CV4011 - Project Planning and Management
AY2016-2017 Semester 1

1 (a) (i) Explanation of "Lump Sum Contracts":

① In a Lump Sum Contract, the contractor offers to carry out whole work under a single Lump Sum payment.
② The contractor is fully responsible for the cost incurred and the works done.
③ At the tender stage, work scope is completely defined and work details are finalized.
④ Lump Sum Contract is suitable for jobs with small scale, little alteration, low level of risk, repetitive job units and finalized details, because all the risk is carried by the contractor.
⑤ Numerous alterations are unlikely allowed. Site variations are seldom made.
⑥ The requirements for site staff, measuring works and accounting works are minimized. Comparing with Admeasurement Contracts, Lump Sum Contract is more beneficial to the project owner in terms of financial issues.

Example of "Lump Sum Contracts":

One example of Lump Sum Contract is the contract for regular maintainance work of Singapore HDB buildings in every 5-year interval.
This project is small-scale, low-tech and repetitive. The risk level is low for the contractor so that the contractor has the capability to carry out the whole work with full responsibility. The nature of this project is simple and common, so it is possible for the project owner to finalize all details at the tender stage.

1 (a) (ii) ① Assume Wong Construction has agreed and signed the letter of order from STE. Assume that STE has already given possession of site to Wong Construction and Wong Construction has started ordering materials and hiring workers.

② Since STE sent the letter of order to Wong Construction to indicate that STE would like to enter a contract with Wong Construction regarding with the project work, and Wong Construction has agreed the letter of order, there is a binding agreement between these two organizations consequently. It is held that by signing an agreement (offer + aueptance), there is a legally binding relationship, and a contract is formed between two parties. But it should be noted that the contract is lack of proper documents.

③ STE breaches conditions of the contract, by withdrawing from the contract. As the innocent party, Wong Construction has the right to: *repudiate the contract
*bring an action for damages
*sue for quantum meruit
*sue for specific performame
*sue for injunction

④ However, it should be noted that the quantum meruit may not coves the full cost and loss incurred. The reason is that these is no contract documents to define the measuring and payment details.

Formal contract documents can explicitly describe the scope of work, rights & obligations of both parties and payment details. Contract documents are mutually explanatory and legally recognized, so it is significant to have formal contract documents to protect rights and profits, and to get sufficient claim.

1(b)(i) ① It is assumed that the work that Island Concrete has done is approved by the Architect / QS and the certificate of payment has already been issued.

② There is no such implied term that the obligation to order concrete is subject to the subsistence of the main contract. So, it is still ABC's obligation to order full amount of concrete since it is already specified in the contract. Termination of the contract by ABC does not free the obligation of ABC.

③ Since the portion of work done by Island Concrete has been approved by Architect / QS, ABC has to pay Island Concrete according to the certificate of payment.

④ It is held that ABC breaches the conditions of contract. Island Concrete, as the injured party, has the legal rights to repudiate the contract and claim for damages. So, in addition to the payment for works done, Island Concrete can sue for additional reimbursement for damages and loss.

1(b)(ii) Contract documents include:

① Contract agreement (letter of offer & letter of acceptance)
② General conditions of Contract
③ Special conditions
④ General requirement specifications
⑤ Technical specifications
⑥ Construction drawings
⑦ Bill of Quantities
⑧ Daywork schedule
⑨ Fesibility study

2(a)(i) It is not appropriate for the managing partner of CAB to direct James to do so as the following reasons:

① If James accepts the offer to design the temporary work for the main contractor, CAB would be playing a dual role as the consultant for both project owner and the main contractor, under the same project. This is not recommended by the code of professional conduct & Ethics.

② If CAB serves the main contractor to design the temporary work, it would be in such situation that CAB checks its own design for the owner. This act is not acceptable by PE Act, as it is not easy to detect mistakes in the design which is done by itself.

③ In this situation, a conflict of interest is likely to arise. This is a potential violation on relevant provision of the code of professional conduct & Ethics.

④ If James accepts the offer, he is actually discharging his duties to his employer without complete fidelity, because a PE should not:
* accept remuneration for any professional engineering service from any one other than his employer.
* accept commission in connection with his professional work
* undertake any assignments that would likely to create conflict of interest

2(a)(ii) If James accepts the offer and the temporary work collapse, the following will happen to him:

① The Professional Engineer License will be canceled or suspended.

② A proper amount of fine will be charged to him.

③ He is possible to be sent to jail.

2(b)(i) ① On completion of building works, owner may apply to CBC for Temporary Occupation Permit (TOP) or Certificate of Statutory Completion (CSC). The building is not allowed to be occupied before the issurance of TOP or CSC.

② TOP can be issued for building works which is not fully completed, but in the opinion of CBC, the non-completion is not detrimental to the safety and well-being of any occupant.

③ CSC will only be issued if building work is complete and statutory requirements of the development are complied and issued with clearances.

2(b)(ii) ① Any building works carried out in contravention of Building Control Act's provisions may be considered by CBC as unauthorized building works.

② For unauthorized building works, CBC may request the owner to perform the following:

* stop the building work
* demolish the building work
* conduct necessary alteration works
* submit the application to regularise the unauthorized building work.

③ If the owner is not approachable, or the owner refused to comply with CBC's requirements, CBC can carry out the necessary works, and recover the cost from the owner.

2(c) Illustration :

Consider that Mr Tan is currently the PE of the project owner. The project owner is not satisfied with the professional service provided by Mr Tan, so the owner is considering to terminate the service from Mr Tan and would like Mr Wong to take up his job. Mr Wong is not allowed to take up the job from Mr Tan, unless he can make sure that Mr Tan has already been paid satisfactorily.

Rationale :

The rationale of this provision can be reflected from the following aspects :

① To ensure the right of the previous PE to be paid satisfactorily for his professional services.

② If the previous PE is not discharged satisfactorily, it will be possible that the latter PE cannot get well paid.

③ To avoid the attempt to supplant between PEs.

3(a)(i) Objectives of LOB method:

① To meet a programmed rate of completion

② To carry out the repetitive work at a uniform rate

③ To move labour and plant through the project in a continuous manner.

④ To achieve the productivity and financial benefits from the repetitive nature of the project.

Conditions of application :

① The project can be divided into a number of identical units.

② The work associated with each unit comprises a number of well defined operations

③ The construction process repeats for each unit.

3(a)(ii) Procedure stages:

Stage ①: Identify the operation associated with the construction in one unit.

Stage ②: Establish the logical sequence between the operations for one unit.

Stage ③: Establish optimum team size and time needed for each operation

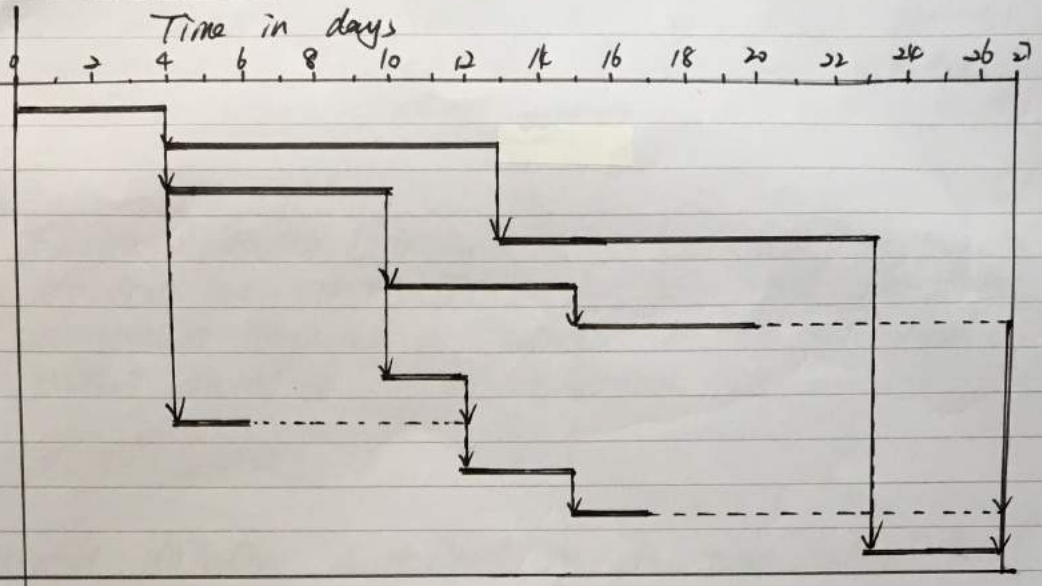
Stage ④: Allocate required resources for each operation so as to achieve the specified target build rate.

Essential field data:

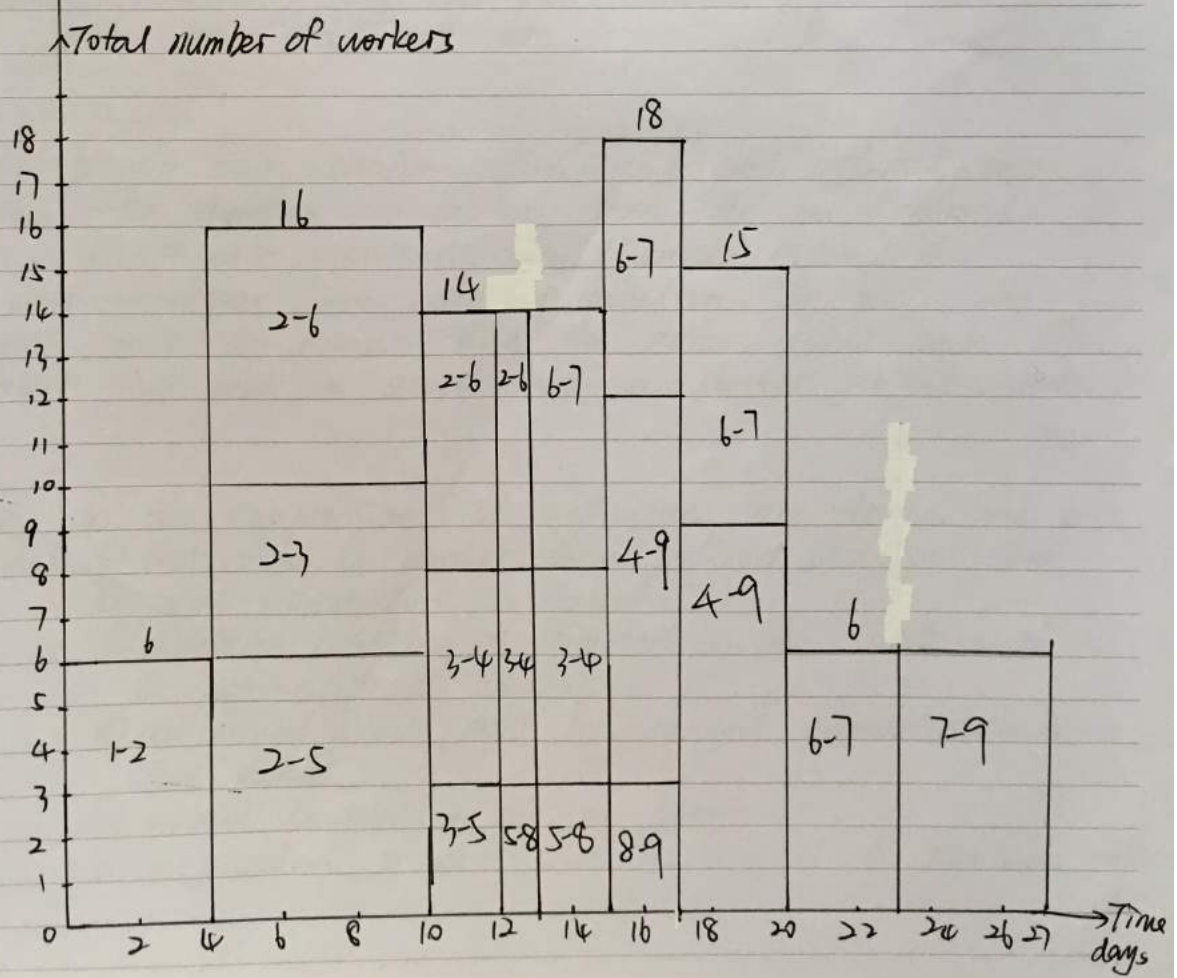
Q: Optimum team size for each operation (men)
R: Target rate of build (units/week)
N: Number of units to build (units)
h: Number of working hours per day (hours/day)
d: Number of working days per week (days/week)
M: Estimated man-hours for each operation per unit (man-hour)
G: Theoretical gangsize $G = RM/dh$ (men)
g: actural gang size (men)
u: actual rate of build $u = gR/G$ (units/week)
T: Time taken per unit for each operation $T = M/Qh$ (days)
S: Time interval between the start of first & last unit $S = \frac{N-1}{u} \times d$ (days)

3(b)(i) Linked Bar chart :

Activity	Duration
1-2	4
2-6	9
2-3	6
6-7	10
3-4	5
4-9	5
3-5	2
2-5	2
5-8	3
8-9	2
7-9	4



Manpower Aggregate Chart :



3(b)(ii) Way 1: Shift Activity 4-9 by 5 days so that it starts at Day 20 and finishes at Day 25. The total manpower is reduced to 15 men and project duration is not changed.

Way 2: Shift Activity 8-9 by 5 days so that it starts at Day 20 and finishes at Day 22. The total manpower required is reduced to 15 men and project duration is not changed.

4(a) The all-normal duration is defined as the time taken to work the activity at the lowest feasible direct cost. To shorten the duration, more direct cost must be invested to re-schedule works, pay overtime salaries, hire more workers, rent more equipment etc.

The total project cost involves direct cost and indirect cost. To shorten the duration to be less than the all-normal duration, direct cost increases as discussed above, but indirect cost decreases with shorter duration. If the saving of indirect cost is larger than the extra direct cost, the total project cost will be saved with a shorter project duration.

Limitations in the compression of activities on the critical path includes that ① cost slope is smaller than indirect cost per day
② total project cost is saved
③ maximum crashing is limited by the float available in non-critical chains.
④ all critical chains must be crashed simultaneously by same amount
⑤ project compression is in stages
⑥ compression of activities is subject to available ranges

4(b) First Compression :

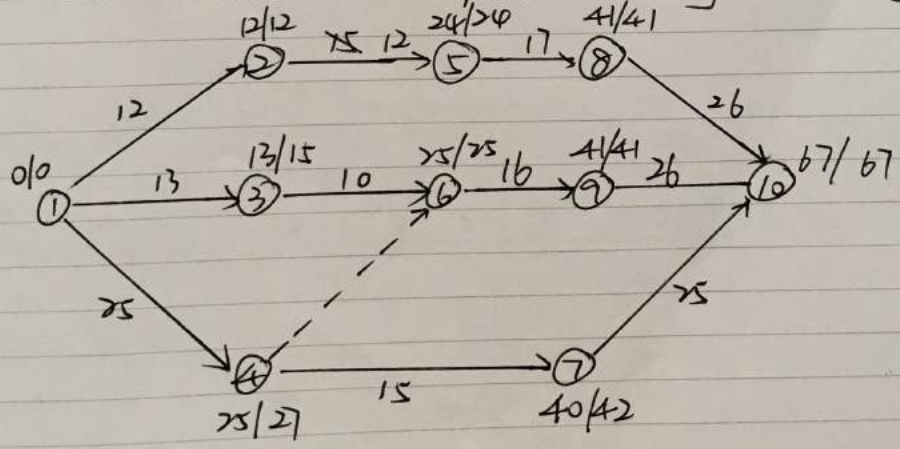
critical path : 1-2-5-8-10
non-critical path : 1-3-6-9-10 TF = 70-13-10-16-26 = 5
1-4-7-10 TF = 70-25-15-25 = 5

Note the effect of dummy activity 4-6, which divides the total floats of two non-critical paths into two parts.

chain	TF
1-3-6	2
6-9-10	3
1-4	0
4-7-10	5

Activity	Range	cost slope	
1-2	3	950	
2-5	5	280	cheapest
5-8	4	450	
8-10	0	-	no range

So we decide to compress activity 2-5 by 3 days.



New project duration = 67 days
Saving in cost = 1200 x 3 - 280 x 3 = 2760

Second Compression :

critical path : 1-2-5-8-10

non-critical path : 1-3-6-9-10 TF = 2

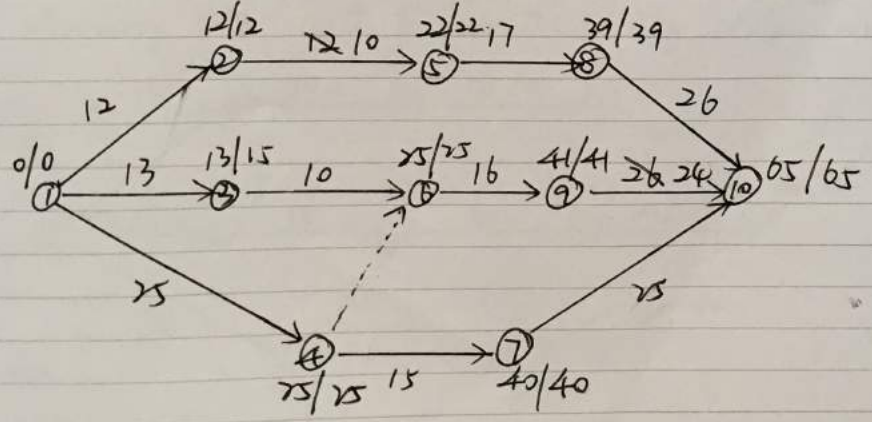
1-4-7-10 TF = 2

Chain	TF
1-3-6	2
6-9-10	0
1-4	0
4-7-10	2

Note that Chain 6-9-10 and chain 1-4 are connected through dummy activity and they are critical chains. The project cannot be compressed unless activities on these two chains are compressed.

Activity	Range	cost slope	
1-2	3	950	
2-5	5-3=2	580	cheapest
5-8	4	450	
8-10	0	-	no range
1-4	3	650	
6-9	0	-	no range
9-10	3	750	cheapest

So we decide to compress Activity 2-5 by 2 days and Activity 9-10 by 2 days.



New project duration = 65 days

Saving in cost = 1200 x 2 - 580 x 2 - 750 x 2 = 1340

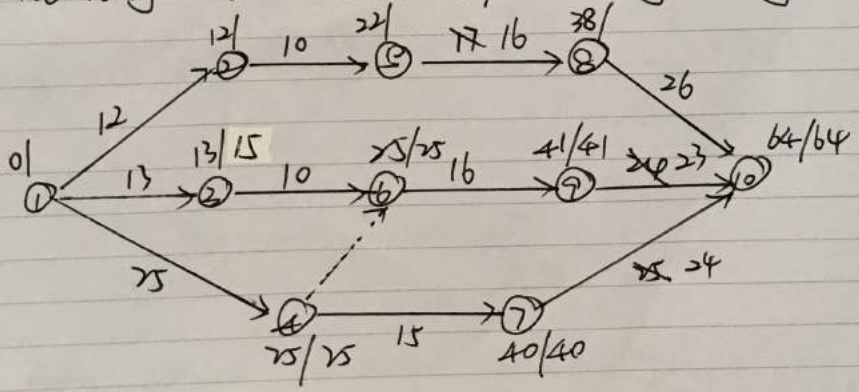
Third compression:

critical path : 1-2-5-8-10
1-4-7-10
non-critical path : 1-3-6-9-10 TF=2

Note that the float on Path 1-3-6-9-10 is controled by the dummy activity. This path cannot be compressed unless activities on chain 6-9-10 or activity 1-4 can be compressed.

Activity	Range	Cost slope	
1-2	3	950	
2-5	5-3-2=0	280	no range
5-8	4	450	cheapest
8-10	0	-	no range
1-4	3	650	
4-7	5	390	
7-10	2	275	cheapest
6-9	0	-	no range
9-10	3-2=1	250	cheapest.

275+250 = 525 < 650
so we should compress 7-10 & 9-10 first, instead of 1-4.
So we decide to compress activities 7-10 and 9-10 by 1 day each
Activity 5-8 will be compressed by 1 day as well.



New project duration = 64 days
Saving in cost = 1200 - 450 - 275 - 250 = 225

Fourth Compression:

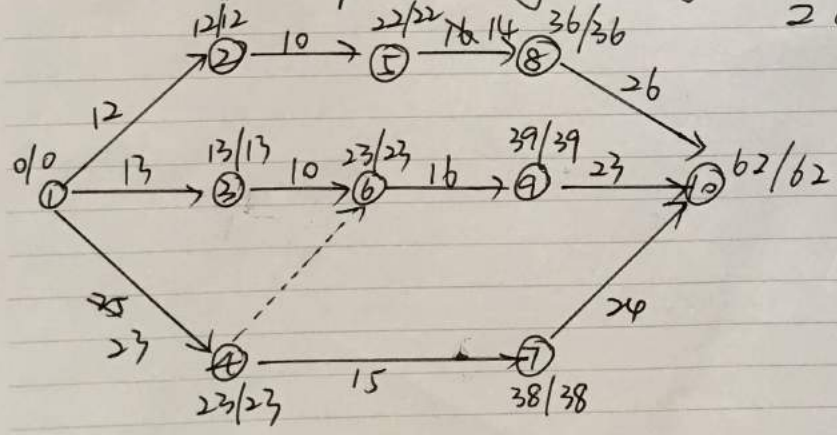
Critical path: 1-2-5-8-10
1-4-7-10

non-critical path: 1-3-6-9-10 TF = 2

Note that the float on path 1-3-6-9-10 is controled by the dummy activity. Activity 1-4 or activities on 6-9-10 must be compressed for further compression of the project.

Activity	Range	Cost slope	
1-2	3	950	
2-5	0	280	no range
5-8	4-1=3	450	cheapest
8-10	0	–	no range
1-4	3	650	
4-7	5	390	
7-10	2-1=1	275	
6-9	0	–	no range
9-10	3-2-1=0	750	no range

Chain 6-9-10 has no capacity for further compression, so Activity 1-4 will be compressed by 2 days. Activity 5-8 will be compressed by 2 days as well.



New project duration = 62 days
Saving in cost = 1200 x 2 – 450 x 2 – 650 x 2 = 200

This project cannot be further compressed because any compression will increase the total cost.

Consider the compression of activities 5-8, 1-3 & 7-10, according to the smallest cost slope principle. This compression will generate float on chain 1-3-6, such that the project duration will not be reduced.

Consider the compression of activities 5-8, 1-3 & 1-4, Now the project duration can be reduced, but the total cost slope exceeds the indirect cost per day.

In conclusion, the total saving in time = 70 - 62 = 8 days.
The total saving in cost = 2760 + 1340 + 225 + 200 = 4525.

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