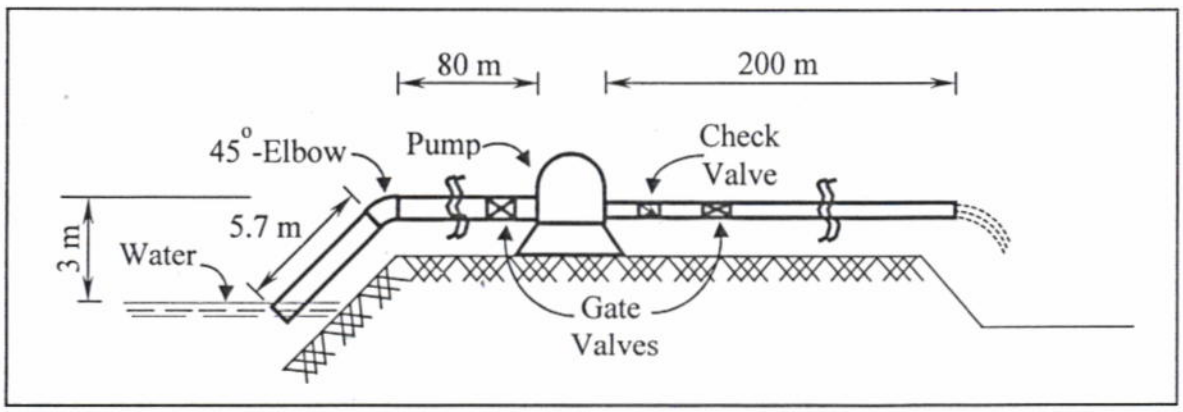
University of Technology
Building & Construction Engineering Department
Final Exam (Set 1) –2013/2014

Subject: Methods of Construction | **Class: 3rd year**
Branch: Structural Engineering | **Time : 3 Hours**
Examiner: Layla Ali Ghalib Yassin | **Date : 17 / 06 / 2014**

(Note: Attempt Four Questions Only)

Q1) (25 marks)

A) It is required to pump (1136 l/min) of water from a construction project. The contractor has decided to use (150 mm) steel pipes on the suction side, and (100 mm) steel pipes on the discharge side, of a proposed self-priming pump, to remove the water as shown in figure below. What capacity pump the contractor should choose to do the job? **(15 marks)**



B) Fill the Blanks with the suitable words selected from the list below: **(10 marks)**

(minimum, bulldozer, smallest, economical, preheating, cooling, front loader, guide, preservative, standard, crane, bank)

1) The quantity of water used in making concrete should be the ------ amount needed to give the concrete the required plasticity.
2) Cement-soil stabilization is ------ and convenient where the soil is clay or silt.
3) In designing concrete forms, the ------ value of (L) calculated for each category of bending, shear and deflection is used as the safe span that satisfies all conditions.
4) ------ the water is the most effective method of providing the required temperature for placing concrete in cold weather.
5) The equipment that can be used economically on more than one project may be defined as a ------ equipment.
6) One of the uses of a ------ is opening up roads through mountains and rocky areas.
7) On multistory buildings, it is possible to use a ------ tower to hoist the bucket of concrete.
8) ------ is a mass of soil rising above an average level, or any soil which is dug from the original position.
9) "Suggested Method and Result Specifications" can serve as a ------ to a less-experienced contractor.
10) The life of timber piles may be short unless the piles are treated with a ------.

Q2) (25 marks)

A) Determine the probable cost per hour for owning and operating a six-rubber-tires truck after renting it for 6 months with an option to buy it later; make use of the following information: **(15 marks)**

5

Actual truck cost	$60000
Total cost of tires	$12000
Salvage Value	$8850
Useful life, N	5 years
Operating hours per year	2500
Rental period	6 months
Rental charges per month	$1000
Tires useful life, N_{Tires}	5000 hr
Maintenance for truck (60% of truck's Depreciation)	
Maintenance for tires (15% of tires' Depreciation)	
Investment (12% of Average Value)	
Cost of fuel, $/hr	7.50
Cost of oil, $/hr	0.50

B) Answer One of the Following: **(10 marks)**

10

B-1) Estimate the approximate output of a bulldozer under the following conditions:

- Swell, 20%.
- Haul distance, 30m.
- Rated moldboard capacity, 3.0 m^3 loose volume.
- Operating factor, 45min/hr.
- Pushing speed, 3 km/hr; Returning speed, 6 km/hr.
- Fixed time, loading and shifting gears, 0.3 min.

B-2) A piece of equipment is available for purchase for ($35000), has an estimated useful life of (5 years), and an estimated salvage value of ($5000). Determine the depreciation and the book value for each of the 5 years using SOY method, and then draw the relationship between useful life and book value.

Q3) (25 marks)

A) Find the maximum spacing between studs, ($L_{sheathing}$), for a concrete wall having the size of (0.24×3×20) m, make use of the following information: **(15 marks)**

- Actual output of mixer used = 18 m^3/hr.
- γ_c= 24 kN/m^3.
- Temperature of concrete = 25°C.
- Lumber used for sheathing have a thickness of 25 mm.
- Lumber used for Studs, (b×h), (50×100) mm.
- Extreme fiber in bending (f=12400 kN/m^2).
- Horizontal Shear (v = 1000 kN/m^2).
- Modulus of Elasticity (E = 11.035×10^6 kN/m^2)
- $D_{(Allowable)}$= 3 mm.
- All members extend continuously over several supports.

B) Choose the correct answer to fill the blanks: **(10 marks)**

1) The output of a concrete mixer will vary with the -------- of the mixer.

a) amount b) type c) size

2) Gradability is defined as the ------ slope that a tractor may move up at a uniform speed.

a) average b) minimum c) maximum

3) The amount of fresh water that will be pumped by a triplex single-acting reciprocating pump of the size (d=150mm, l= 350mm), driven by a crankshaft making (80 rpm), with a 5% of water lslippage is about ------.

a) 1410 (l/min) b) 1510 (l/min) c) 1140 (l/min)

4) If the placement rate (R≥ 3 m/hr), the pressure is equal to ------.

a) $P_m = 7 + \frac{1414R}{1.8T + 32}$ b) $P_m = \gamma_c \times h$ c) $P_m = 7 + \frac{2079 + 440R}{1.8T + 32}$

5) The safe load on a 50ft long steel pile that was driven to full penetration using a double-acting steam hammer, with a falling ram of (4500 lb) in weight, (12.5 in) free fall height, a (7500 ft-lb) theoretical energy and an average penetration per blow for the last 10 blows of (0.4 in) is ------.

a) 40000 lb b) 30000 lb c) 20000 lb

6) Reduction in volume of earth after it is placed in a fill and compacted is defined as ------.

a) swell b) shrinkage c) stabilization

7) A (1.59 S) concrete mixer is a ------ mixer.

a) construction b) paving c) transit

8) A contractor who employs an average of (200) men (40) hours per week for (60) weeks has (6) disabling injuries, that resulted in a total of (132) days lost from work, will have an Injury-Frequency Rate of ------.

a) 12.5 b) 9 c) 6.5

9) For the same contractor in item 8, if two of the six disabling injuries, involving a time loss of (60) days, resulting in a loss of a foot, at ankle, and a thumb, the Injury index will be ------.

a) 0.07 b) 0.08 c) 0.09

10) In order to reduce segregation, concrete should flow ------ downward as it is discharged into forms or from one unit of equipment to another.

a) horizontally b) laterally c) vertically

Q4) (25 marks)

A) Determine the quantities of materials required per batch and the probable output for a 0.79 S mixer, the quantity of materials per cubic meter are: **(15 marks)**

10

Cement, 8 bags/m^3

Sand, 650 kg/m^3

Gravel, 1000 kg/m^3

Water, 180 litters/m^3

Operating Factor is 45- min hour

If the mixer discharges the entire batch of concrete into a single bucket, the time per cycle should be as follows: (Charging mixer: 0.25min, Mixing concrete: 1min, Discharging mixer: 0.25min and lost time: 0.1min).

B) Fill the Blanks with the suitable words selected from the list below (answer 5 sentences only): **(10 marks)**

(~~centrifugal~~, sheet, ~~variable~~, ~~labor accidents~~, ~~load-bearing~~, ~~fixed~~, open, ~~displacement~~, fatal occurrences, ~~head~~, enclosed, accident, prevention, ~~speed~~)

1) Piles may be classified on the basis of their use into two major classifications, ------ and ------ piles.
2) The capacity of a reciprocating pump is dependent on the ~~head~~ at which the pump is operated and is independent of the ~~speed~~.
3) Construction Industry is one of the productive sections with high index of ------ and ------.
4) Single-acting steam hammers may be ------ or ------.
5) Pumps used on construction projects may be classified as: ------ and ------.
6) The employer cost can be divided into: ------- and ------ costs.

Q5) (25 marks)

A) Find the cost of using a (1.6 m^3) power shovel to excavate (150000 m^3) of hard, tough clay soil, using the following information: **(15 marks)**

- Actual depth of (2.5m)
- Angle of swing of (120°).
- Job conditions are good.
- Management conditions are fair.
- Working day=8 hrs.
- Working hour=50 min.
- Percentage of stops=10%.
- Month=30 days.
- Cost of power shovel per day= ID 10000.

B) State whether the following statements are true or false: **(10 marks)**

1) If the unit is used to haul ready mixed concrete, which requires agitation en route to the project only to prevent segregation, the unit is called a transit mixer.
2) Grout may be injected into the full length of a hole at one time; this is referred to as the zone method of grouting.
3) An enclosed impeller has higher efficiency than an open impeller.
4) If the water is pumped during a piston movement in one direction only, the pump is classified as single-acting.
5) Drop hammers are suitable for driving piles on projects for which the time of completion is an important factor.
6) Weight batching is much more dependable and more commonly used in producing concrete.
7) The life of timber piles may be short unless they are treated with a preservative.
8) Gradability is the resistance which is encountered by a vehicle in moving over a road or surface.
9) If the aggregate and the cement are charged into the mixer at a central batching plant, with mixing to be done en route to the job, the unit is called an agitator mixer.
10) Economical concrete, having the required properties can be produced by using the smallest practical sizes of coarse aggregate and the largest practical quantity of water.

(Good Luck)

University of Technology
Building & Construction Engineering Department
Final Exam (Tables) –2013/2014

Subject: Methods of Construction
Branch: Structural Engineering
Examiner: Layla Ali Ghalib Yassin

Class: 3rd year
Time : 3 Hours
Date : 17 / 06 / 2014

Table (6-1) - Ideal Output of Power Shovel, in cubic meter per 60-min hour, Bank Measure

Class of material	Size of Shovel, (cubic meter)								
	0.3	0.4	0.6	0.8	1	1.2	1.4	1.6	2
Moist loam or high sand clay	1.1 65	1.4 88	1.6 126	1.8 157	2.0 190	2.1 218	2.2 245	2.4 271	2.6 310
Sand and gravel	1.1 61	1.4 84	1.6 118	1.8 153	2.0 178	2.1 206	2.2 229	2.4 252	2.6 298
Good common earth	1.4 54	1.7 73	2.1 103	2.4 134	2.6 160	2.8 183	2.9 206	3.1 229	3.4 268
Hard, tough clay	1.8 38	2.1 57	2.4 84	2.7 111	3.0 137	3.3 156	3.5 180	3.7 202	4.1 236
Well-blasted rock	— 30	— 46	— 72	— 95	— 118	— 137	— 156	— 175	— 210
Wet, sticky clay	1.8 19	2.1 30	2.4 53	2.7 73	3.0 91	3.3 110	3.5 125	3.7 141	4.0 175
Poorly blasted rock	— 11	— 19	— 38	— 57	— 73	— 88	— 107	— 122	— 149

Table (6-2) Conversion Factor for Depth of Cut and Angle of Swing

Angle of swing , degrees							Percent of Optimum Depth, %
180	150	120	90	75	60	45	
0.59	0.65	0.72	0.80	0.85	0.89	0.93	**40**
0.66	0.73	0.81	0.91	0.96	1.03	1.10	**60**
0.69	0.77	0.86	0.98	1.04	1.12	1.22	**80**
0.71	0.79	0.88	1.00	1.07	1.16	1.26	**100**
0.70	0.77	0.86	0.97	1.03	1.11	1.20	**120**
0.66	0.73	0.81	0.91	0.97	1.04	1.12	**140**
0.62	0.67	0.75	0.85	0.90	0.96	1.03	**160**

Table (6-3) Coefficient Related to Management and Job Conditions

Job Conditions	Management Conditions			
	Excellent	Good	Fair	Poor
Excellent	0.84	0.81	0.76	0.70
Good	0.78	0.75	0.71	0.65
Fair	0.72	0.69	0.65	0.60
Poor	0.63	0.61	0.57	0.52

Table (10-1) – Minimum Capacities for M-Rated Self-Priming Centrifugal Pumps Manufactured in accordance with Standards of the Contractors Pump Bureau

Model 20-M				
Total Head including Friction, (m)	Capacity, (liters per min) Height of Pump above Water, (m)			
	3.0	4.5	6.0	7.5
9	1260	1060	890	625
12	1192	1022	871	613
15	1098	965	833	583
18	965	890	776	541
21	802	791	696	492
24	625	625	594	432
27	439	439	439	356
30	227	227	227	227
Model 30-M				
Total Head including Friction, (m)	Capacity, (liters per min) Height of Pump above Water, (m)			
	3.0	4.5	6.0	7.5
9	1893	1646	1325	946
12	1874	1628	1306	946
15	1798	1571	1287	927
18	1703	1541	1230	908
21	1571	1400	1136	871
24	1344	1230	1022	799
27	946	908	814	662
30	379	379	379	379
Model 40-M				
Total Head including Friction, (m)	Capacity, (liters per min) Height of Pump above Water, (m)			
	3.0	4.5	6.0	7.5
9	2498	2176	1798	1344
12	2441	2139	1760	1325
15	2347	2063	1722	1306
18	2214	1930	1647	1268
21	2025	1798	1552	1192
24	1760	1552	1382	976
27	1419	1230	1136	833
30	946	814	738	549
Model 90-M				
Total Head including Friction, (m)	Capacity, (liters per min) Height of Pump above Water, (m)			
	3.0	4.5	6.0	7.5
9	5602	4845	3974	2990
12	5413	4656	3861	2952
15	5110	4391	3672	2782
18	4637	3974	3407	2612
21	3974	3407	2933	2309
24	3028	2574	2271	1855
27	1703	1514	1382	1135
30	379	379	379	379

Table (10-2) – Friction Loss for Water, in m/100m of Clean Wrought-Iron or Steel Pipes

Flow (l/min)	Nominal Size, mm											
	25	31.5	37.5	50	62.5	75	100	125	150	200	250	300
643				48.4	19.6	6.53	1.67	0.54	0.22			
757				66.3	26.7	8.9	2.27	0.74	0.3	0.08		
833					32.2	10.7	2.72	0.88	0.36	0.09		
984					44.5	14.7	3.24	1.2	0.49	0.13		
1060					51.3	16.9	4.3	1.38	0.56	0.14		
1136						19.2	4.89	1.58	0.64	0.16		
1287						24.8	6.19	2	0.81	0.21		
1514						33.9	8.47	2.72	1.09	0.28	0.09	
1893						52.5	13.0	4.16	1.66	0.42	0.14	0.06
2271							18.6	5.88	2.34	0.6	0.19	0.08
2650							25	7.93	3.13	0.8	0.26	0.11

Table (10-3) – Length of Steel Pipe, (m), Equivalent to Fittings and Valves

Item	Nominal Size, mm											
	25	31.5	37.5	50	62.5	75	100	125	150	200	250	300
90° Elbow	0.9	1.1	1.3	1.7	2.0	2.5	3.4	4.1	4.9	6.4	7.9	10.0
45° Elbow	0.4	0.5	0.6	0.8	0.9	1.2	1.5	1.9	2.3	3.0	4.0	4.6
Close Return	1.9	2.6	3.1	4.0	4.6	5.6	7.3	9.5	11.2	14.9	18.9	22.3
Gate Valve	0.2	0.2	0.3	0.4	0.4	0.5	0.8	0.9	1.1	1.4	1.7	2.1
Check Valve	3.2	4.0	4.8	6.4	8.0	9.7	12.9	16.1	19.2	24.7	32.0	83.1
Foot Valve	7.3	10.1	11.6	14.0	16.8	19.5	22.9	23.2	23.2	23.2	23.2	23.2

Table (11-1) - The American Standard Scale for Lost Time Resulting from Death or Permanent Disability

Nature of Injury	Time Charge, Days
Loss of member or function:	
Arm, at or above elbow	4500
Arm, below elbow	3600
Hand	3000
Thumb	600
3 fingers on same hand	1200
Foot, at ankle	2400
1 eye, loss of sight	1800
1 ear, loss of hearing	600
Both ears, loss of hearing	3000

University of Technology
Building & Construction Engineering Department
Final Exam (Set 1) - Answers –2013/2014

Subject: Methods of Construction | **Class: 3rd year**
Branch: Structural Engineering | **Time : 3 Hours**
Examiner: Layla Ali Ghalib Yassin | **Date : 17/ 06 / 2014**

(Note: Attempt Four Questions Only)

Q1) A) (15 marks)

1) For the suction side with (150 mm) pipes, from table (10-3), the total equivalent length of pipe will be:

No.	Item	Quantity	Equivalent Length of Pipe, m	Total Length of Pipes, m
1)	45° Elbow	1	1(2.3)	2.3
2)	Gate Valve	1	1(1.1)	1.1
3)	Pipes		5.7+80	85.7
				89.1

From table (10-2) the friction loss/100m of (150 mm steel pipe) and 1136 l/min flow will be: 0.64

2) For the discharge side with (100 mm) pipes, from table (10-3), the total equivalent length of pipe will be:

No.	Item	Quantity	Equivalent Length of Pipe, m	Total Length of Pipes, m
1)	Gate Valve	1	1(0.8)	0.8
2)	Check Valve	1	1(12.9)	12.9
3)	Pipes		200	200.0
				213.7

From table (10-2) the friction loss/100m of (100 mm steel pipe) and 1136 l/min flow will be: 4.89

The total head including lift plus heads lost in friction will be:

Item	Total Equivalent Length of Pipes, m	
Lift	3	3.00
Head lost in friction (150mm)	89.1 (0.64)/100	0.57
Head lost in friction (100mm)	213.7(4.89)/100	10.45
	Total Head	14.02

For a total head of 15m>14.02m, a suction head of 3m and a flow of 1136 l/min, a model 30-M self-priming pump with a capacity approximately (1798 l/min) > (1136 l/min) will be satisfactory to do the job.

Q1) B) (10 marks)

(1-minimum, 2-economical, 3-smallest, 4-preheating, 5-standard, 6-bulldozer, 7-crane, 8-bank, 9-guide, 10-preservative)

Q2) A) (15 marks)

Actual Cost		$	60000
Rent charges	$6\times1000=$	$	6000
Discount on rent	$6000\times90/100=$	$	5400
Remained cost	$60000-5400=$	$	54600
Remaining cost w/o Tires	$46500-12000=$	$	42600
Salvage cost		$	8850
Remaining useful life, N	$N=5-6/12=$	yr	4.50
Depreciation, Equipment	$D_{Equ.}=(P-S)/N=(42600-8850)/4.50=$	$	7500
Maintenance as if the equipment is new = 60% of depreciation			
Maintenance, Equipment	$M_{Equ.}=0.6\times[(60000-12000)-8850]/5=$	$	4698
Average cost, $\overline{P}=\frac{P(N+1)+S(N-1)}{2N}$	$\overline{P}=\frac{42600(4.50+1)+8850(4.50-1)}{2(4.50)}$	$	29475
Investment	$I=12\%\overline{P}=0.12(29475)=$	$	3537
Total fixed cost/yr	$D+M+I=7500+4698+3537=$	$	15735
Hourly Fixed Cost, HFC	$HFC=15735/2500=6.294$	$/hr	6.30
Depreciation, Tires	$D_{Tires}=P_{Tires}/N_{Tires}=12000/5000=$	$/hr	2.40
Maintenance, Tires	$M_{Tires}=0.15\times2.4=$	$/hr	0.36
Fuel cost		$/hr	7.50
Lubrication oil cost		$/hr	0.50
Total Cost, excluding labor	6.3+2.4+0.36+7.50+0.5=	$/hr	**17.06**

Q2) B-1) (10 marks)

Net moldboard capacity (Bank Volume) = $3\div1.20=2.5m^3$

Probable round-trip time: Fixed time, 0.3 min

$$Pushing\ Time,\ 30m\ @\ 3km/hr=\frac{Distance}{Speed}=\frac{(30/1000)}{(3/60)}=0.6\ \ min$$

$$Returning\ Time,\ 30m\ @\ 6km/hr=\frac{Distance}{Speed}=\frac{(30/1000)}{(6/60)}=0.3\ \ min$$

Total time= 0.6+0.3+0.3= 1.2 min

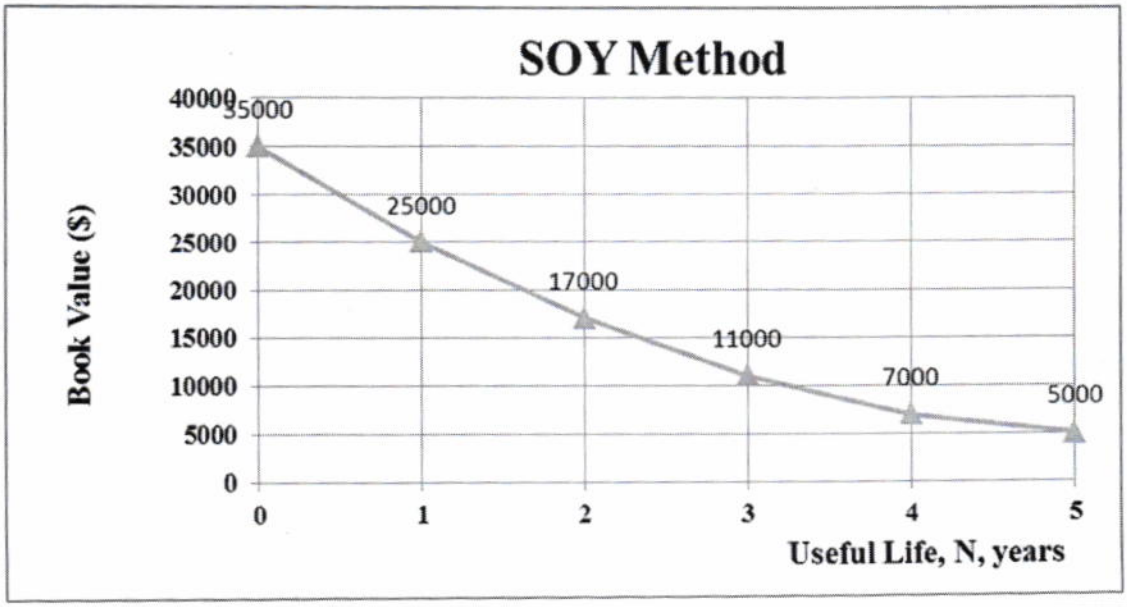
Trip per hour, $45\div1.2=37.5$

Output per hour, $37.5\times2.5=93.75\ m^3/hr$

Q2) B-2) (10 marks) $SOY=0+1+2+3+4+5=15$ or $SOY=N(N+1)/2=5(5+1)/2=30/2=15$

$R_m=(N-m+1)/SOY$, $D_m=R_m(P-S)$, $BV_m=BV_{m-1}-D_m$, N=5, Purchase Price=$35000

m	$R_m=(N-m+1)/SOY$	$D_m=R_m(P-S)$, ($)	$B.V.$, ($)
			35000
1	$R_1=(5-1+1)/15=5/15$	$D_1=5/15(35000-5000)=10000$	25000
2	$R_1=(5-2+1)/15=4/15$	$D_2=4/15(35000-5000)=8000$	17000
3	$R_1=(5-3+1)/15=3/15$	$D_3=3/15(35000-5000)=6000$	11000
4	$R_1=(5-4+1)/15=2/15$	$D_4=2/15(35000-5000)=4000$	7000
5	$R_1=(5-5+1)/15=1/15$	$D_5=1/15(35000-5000)=2000$	5000



Q3) A) (15 marks)

$$Rate\ of\ filling\ (R) = \frac{output}{b \times l} = \frac{18}{0.24 \times 20} = 3.75\ m/hr$$

$$3.75\ m/hr > 3\ m/hr$$

$$P_m = \gamma_c \times h = 24 \times 3 = 72\ kN/m^2$$

To design sheathing, select a strip of 1m width:

b=1m, h=0.025m

$$W_{Sheathing} = P_m \times b_{Sheathing} = 72 \times 1 = 72\ kN/m$$

Check Bending: $L = 1.29h\sqrt{\frac{fb}{w}} = 1.29(0.025)\sqrt{\frac{(12400)1}{72}} = 0.42m$

Check Shear: $L = \frac{2vbh}{1.5w} = \frac{2(1000)(1)(0.025)}{1.5(72)} = 0.46m$

Check Deflection:

$$L = 0.787 \times \sqrt[4]{\frac{EID}{w}}$$

$$I = \frac{bh^3}{12} = \frac{1(0.025)^3}{12} = 1.302 \times 10^{-6}\ m^4$$

$$L = 0.787 \times \sqrt[4]{\frac{(11.035 \times 10^6)(1.302 \times 10^{-6})(3)}{72}} = 0.69m$$

$$\therefore Spacing\ between\ Studs = L_{Sheathing} = 0.42m \approx 0.40m$$

$$\therefore Spacing\ between\ Studs = L_{Sheathing} = 0.40m$$

Q3) B) (10 marks)

1) c- size.
2) c- maximum.
3) a- $Q = N \times C \times \left(\frac{\pi}{4}\right) \times (d^2) \times (l) \times (n) \times 10^{-6} = 3 \times (1 - 0.05) \times \left(\frac{\pi}{4}\right) \times (150^2) \times (350) \times (80) \times 10^{-6} = 1410.2\ l/min$
4) b- $P_m = \gamma_c \times h$.
5) b- $R = \frac{2 \cdot E}{S + 0.1} = \frac{2 \times 7500}{(0.4 + 0.1)} = 30000\ lb$.

6) b- shrinkage.
7) a- construction.
8) a- $Injury\text{-}Frequency\ Rate = \dfrac{No.\ Disabling\ \ Injuries \times 10^6}{No.\ Man\text{-}Hr\ Worked} = \dfrac{6 \times 10^6}{200 \times 40 \times 60} = 12.5$
9) b- 0.08.

$$\left.\begin{matrix} loss\ of\ \ foot, at\ ankle & 2400\ days \\ loss\ of\ a\ thumb & 600\ days \end{matrix}\right\} (2400+600) - 60 = 2940\ days$$

$2940 + 132 = 3072\ days$

$or \Rightarrow 132 - 60 + 2400 + 600 = 3072\ days$

$Injury\text{-}Severity\ Rate = \dfrac{3072 \times 1000}{200 \times 40 \times 60} = 6.4$

$Injury\text{-}Index = \dfrac{12.5 \times 6.4}{1000} = 0.08$

10) c- vertically.

Q4) A) (15 marks)

If the batch is 0.79 m^3 the required volume of cement will be:

$0.79 \times 8 = 6.32$ bags

Instead of mixing 0.79m^3 per batch which required a fractional bag of cement (6.32 bags), reduce the quantity to (6 bags), and the quantity of other materials will be reduced in the same proportion.

So the proportion of reduction per batch will be (volume per batch):

$6(bags/batch)/8(bags/1m^3) = 0.75\ (m^3/batch)$

So the quantity of material per batch will be as follows:

Cement, 6bags

Sand, $650(kg/m^3) \times 0.75(m^3/Batch) = 487.5\ kg/Batch$

Gravel, $1000 \times 0.75 = 750\ kg/Batch$

Water, $180 \times 0.75 = 135\ lt/Batch$

$Total\ Time\ per\ Cycle = 0.25 + 1.00 + 0.25 + 0.10 = 1.6\ \ min$

$No.\ of\ Batches\ per\ Hour = 60/1.6 = 37.5\ \ Batches/hr$

$Output\ per\ Hour = 37.5 \times 0.75 = 28.125\ m^3/hr$

$Output\ per\ 45\text{-}min\ Hour = 28.125 \times 45/60 = 21.1\ m^3/hr$

Or: $No.\ of\ Batches\ per\ Hour = 45/1.6 = 28.125\ \ Batches/hr$

$Output\ per\ 45\text{-}min\ Hour = 28.125 \times 0.75 = 21.1\ m^3/hr$

Q4) B) (10 marks)

1) sheet, load-bearing.
2) speed, head.
3) labor accidents, fatal occurrences.
4) open, enclosed.
5) displacement, centrifugal.
6) accident, prevention.

Q5) A) (15 marks)

From table (6-1), for ($1.6m^3$) power shovel and Hard, tough clay soil:
Ideal output= 202 m^3/hr, Optimum depth= 3.7 m

$$\%\ of\ optimum\ cut = \frac{2.5}{3.7} \times 100 = 67.57\%$$

In table (6-2), there is no 67.57% of optimum height, therefore, interpolation must be done for 67.57% between 60 and 80:
From table (6-2), for 67.57% of optimum height and 120° angle of swing:

60	→	0.81		
67.57	→	F_{R1}	→	F_{R1}=0.829
80	→	0.86		

$$\left(D_{cut} - A_{swing}\right)_F = F_1 + (F_2 - F_1)\left(\frac{D_R - D_1}{D_2 - D_1}\right) = 0.81 + (0.86 - 0.81)\left(\frac{67.57 - 60}{80 - 60}\right) = 0.829$$

$$\left(D_{cut}\ \&\ A_{swing}\right)_F = 0.829$$

From table (6-3), $(J\ \&\ M)_F = 0.71$

$$(Time)_F = 50/60$$

$$Probable\ Output = Ideal\ Output \times \left(D_{cut}\ \&\ A_{swing}\right)_F \times (J\ \&\ M)_F \times (Time)_F$$

$$Probable\ Output = 202 \times 0.829 \times 0.71 \times 50/60 = 99.08\ m^3/hr$$

Days required to do the job= $\frac{150000}{(99.08)\times(8)\times(1-0.1)} = 210.3 \approx 210\ days$

$\therefore Cost\ of\ shovel = 210 \times 10000 = 2\ 100\ 000\ ID$

Q5) B) (10 marks)

1) If the unit is used to haul ready mixed concrete, which requires agitation en route to the project only to prevent segregation, the unit is called a transit mixer. F
2) Grout may be injected into the full length of a hole at one time; this is referred to as the zone method of grouting. F
3) An enclosed impeller has higher efficiency than an open impeller. T
4) If the water is pumped during a piston movement in one direction only, the pump is classified as single-acting. T
5) Drop hammers are suitable for driving piles on projects for which the time of completion is an important factor. F
6) Weight batching is much more depend able and more commonly used in producing concrete. T
7) The life of timber piles may be short unless they are treated with a preservative. T
8) Gradability is the resistance which is encountered by a vehicle in moving over a road or surface. F
9) If the aggregate and the cement are charged into the mixer at a central batching plant, with mixing to be done en route to the job, the unit is called an agitator mixer. F
10) Economical concrete, having the required properties can be produced by using the smallest practical sizes of coarse aggregate and the largest practical quantity of water. F