Ain Shams university
Faculty of Engineering
Public works Department

3rd year Civil
Fall (2014-2015)
Assignment no. (P1)

Highway and Airports Engineering (CEP 371)

Flexible and Rigid Pavement

Question 1

Shown below is a load-meter study on axle weight load distribution at a particular highway. The survey involved a total of 1500 trucks. Determine the truck factor for the information given below:

Single axle	
Axle load (klps)	No. of axles
2	1200
6	800
10	120
14	45
18	145
22	20
26	2
Tandem axles	
14	4
18	25
22	85
26	90
30	120
34	90
38	30

Question 2

Calculate the number of repetitions of the standard axles given the following data:

- Average daily traffic = 20000 vpd
- Directional Distribution = 60/40
- Lane distribution factor = 0.8
- Truck percent = 25%
- Rate of traffic increase = 2.5%
- Design analysis period = 20 years
- Truck factor = 4

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Question 3

Assuming the following conditions and using the AASHTO 1993 procedure, design the pavement cross section.

- Reliability level = 90%
- Standard deviation = 0.35
- Traffic repetitions = 3×10^6 ESALs
- Terminal serviceability = 2.5
- Modulus of resilience of the asphalt mixture = 400000 psi
- Modulus of resilience of the base layer = 35000 psi
- Modulus of resilience of the subbase layer = 14000 psi
- Modulus of resilience of the subgrade layer = 5000 psi
- Quality of drainage of sub base is good and it is saturated during 20% of the year
- Assume drainage coefficients of (1) for the base layer

Question 4

An eight lane divided highway is to be constructed on a new alignment. Traffic volume forecast indicate that the average annual daily traffic (AADT) in both directions during the first year of operation will be 12,000 with the following vehicle mix and axle loads.

Passenger cars (1000 lb/axle) = 50%
2-axle single unit trucks (6000 lb/axle) = 33%
3-axle single unit trucks (10,000 lb/axle) = 17%

The vehicle mix is expected to remain the same throughout the design life of the pavement. If the expected annual traffic growth rate is 4% for all vehicles, determine the design ESAL, given a design period of 20 years. The percent of traffic on the design lane is 45%, and the pavement has a terminal serviceability index (Pt) of 2.5 and SN of 5.

The following data apply:

- Growth factor = 29.78
- Percent truck volume on design lane = 45%
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Question 5

Determine minimum thickness of a pavement with doweled joints and without concrete shoulders, the following data are available:

- Four lane interstate highway
- Rolling terrain in rural location
- Design period = 20 years
- Subbase subgrade k = 130 lb / in3
- Concrete modulus of rapture = 650 lb/ in2
- Axle loads and expected repetitions are shown in figure

Single Axles:

Axle load (kips)	Expected repetitions
30	6310
28	14690
26	30140
24	64410
22	106900
20	235800
18	307200
16	422500
14	586900
12	1837000

Tandem Axles:

Axle load (kips)	Expected repetitions
52	21320
48	42870
44	124900
40	372900
36	885800
32	930700
28	1656000
24	984900
20	1227000
16	1356000

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Question 6

Calculate various warping stresses for a rigid pavement slab with the following parameters and conditions:

- K= 200pci
- ? T = 3 °F/in.
- e = 0.000005/°F
- μ = 0.15
- E = 5,000,000 psi
- Slab length = 14 ft
- Slab width = 12 ft.
- Slab thickness h = 9 in.