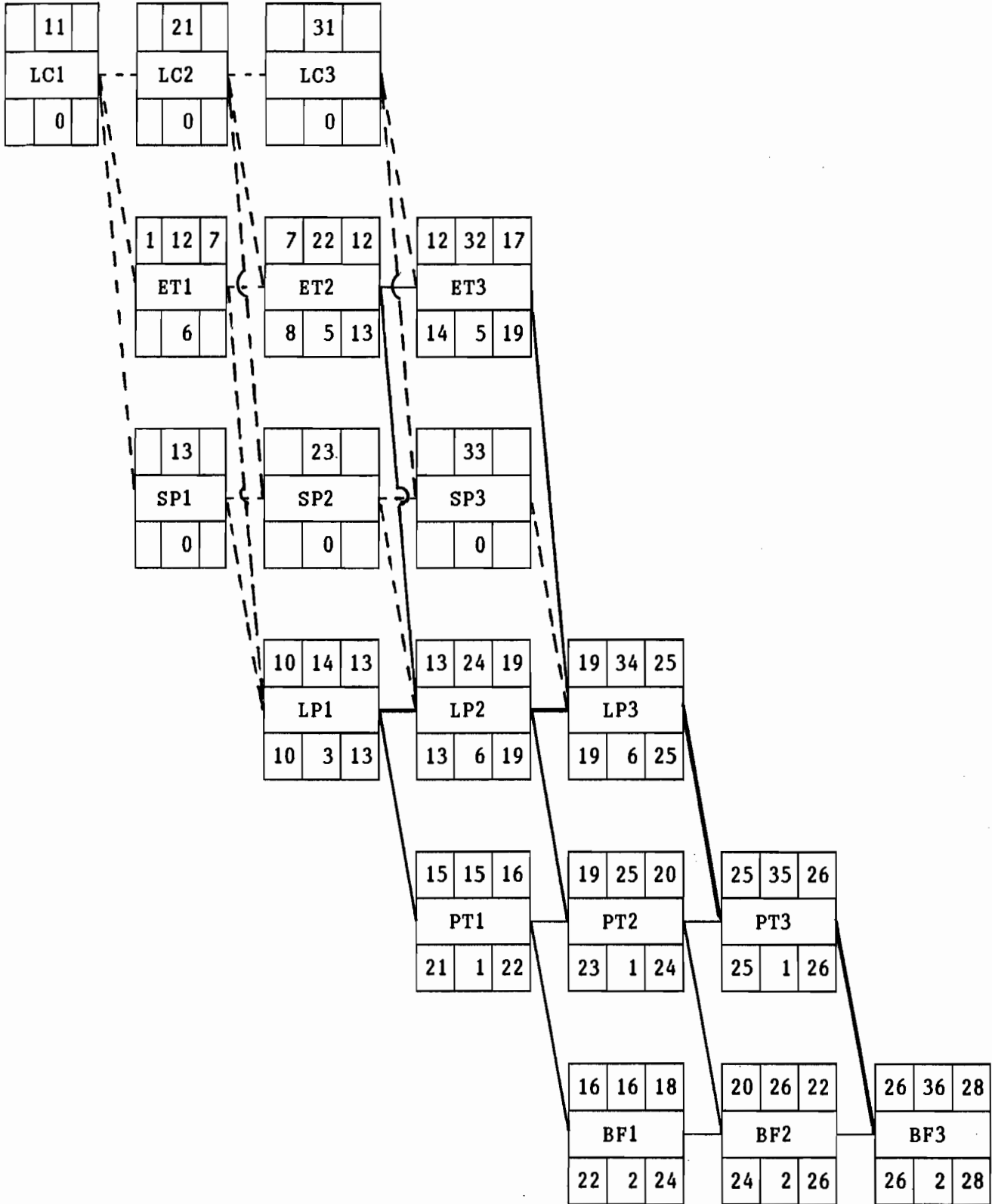
No.	Act.	Dur.	Depend on
11	LC1	1	--
12	ET1	5	11
13	SP1	2	11
14	LP1	6	12,13
15	PT1	1	14
16	BF1	2	15
21	LC2	1	11
22	ET2	5	21,12
23	SP2	2	21,13
24	LP2	6	22,23,14
25	PT2	1	24,15
26	BF2	2	25,16
31	LC3	1	21
32	ET3	5	31,22
33	SP3	2	31,23
34	LP3	6	32,33,24
35	PT3	1	34,25
36	BF3	2	35,26



Activity schedule

b)

Updated schedule



Total direct cost = 7000 x 3 = 21000
 Indirect cost = 77.77 x 27 = 2100 = 10 % of direct cost

Activities costs:	LC	440
	ET	3300
	SP	600
	LP	1980
	PT	220
	BF	1100
		7700

Calculation of BCWS (up to day 10)

		1			
	1 2 3 4 5 6 7 8 9 0 1 2 3				
LC	_____				3 x 440 = 1320
ET	_____				1.8 x 3300 = 5940
SP	_____				3 x 660 = 1980
LP	_____				0.666 x 1980 = 1320
					BCWS = 10560

Calculation of BCWP (up to day 10)

		1			
	1 2 3 4 5 6 7 8 9 0 1 2 3				
LC	_____				3 x 440 = 1320
ET	_____				1.6 x 3300 = 5280
SP	_____				3 x 660 = 1980
LP	_____				0.5 x 1980 = 990
					BCWP = 9570

SPR = 9570 / 10560 = 0.91 → behind schedule
 CPR = 9570 / 9570 = 1 → on cost

The contract is behind schedule due to the delay of activity ET but it is on cost.

Solution 2

In cost-plus contracts the contractor is in harmony with the client, but in price-based contracts the two parties are in conflict. The reason behind this situation is that in cost-plus contracts the contractor is reimbursed for actual cost plus a specified fee for head office overheads and profit, no special payment for risk. Thus the contract involves a high level of flexibility for design changes. Final price depends on changes and extent to which risks materialize. If a cost target is added to this contract, specified risks can be excluded from the tendered target cost and when these risks occur the target is adjusted accordingly.

On the other hand, in price-based contracts the contractor chooses rates against each item in BOQ or a single price in lump sum contract. The rates or the single price include risk contingency and financing charges. Considerable risk is usually placed with the contractor. Accordingly, the lump sum contract has a very limited flexibility for design change and the BOQ contract offers some. In the latter case, the contractor can claim additional payment but claims resolution is difficult because the client has no knowledge of actual costs or hidden contingency.

Solution 3

	Capital cost	Salvage value	Labour cost	Maintenance
Equipment	21000	2000	3000	420
Manual	---	---	9600	---

EUAC of labour = 9600

$$\text{EUAC of equip.} = 3420 + 21000 \times \frac{r(1+r)^n}{(1+r)^n - 1} - 2000 \times \frac{r}{(1+r)^n - 1}$$

$$\therefore 9600 = 3420 + \frac{2000r}{(1+r)^n - 1} [10.5(1+r)^n - 1]$$

$$r = 10\% \longrightarrow n = 4.011 \text{ years} = \text{min. contract period.}$$

Solution 4

a) The role of R.P.R. to provide Q.A. on a project:

- He should :
- supervise work of any activity as long as it is proceeding
 - check materials as soon after they are delivered as possible
 - inspect work as it progresses and decides on acceptance of it
 - notify the contractor if any material or portion of work does not conform to the requirements
 - control site testing laboratory
 - follow up daily any work to be corrected by the contractor.

b) The risk should be allocated to the party best able to assess it. If there is any doubt, it should be carried by the client. This is because it is better for the client to pay for what happens rather than for what the contractor thought might happen in these risks.

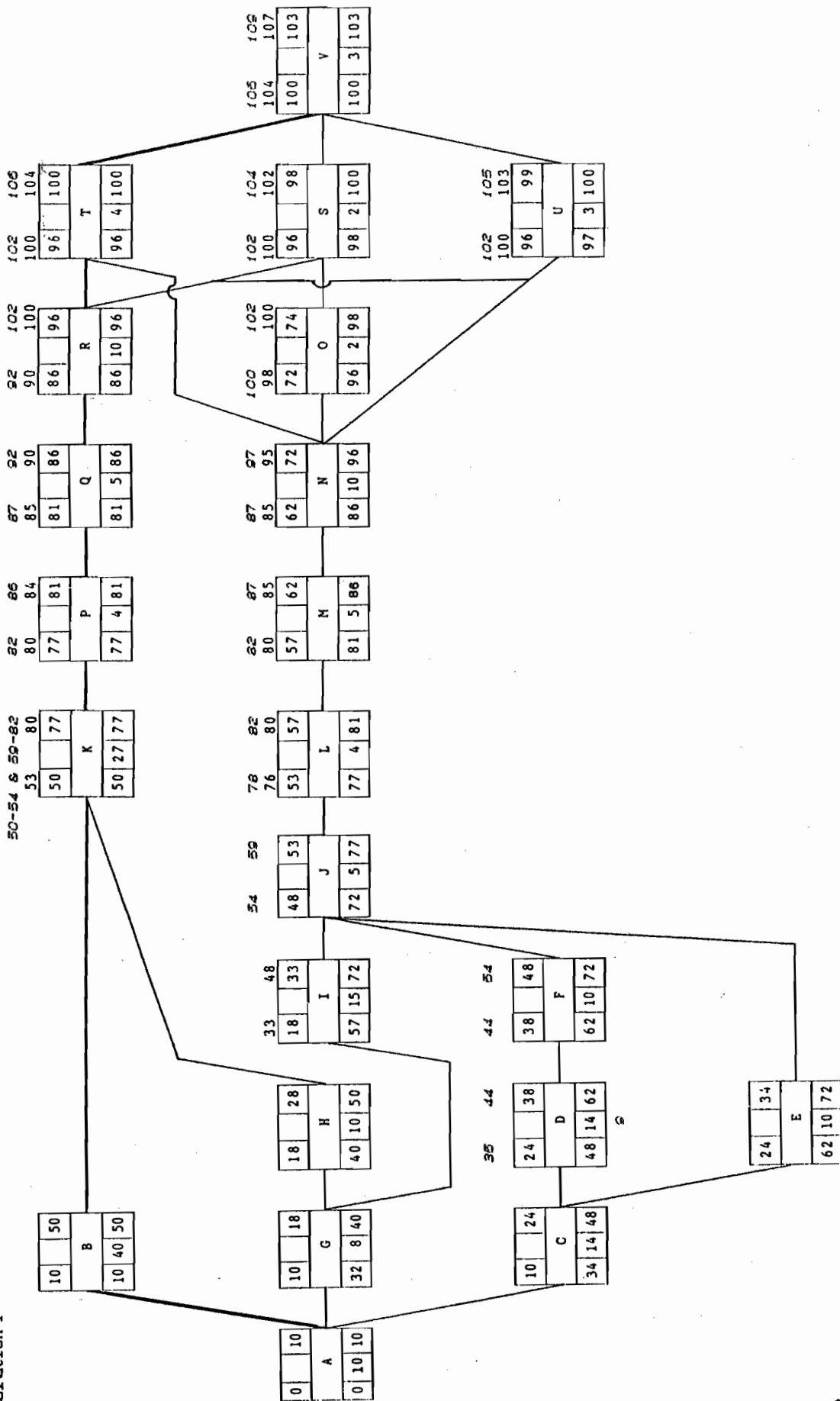
c) Head office overheads allocated to a specific contract =

$$\frac{\text{Contract direct cost} \times \text{total H.O. overheads in a year}}{\text{Expected direct cost of all contracts during the year}}$$

Monthly monitoring of the company works will help to adjust the expected direct cost during the year.

EXAM OF JUNE 95

Solution 1



Activity schedule

b)

Activity	SS	SF
I	33	48
J	48	53
K	53	80
L	76	80
P	80	84
M	80	85
Q	85	90
O	98	100
S	100	102

Minimum contract duration = 107 days

c) Total delay = 6 days (Activity K is executed as two separate activities). We can crash K by 2 days.

Solution 2

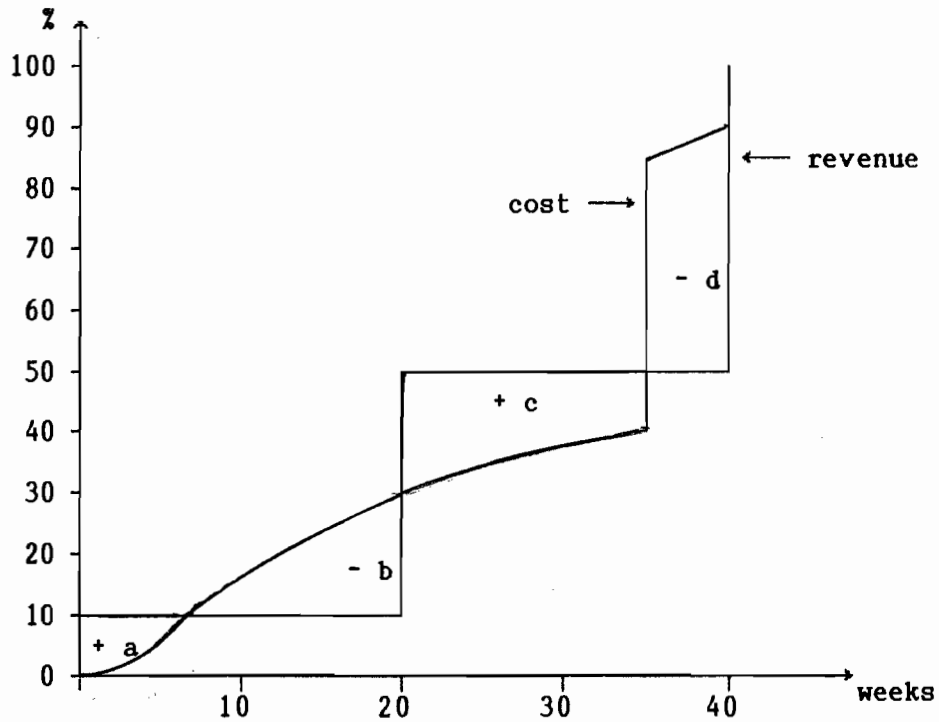
a) The main stages are:

1. Pre-tender evaluation of contractors (Prequalification): the client may press an announcement requesting response from interested firms. The willing contractors can then provide information including details of similar work, financial data, turnover and the management structure to be provided to the project.
Reputable and acceptable contractors will be allowed to bid.
2. Preparation of tender documents which include :
 - general and special conditions of contract
 - specification
 - tender drawings
 - unpriced BOQ
 - form of agreement
 - instruction to bidders.
 Issue of tender documents to selected contractors.
3. Tender preparation by the contractor: in order to submit a realistic and competitive bid. The contractor will plan and schedule the works, estimate the costs, and choose the markup. He then translates the price into rates in BOQ.
The contractor submits his bid.
4. Tender analysis by the Engineer. He will open the bids from various contractors on a given date and time. He will evaluate the bids to ensure that they are realistic and the proposed resources are adequate. A recommendation is given as for the best bid.

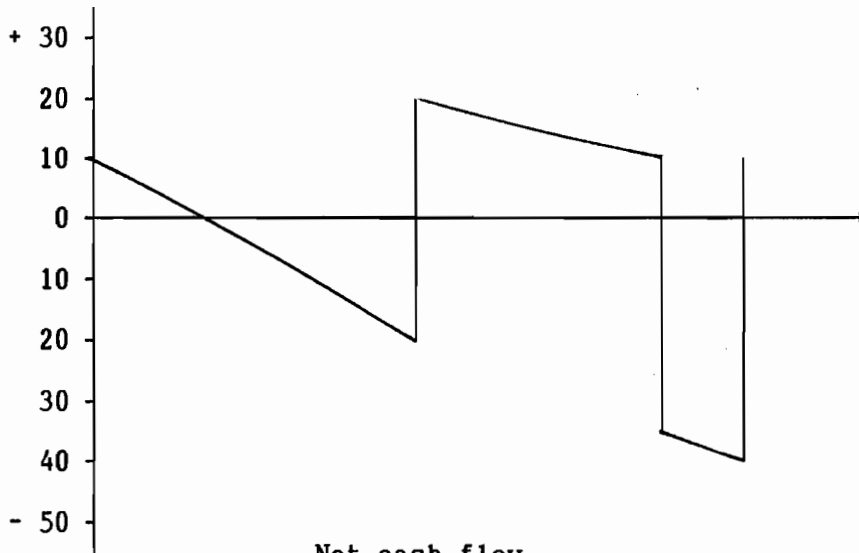
b)

	Lump sum	Admeasurement	Cost-plus
Early start to construction	impossible	limited	normal
Claims resolution	very difficult	difficult	easy

Solution 3



Cash flow



Net cash flow

b) Area = area a + area c - area b - area d

Financial charges = Area x investment rate %

c) The contractor can reduce negative cash flow during construction of this project by following the late start S-curve.

Solution 4

a) The estimator should visit the site before producing the cost estimate in order to obtain information about:

- site description and ground conditions
- labour availability
- location of existing services
- problems relating to site security
- access to the site
- details about any demolition

Evidently, this information will affect the cost estimate of the works.

b) Two procedures are followed:

- a general allowance is added to the overall contract duration when the majority of the activities may be affected by the risk, for example, effect of bad weather on highway contracts.
- allowances for time lost are commonly applied to particular activities easily affected by the risk, for example, building an earth dam embankment.

c) $\text{Tender price} = \text{total cost} + \text{profit} + \text{financial charges} + \text{risk allowance}$

The risk allowance will affect the tender price, but has the total cost been accurately estimated? In many cases the total cost has not accurately estimated, so adding a risk allowance will not be the sole reason for losing the tender. On the other hand, if the contractor does not add this allowance and he wins the tender, he will lose his profit for covering the risks.

EXAM OF MAY 96

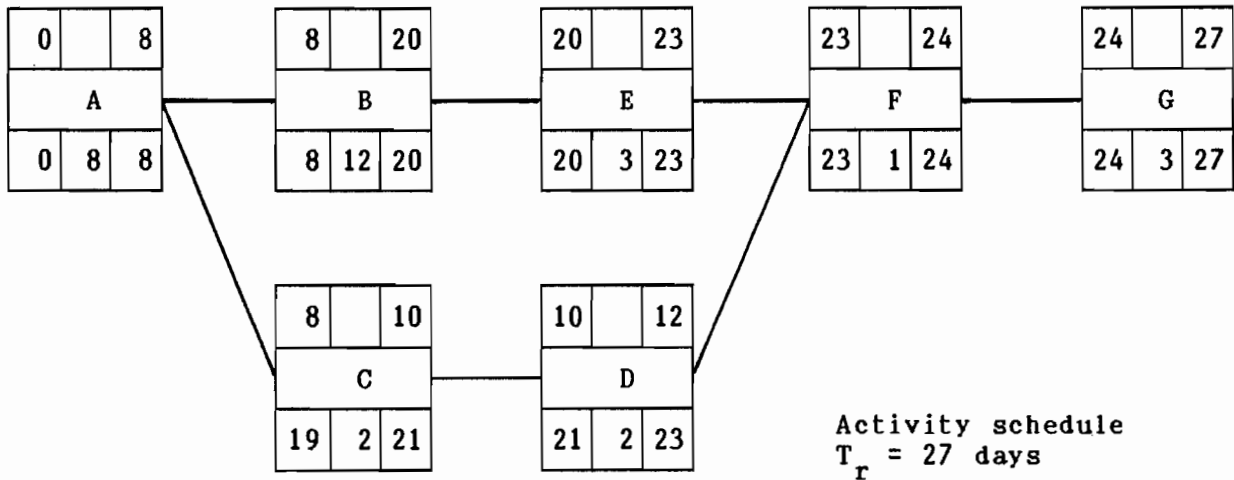
Solution 1

$N = 12$ $T_c = 38$ $S_o = 1$ buffer time = 0

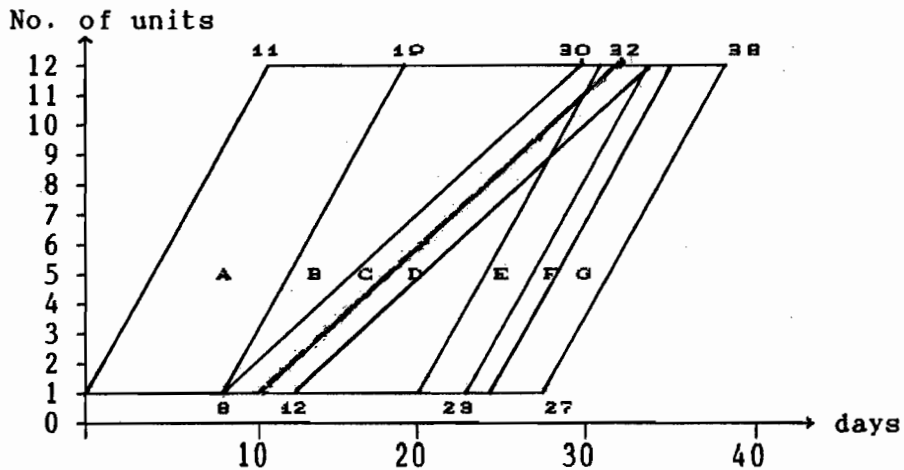
Min. no. of crews = make use of TF

$M = D S_o n$ $S_t = (D S_o n) \frac{r}{n} = D r$

$m = r \frac{S_a}{S_t}$ $r = \frac{N - 1}{(T_c - T_r) + TF}$



Act.	r	D	S_o	S_t	S_a	m	$ST_N - ST_1$
A	1	8	1	8	8	1	11
B	1	12	1	12	12	1	11
C	1/2	2	1	1	1	1/2	22
D	1/2	2	1	1	1	1/2	22
E	1	3	1	3	3	1	11
F	1	1	1	1	1	1	11
G	1	3	1	3	3	1	11



Solution 2

Act	Budget/wk	Weeks											
		1	2	3	4	5	6	7	8	9	10	11	12
I	13	████████████████████											
J	5				████████████████████	████████████████████	████████████████████	████████████████████	████████████████████	████████████████████	████████████████████	████████████████████	
K	6				████████████████████	████████████████████	████████████████████						
L	9							████████████████████	████████████████████	████████████████████	████████████████████	████████████████████	
Σ		13	13	13	13	11	11	11	14	14	14	14	14 = 155

At end of week 12, progress is on schedule, i.e., $SPR = 1$ and $BCWP = BCWS$

ACWP = LE 160 000
 BCWP = LE 155 000

$CPR = BCWP / ACWP = 155000 / 160000 = 96.88\%$
 There is a cost overrun of 3.12% although the progress is on schedule.

Solution 3

a) Main duties of the Engineer are:

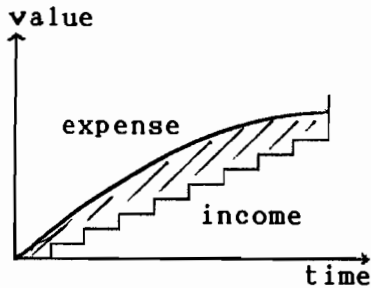
- preparation of tender document
- testing prequalifications of contractors
- selection of the best bid
- review of shop drawings
- certify monthly payment to contractors
- review contractor's plan and schedule
- issue of variation orders
- inspection of completed work
- prediction of final cost
- assessment of contractor's claims

b) The client should consider use of the management contract to organize design and construction of his project in the following cases:

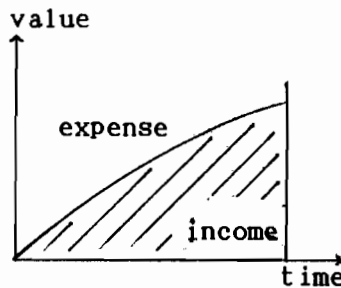
1. need for early start of construction or need for overall time saving
2. the client has not enough resources for management
3. flexibility for design change is required.

c) Site overheads : actual cost on site will be reimbursed to the contractor
 Head office overheads : the fee will cover this charge
 Risk allowance : no special payment for risk. If any risk materializes, actual costs to cover the risk will be paid.

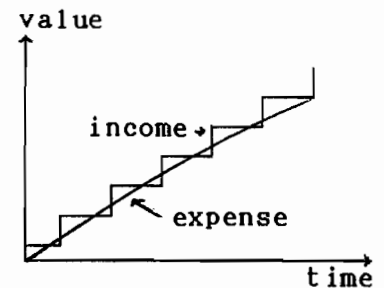
d) Effect of type of contract on amount of financial charges :



Admeasurement contract
small financial charges



Lump sum contract
great financial charges



Cost-plus contract
no financial charges

The area between expense and income curves represents financial charges. Payment in admeasurement contract is monthly, in lump sum contract at project completion and in cost-plus contract in advance of expenditures.

Solution 4

- a)
1. -- in order to cover lack of specialized resources.
 2. -- is reports of completed similar works, i.e. construction company data bank.
 3. -- aims at determining the best method of construction and sequence of work.
 4. -- because it is better for the client to pay for what have happened rather than for what the contractor thought might happen.
 5. -- the contractor could prepare his tender based on the optimum duration (min. cost) and rely on claims to avoid liquidated damages.
 6. -- when an item in BOQ is loaded and the associated quantity is increased.

b)

	Operational estimating	Unit rate estimating
When to use	Civil Eng. works, i.e. plant-intensive projects	Building works, i.e. labour-intensive projects
Basic data required	<ul style="list-style-type: none"> - labour production rates - equip. production rates - labour, equip. and materials prices. - method statement - activity schedule - likely-usage of resources (histograms) 	<ul style="list-style-type: none"> - labour production rates - equip. production rates - labour, equip. and materials prices ----- ----- -----
Cash flow predict.	Easy because of knowledge of activity schedule	Very difficult because of absence of schedules

inherent	ملازم ل - مرتبط ب
injury	اصابة
inspector	فاحص
installation	تركيب
instructions	تعليمات
insurance	تأمين
integrated	مجمعة
intensive	مركزة
intent	نية
interest	اهتمام
interest rate	سعر الاستثمار
interfering	يتدخل مع
interim	الحالي
interpretation	فهم
interrupt	يقاطع - يزعج
interview	مقابلة
investment	استثمار
invoice	فاتورة
involvement	مشاركة
issuing	اصدار
item	بند

J

joint account	حساب (بنكي) مشترك
---------------	-------------------

L

lag	تأخير
lease	تأجير
leeway	احتياطي
legal	قانوني
legend	مفتاح خريطة
likelihood	احتمال
line-of-balance	خط التوازن
liquidated damages	غرامة تأخير
local authority	هيئة عامة للمرافق
logical	منطقي
lump sum	مقطوعة

M

maintenance	صيانة
management	ادارة
margin	هامش
materialize	يتجسد - يصبح واقعا
maximize	تعظيم
method-related charges	الاسعار المرتبطة بالطريقة
milestone	تاريخ مهم للمشروع
minimize	تقليل
minutes	دقائق الامور
mitigate	يقلل التأثير الضار
mobilization	تجهيز موقع العمل
model	نمطي - نموذج
money-of-the-day	سعر اليوم (للتفود)
monitoring	ملاحظة (تقدم العمل)
most likely	الاكثر احتمالا
motivation	تحفيز

N

national	قومي
negotiation	مفاوضات
net present value	القيمة الصافية الحالية
network	شبكة
neutral	محايد
newcomer	حديث العهد
normal	طبيعي
notation	مصطلحات
notify	يخبر

O

objective	هدف
obligations	واجبات
obviously	من الواضح
openbook accounting	حسابات مفتوحة
operation	تشغيل
operational	المرتبط بالعمليات
opportunity	فرصة
optimistic	متفائل
optimum	مثالي
oral	شفهي
organization	تنظيم
output	انتاجية
overcome	يتغلب على
overhead	مصاريف ادارية
overlap	تداخل في التوقيتات
ownership	ملكية

P

package	جزء متكامل من الاعمال
participants	مشاركون
party	طرف من اطراف المشروع
path	مسار
payment	دفع (مستحقات)
performance	اداء
pertain	يخص
pessimistic	متشائم
phase	مرحلة
policy	سياسة
possession	امتلاك
pour	يصب (خرسانة)
precedent	سابق
precisely	بدقة
predecessor	سابق
predictable	يمكن التنبأ به
pre-qualification	سابق خبرات
prescribe	ينصح ب
prevail	يحصل على الريادة - يتفوق
price	سعر
principles	اساسيات
priority	افضية - اولوية
probabilistic	احتمالي
procurement	توريد

S

productivity	انتاجية	salvage value	سعر بيع الشيء المستخدم
professional	مهني	sanction	اقرار (المشروع)
profitable	مربح	satisfactorily	بصورة مرضية
progress	تقدم	scaffolding	سقالات
projected	متوقع	schedule	برنامج زمني
prolonged	مطول - مزيد	schedule of rates	دفتر الفئات
provision	توفير احتياجات	sector	قطاع
purchase	شراء	seniority	اقدمية

Q

qualitative	مرتبب بالتنوع
quantifiable	يمكن تحديد كميته
quantity surveyor	مساح كميات
quarry	مخبر
quotation	عرض اسعار
quoted	السعر المعروض

R

ranking	ترتيب
rate	سعر
rate of return	معدل العائد
realistic	حقيقي - واقعي
receipt	يتلقى اموال
record	يسجل - سجل
recovery	استعادة
refinement	تعديل - تنقيح
regime	نظام
regulatory	لوائح تنظيمية
reimburse	يعيد دفع
release	يطلق سراح - يحرر
relevant	على صلة بالموضوع
relief	علاج
remedy	علاج
remoteness	بعد عن
repetitive	متكرر
replacement	تبديل - تعويض
representative	ممثل (المشروع)
reputation	سمعة
request	طلب
resident	مقيم
residual	متبقى
resolution	حل المشكلة
resource	عنصر عمل
restore	يسترجع
restraint	قيود
restrict	يحدد
retention	مستبقى
revenue	عائد
revise	يراجع
ring	حلقة
risk	خطر
role	دور

shift	وردية
shifting	تحريك - نقل
shop drawings	رسومات الورشة
shorten	يقلل
shuttering	شدة (خشبية)
sign	بوقع على
simulation	محاكاة
site	موقع عمل
smoothing	تهذيب - جملة منتظما
social security	ضمان اجتماعي
sole	وحيد
specialized	متخصص
specification	مواصفات
spokesperson	الشخص المتحدث باسم
steelwork	منشأ من الصلب
strategy	سياسة ادارية
strict	معرف بدقة
strike	يفك (الشدة)
strip	يفك (الشدة)
subcontract	عقد من الباطن
subjective	شخصي
submit	يسلم شيىء ل
substantial	ذو اهمية حقيقية
succeeding	التالي
successor	لاحق
superintendent	مدير موقع
supervision	اشراف
supplier	الجهة الموردة
surety	كفيل
surpass	يزيد عن
suspension	معلق
sustain	يدعم (لفترة طويلة)

T

tabulation	جدولة
target	هدف - مستهدف
tax	ضرائب
temporary	مؤقت
tender	مناقصة
theorem	نظرية
title	اسم وظيفة
tolerance	سماح
tradesmen	حرفيين
transaction	اداء من خلال (العمل)

trivial
trough
turnkey
turnover

لا فائدة لة
منخفض
تسليم مفتاح
رأسمال (الشركة)

U

ultimate
uncertainty
undermine
undertaking
underway
undisclosed
unforeseen
updating
urgent
usage
utilization

نهائى
عدم التاكيد
يضعف
ينفذ
تحت التنفيذ
غير واضح
لا يمكن معرفته مسبقا
تحديث
ملح - عاجل
استخدام
الاستفادة من

V

vague
variance
variation order
violate
virtual
vital

غير واضح
اختلاف
امر تغيير
يتعدى
افتراضى
حيوى

W

wayleaves اماكن مستخدمة حول موقع العمل
weighting of rates تحميل الاسعار
willing راغب فى - عازم على
working drawings لوحات تنفيذية
workmanship عمالة

Y

yield

يعطى

Principles of Construction Project Management is a balanced and comprehensive text that provides the reader with necessary skills required to manage construction projects. The book demonstrates the principles of organization of construction projects, planning and scheduling, contract strategy, cash flow and investment appraisal, estimating and tendering and construction progress control. Basic management techniques are described and their use illustrated in exercises. Sectors of civil engineering are represented throughout the applications. While it is suitable for use of civil engineering undergraduate students, the book will also be of great interest to project managers, consultants and contractors.

Adel Eldosouky is Professor of Construction Project Management and the leader of the Project Management Group in the Department of Civil Engineering at Tanta University. His previous academic appointment was that of Associate Professor at Mansoura University. He earned his Ph.D. degree in construction project management from the University of Manchester Institute of Science and Technology, U.K, in 1987. Since that time, he has supervised many research works including risk analysis, project time-cost problem, multi project scheduling, automated cash flow prediction, construction quality measurement, and development of Egyptian bills of quantities. He is the author of many technical papers. He has participated in many training courses for practicing engineers on construction management.

