UNIVERSITY OF TECHNOLOGY
Building and Construction Eng. Dept.
Final Exam– 2013/2014

Subject : Airports Engineering — Class: 4th
Branch : Highways &Bridges — Time : 3 Hours
Examiner : Dr. Karim Al Helo — Date : 09/06/2014

Note: Attempt FIVE of the following questions.

Q1: a: State in points the program of the federal Aviation Administration (FAA). *(5 marks)*

b: What are the Revenues and Expenditure in U.S. Airports. *(5 marks)*

c: Show in drawings the effect of developed aircraft design on cost of travel, absolute power, speed, and seat. mile/hour. *(5 marks)*

d: Draw relationship between the speed and distance of runway showing all probabilities of take off. *(5 marks)*

Q2: a: State the weight component of an aircraft. *(5 marks)*

b: The demand - Capacity analysis should cover six forecasting items, State them briefly. *(5 marks)*

c: Determine the size, capacity, velocity of water, slope of pipe, and the end level for line segment of **40 acres** drainage **(10% paved)**; average runoff coefficient equals **0.45**, **if** you know the following:

Area	Distance (ft)	Slope %
Over pavement	300	1
Over turf	3,000	0.8

Use **5** years curve in *Fig. 10.2*, assume **n** Manning= **0.015, c** for turf=**0.40** and **c** for pavement = **0.90.** The inlet level is ***(30 ft above the MSL)*** and the pipe length =3,000 ft. *(10 marks)*

Q3: a: State briefly the recommendations of (FAA) for min. site selection analysis. *(5 marks)*

b: What are the two flying rules and when they are used. *(5 marks)*

c: An airport pavement to be designed for the traffic mix below. Convert the traffic to equivalent DC-8-61 departures.

Note: to convert from dual wheel to dual tandem use factor equals **0.6**

Aircraft wheel configuration	Departure R	Load per wheel lb
CV-880 (dual tandem)	8,000	20,000
DC-9-32 (Dual wheel)	18,000	25,000
DC-8-61 (dual tandem)	2,500	40,000

(10 marks)

Q4: **a:** One or more of five conditions requires installing visual approach slope indicator system (VASIS) to the runway, State these conditions. ***(5 marks)***

b: What are the factors must be considered in environmental study. ***(5 marks)***

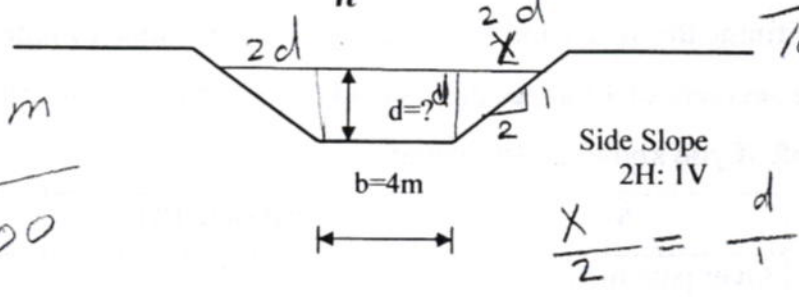
c: Use Fig. 10.10 and find the thickness of 1. Sub base, 2. Base, and 3. Pavements for primary traffic area and wheel load of **40 K** if you know that the thickness factor equals 1.15 and: CBR for Sub grade = **3**, for Sub base= **10**, and for Base = **20** ***(10 marks)***

Q5: **a:** What are the five principal imaginary surfaces to protect airspace around airport? Draw them. ***(5 marks)***

b: Whom will be affected by the environmental impact of sitting of airport. ***(5 marks)***

c: For the shown trapezoidal channel, find **d** for the cross section to carry a discharge of **5m^3/sec** at a suitable velocity if the bed width **b= 4m**. Then find the real discharge using the following equation if you know the bed slope is **10cm/km** and **Manning's n =0.015**

$$Q = \frac{A\,R^{2/3}\,S^{1/2}}{n}$$



(10 marks)

Q6: **a:** What are the three functions of subsurface drainage? Show briefly the material used for and the construction method. ***(5 marks)***

b: What are the factors that influence pavement performance. ***(5 marks)***

c: Calculate the discharge **(Q)** for following inlets:

i. Law head of c=3, L=13 ft, H= 0.4 ft. ***(5 marks)***

ii. High head of c=0.6, A=5sq.ft, H=1.6 ft ***(5 marks)***

(Good Luck)

(1)

Solution of Final exam 2013-2014
Airports Engineering

Q_1 : a:

The Federal Aviation Adminstration program is

a- Safety Regulation

b- Research and development

c- Air Navigation facilities (construction, maintenance ...)

d- Air space and Air traffic management (towers, routes ...)

e- Arrport planning and development programs (type and cost of airports)

f- Regestration and Recordation (engines, aircraft ownership)

g- Civil Aviation Abroad (technical and training

h- Other programs (technical materials, guarantee programs)

Q1: b: The Revenues and Expenditures are:

Revenues

1- landing Area (landing and Parking)

2- Terminal Area : non airline use in terminal areas gives incomes (e.g : duty free , stores , bookshops, news stand)

3- Airline leased

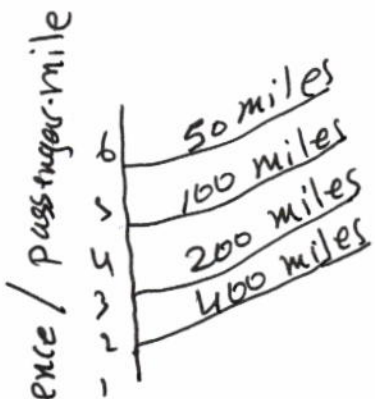
4- Other leased areas (fuel and servicing)

5- other operating (equipment rental)

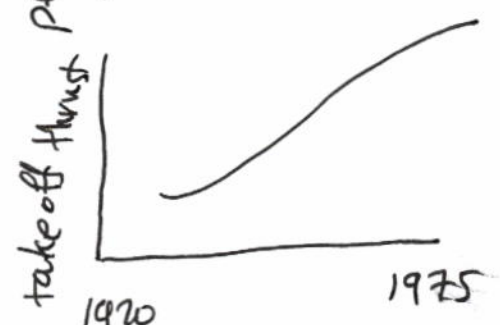
Expenditures 1-maintenance
2-operating cost
3-Non operating cost

Q1: c

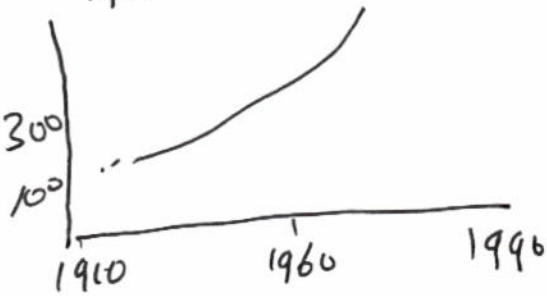
1- Cost travel will be decreased with increasing of distance



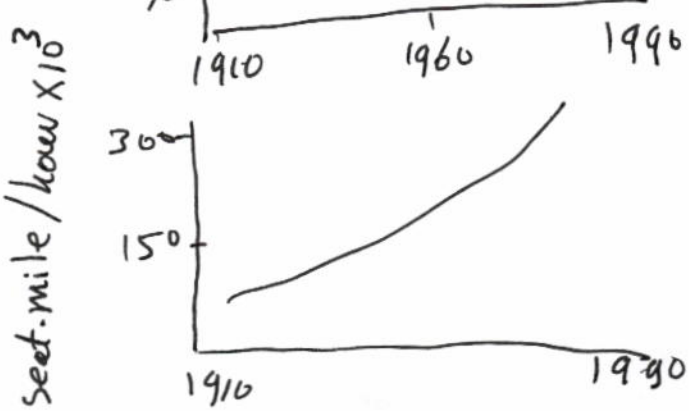
2- Increasing of Absolute power



3- Increasing of speed

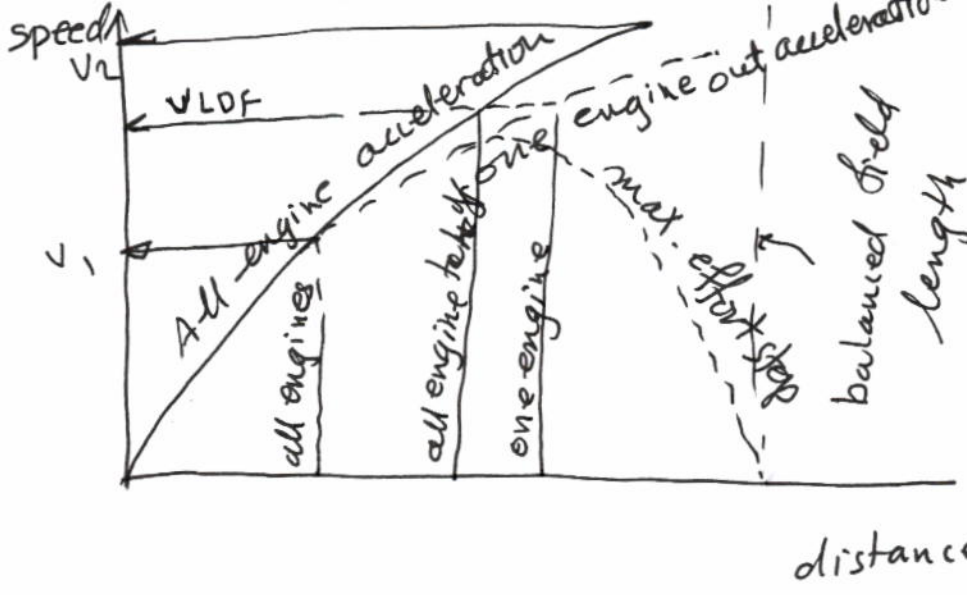


4- Increasing of power, speed resulting in increasing of Seat. mile/hour reffect ~~miles~~ seat. mile/gallon



(3)

d:



V_1: critical engine failure speed choosen by manufacturer

$V_1 > V_{mc}$

$V_1 >$ speed at which brakes overload $< V_R$

V_{mc} : min. Control speed

V_{LOF}: lift off speed $\geq 1.1\, V_{mu}$

V_{mu} : min unstick speed > min speed that give hazard

V_2: take off climb speed

V_s: stall speed

V_R: speed at which nosewheel can lifted from runway

(4) Q2

a: The weight components of an aircraft are

1- Empty operating weight is constant
2- Zero fuell weight.
3- Max. take off weight.
4- Max. Ramp weight > Max. take off weight. by the weight of fuell required for taxiing.
5- Max. loarding weight < max take off weight by weight of burned fuell

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Q2: b: Demand capacity analysis covers the following forecasting items:

1- Forecast of aircraft vis-a-vis air space analysis.
2- Forecast of aircraft vis-a-vis air traffic cont. facilit
3- Forecast of aircraft operation vis-a-vis air field capacity
4- Forecast of passengers movements vis-a-vis passenger terminal capacity
5- Forecast of cargo volumes vis-a-vis cargo terminal capacity
6- Forecast of access traffic vis-a-vis surface access route capacity

(5)

Q2 : c

$$T_t = \frac{1.8\,(1.1-C)\,D^{1/2}}{S^{1/3}}$$

$$= \frac{1.8(1.1-0.4)(3000)^{1/2}}{(0.8)^{1/3}} = 74.34 \text{ min}$$

$$T_{pav} = \frac{1.8(1.1-0.9)(300)^{1/2}}{1^{1/3}} = 6.23 \text{ min}$$

$T = T_t + T_{pav} = 74 + 6 = 80$ min

From fig 10.2 $\Rightarrow$ Duration of 80 min $\Rightarrow$

$I = 1.4$ in 1 hour

$Q = CIA = 0.45 \times 1.4 \times 40 = 25.2$ cfs

From fig 10.6 and velocity $\cong$ 2.5 ft/sec

Diameter of pipe = 46 inches

$Q = 33$ cfs

velocity = 2.7 ft/sec

$S = 0.0007$

The end level $= 30 - (0.0007 \times 3000)$

$= 27.9$ ft

above MSL

(6)

Q3:

a- The recommendation of (FAA) for min site selection analysis are

1- Airspace analysis
2- Obstructions
3- Environmental Impact and nature of surrounding development
4- Closing to area of aviation trip generation
5- Ground access
6- physical site characteristics, including atmosphere condition
7- Utilities
8- Land cost and availability
9- Comparative analysis of alternative sites.

Q3 b

The two flying rules are:

1- VFR visual flying rule and it is used when weather conditions are good enough and when traffic densities are low to permit the pilot to depend on vision

2- IFR Instrumed flying rule and it is used when the visibility of the ceiling (height of clouds above ground level) falls below the range of VFR

Q3 c For CV-880 (dual tandem)

$$\log R_1 = \log R_2 \left(\frac{W_2}{W_1}\right)^{1/2}$$

$$\log R_1 = \log (8000 \times 1) \times \left(\frac{20000}{40000}\right)^{1/2} = 2.7594 \Rightarrow R_1 = 575$$

For DC-9-32 (Dual wheel)

$$\log R_1 = \log (18000 \times 0.6) * \left(\frac{25000}{40000}\right)^{1/2} = 3.1887$$

$\therefore R_1 = 1544$ departures

For DC-8-61 $\Rightarrow$ departure = 2500

$R_{total} = 575 + 1544 + 2500 = 4619$ departures

Q4 a

(7) The conditions require installing (visual approach slope indicator system (VASIS) are

1- Runway is used by turbojet aircraft
2- Pilot may has difficulties in judging the final approach because of inadequate visual reference.
3- There are serious hazard in approach area
4- Serious hazard would accur (undershooting)
5- Turbulence because of terrain or meterological condition

Q4 b

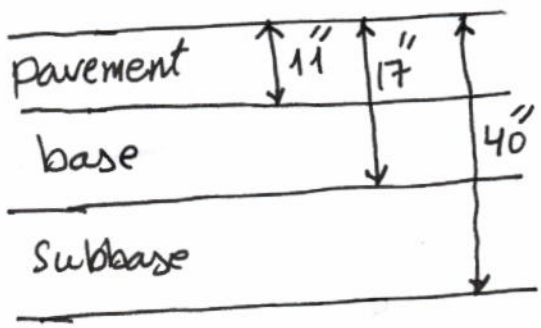
Factors must be considered in Environmental Study are :

1- The environmental Impact of proposed action
2- Adverse environmental impact effects that could not be avoided if the proposed implement-
3- Alternative to the proposed action
4- The relationship between local short term users of enviroment and improved long term-
5- Any ireversible commitment in proposal

Q4 c

pavement = 11

For subgrade of CBR = 3
thickness = 35"
35 x 1-15 = 40"
For subbase of CBR = 10
thickness = 17"
For base of CBR = 20
thickness = 11 in



∴ pavement = 11"
base = 17 - 11 = 6"
Subbase = 40 - 17 = 23"

(8) Q5a

The principals imaginary surfaces are.

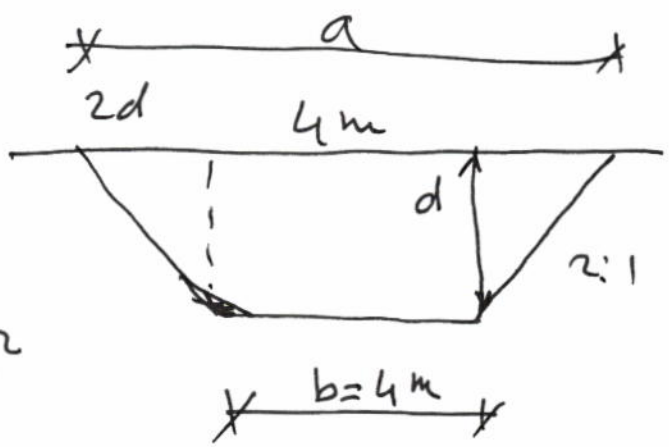
1- Primary Surface, longitudenally centered on the runway, extended 200ft in each direction.
2- Approach Surface
   Inclined plane from the end of primary Surface
3- Horizontal Surface 150 ft above airport elevation
4- Transition Surface
   plane of 7:1 extending upward and outward from primary surface
5. Conical Surface : Inclined at slope 20:1
   extending upward and outward from Horizontal surface.

Q5b Following are effected by siting of airport

1. Rural, agriculture
2- Industrial
3- Office and commercial
4- Public building (schools) hospitals, universities etc)

Q5 c

(9) Q5 c



$Q = 5\ m^3/sec$

$V = 0.75\ m/sec$

$A = \frac{Q}{V} = \frac{5}{0.75} = 6.67\ m^2$

$A = \frac{a+b}{2} \times d$

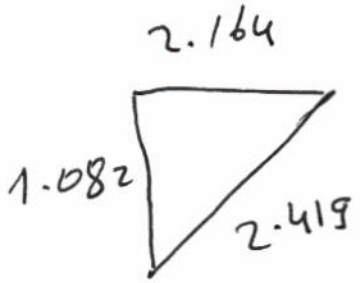
$A = \frac{4+4+4d}{2} * d = \frac{8+4d}{2} d$

$6.67 = 4d + 2d^2$

$2d^2 + 4d - 6.67 = 0$

$d^2 + 2d - 3.335 = 0$

$d = 1.082\ m$



$P = 2(2.419) + 4$

$= 8.838$

$R = \frac{A}{P} = \frac{6.67}{8.838} = 0.7546\ m$

$S = \frac{10\ cm}{1\ km} = \frac{10\ cm}{100000\ cm} = \frac{1}{10000}$

$Q = \frac{AR^{2/3} S^{1/2}}{n} = \frac{6.67 (0.7546)^{2/3} \left(\frac{1}{10000}\right)^{1/2}}{0.015}$

$= 3.6856\ m^3/sec$