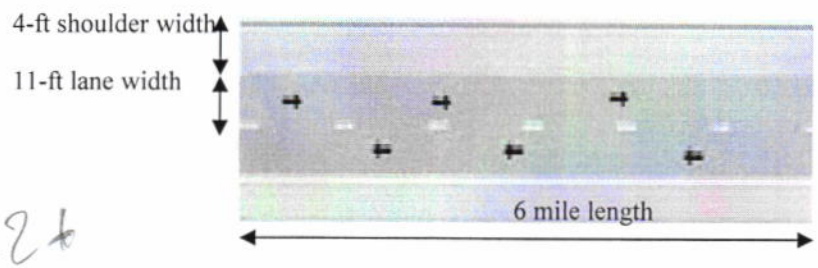
University of Technology
Building and Construction Eng. Dept.
Final Exam – 2013/2014

Branch: Highways and Bridges Branch — **Class : 4th stage**
Subject : Computer Application to HWY Eng. — **Time: 3 Hours.**
Examiners: Dr. Nisreen S. Mohammed — **Date: 11th of June**
Dr. Zaynab I. Qasim

Part (I): **(50 marks)**

Note: *Answer* ***THREE*** *Questions only* ***(including Question No.1)***

Q1: Class I two-lane highway segment .What is the two-way segment (ATS) for the peak hour for the following factors:
1600 veh/h (two-way volume), (50/50) directional split, 14 percent trucks and buses, 4percent RVs , 0.95 PHF, 60-mi/h base FFS , Rolling terrain, 11-ft lane width , 4 ft shoulder width, 6 -mi length, 50 percent no-passing zones, and, 20 access points/mi.



(16 marks)

Q2: For the factors above in **(Q1)** ,what is the Percent Time - spent Following (PTSF) and the LOS for the two –lane highway segment?

(17 marks)

Q3: Answer ***one*** of the branches: *(17 marks)*

A- The Free flow speed FFS of a freeway depends on many traffic and road way conditions . what are the factors affecting on FFS ?

B- Describe the traffic characteristics associated with the six levels of service for two lane highways .

Q4: Determine the level of service (LOS) of two- lane roads (Class I) for the following values of PTSF and ATS: *(17 marks)*

Roads	PTSF (%)	ATS (mi/hr)	LOS
1	67	43	?
2	62	46	?
3	48	51	?
4	20	80	?

Solutions of computer application / Final Exam 2013/2014:

Q1:

Steps	
1. Determine grade adjustment factor for average travel speed (*use Exhibit 20-7*).	$f_G = 0.99$
2. Compute f_{HV} for average travel speed (*use Exhibit 20-9 and Equation 20-4*).	$f_{HV} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$ $f_{HV} = \frac{1}{1 + 0.14(1.5 - 1) + 0.04(1.1 - 1)} = 0.931$
3. Compute v_p (*use Equation 20-3*).	$v_p = \frac{V}{PHF * f_G * f_{HV}}$ $v_p = \frac{1,600}{(0.95)(0.99)(0.931)} = 1,827$ pc/h
4. Calculate highest directional flow rate.	$v_p * 0.50 = 1,827 * 0.50 = 914$ pc/h
5. Check the highest directional flow rate and two-way flow rate against capacity values of 1,700 pc/h and 3,200 pc/h, respectively.	914 pc/h < 1,700 pc/h 1,827 pc/h < 3,200 pc/h
6. Compute the FFS (*use Exhibits 20-5 and 20-6 and Equation 20-2*).	$FFS = BFFS - f_{LS} - f_A$ FFS = 60 – 1.7 – 5.0 = 53.3 mi/h
7. Compute the average travel speed (*use Exhibit 20-11 and Equation 20-5*).	$ATS = FFS - 0.0125v_p - f_{np}$ ATS = 53.3 – 0.00776(1827) – 0.8 = 38.3 mi/h

Q2:

8. Determine grade adjustment factor for percent time-spent-following (*use Exhibit 20-8*).	$f_G = 1.00$
9. Compute f_{HV} for time-spent-following (*use Exhibit 20-10 and Equation 20-4*).	$f_{HV} = \frac{1}{1 + 0.14(1.0 - 1) + 0.04(1.0 - 1)} = 1.000$
10. Compute v_p (*use Equation 20-3*).	$v_p = \frac{1,600}{(0.95)(1.000)(1.00)} = 1,684$ pc/h
11. Calculate the highest directional flow rate.	$v_p * 0.50 = 1,684 * 0.50 = 842$ pc/h
12. Check the highest directional flow rate and two-way flow rate against the capacity values of 1,700 pc/h and 3,200 pc/h, respectively.	842 pc/h < 1,700 pc/h 1,684 pc/h < 3,200 pc/h
13. Compute base percent time-spent-following (*use Equation 20-7*).	$BPTSF = 100\left(1 - e^{-0.000879v_p}\right)$ $BPTSF = 100\left[1 - e^{-0.000879(1,684)}\right] = 77.2\%$
14. Compute percent time-spent-following (*use Exhibit 20-12 and Equation 20-6*).	$PTSF = BPTSF + f_{d/np}$ PTSF = 77.2 + 4.8 = 82.0%
15. Determine LOS (*use Exhibit 20-3*).	ATS = 38.3 mi/h and PTSF = 82.0% LOS E

Q3:A

1-lane width and lateral clearance, 2- number of lanes, 3- interchange density, 4- passenger car equivalents, 5- driver population, 6- other factors

B:

LOS A describes free-flow operations. Free-flow speeds prevail. Vehicles are almost completely unimpeded in their ability to maneuver within the traffic stream. The effects of incidents or point breakdowns are easily absorbed at this level.

LOS B represents reasonably free flow, and free-flow speeds are maintained. The ability to maneuver within the traffic stream is only slightly restricted, and the general level of physical and psychological comfort provided to drivers is still high. The effects of minor incidents and point breakdowns are still easily absorbed.

LOS C provides for flow with speeds at or near the FFS of the freeway. Freedom to maneuver within the traffic stream is noticeably restricted, and lane changes require more care and vigilance on the part of the driver. Minor incidents may still be absorbed, but the local deterioration in service will be substantial. Queues may be expected to form behind any significant blockage.

LOS D is the level at which speeds begin to decline slightly with increasing flows and density begins to increase somewhat more quickly. Freedom to maneuver within the traffic stream is more noticeably limited, and the driver experiences reduced physical and psychological comfort levels. Even minor incidents can be expected to create queuing, because the traffic stream has little space to absorb disruptions.

At its highest density value, LOS E describes operation at capacity. Operations at this level are volatile, because there are virtually no usable gaps in the traffic stream. Vehicles are closely spaced, leaving little room to maneuver within the traffic stream at speeds that still exceed 49 mi/h. Any disruption of the traffic stream, such as vehicles entering from a ramp or a vehicle changing lanes, can establish a disruption wave that propagates throughout the upstream traffic flow. At capacity, the traffic stream has no ability to dissipate even the most minor disruption, and any incident can be expected to produce a serious breakdown with extensive queuing. Maneuverability within the traffic stream is extremely limited, and the level of physical and psychological comfort afforded the driver is poor.

LOS F describes breakdowns in vehicular flow. Such conditions generally exist within queues forming behind breakdown points. Breakdowns occur for a number of reasons:

Q4:

1- LOS D

2- LOS C

3- LOS B

4- LOS A

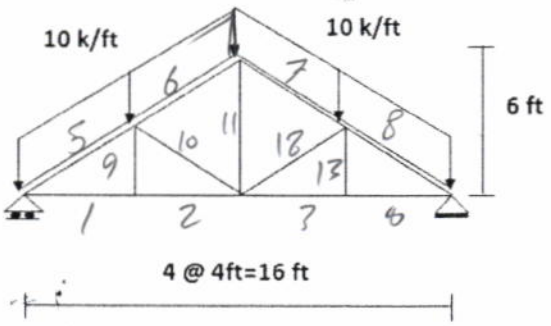
Part II : Computer Applications **(50 Marks)**

(Answer Two Questions Only)

Q1:A- Draw the Truss steel structure as shown in the Fig.(1), below with numbering all joints and members are required. The properties of vertical and horizontal members section is (W 10 x 30) , and inclined members section is (L 3x3x7/16 in). Compute selfweight of structure. By using the Staad Pro program, edit the analysis commands of structure. Print member forces results and draw axial force for structure in the output file.

(10 Marks)

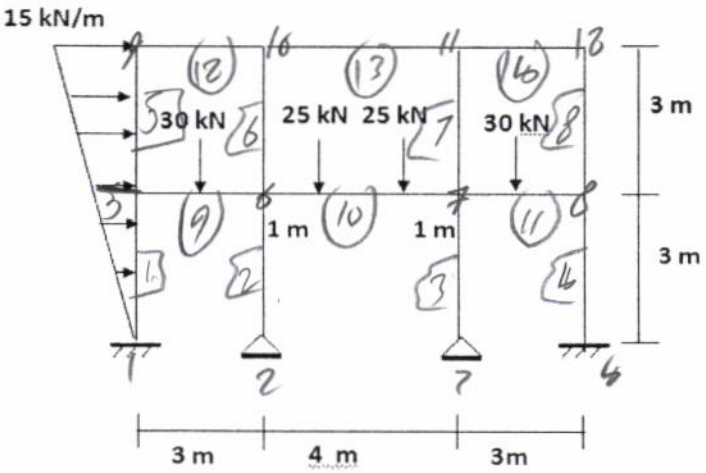
Fig.(1)

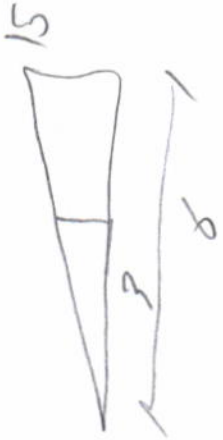


B- Draw the concrete structure as shown in the Fig. (2), below with numbering of joints and members are required. The Properties of column member section is (300 mm) and beam member (300x500 mm). By using the Staad Pro program, edit the analysis and design commands of structure and print all design results in the output file from the following equation. For beams (Fy=400 MPa), for columns (Fc=35 MPa & the spiral reinforced diameter is 8 mm. Neglected selfweight of structure.

(15 Marks)

Fig.(2)





Q2: Draw the concrete structure (using auto generation approach and start from point A) as shown in the Fig. (3), below with numbering of joints and members are required. The Properties of columns members section is 400x400 mm and beams members section is (H=750mm, IZ=1.17E10, Iy=3.9E9 mm^4). By using the Staad Pro program, edit the analysis of structure under the effects of following loading conditions. Print all analysis results for load case (4) in the output file

1. Selfweight(DL)
2. Vertical Load (LL)
3. Horizontal Load(WL)
4. Wu=1.2DL+ 1.6LL+0.75 WL

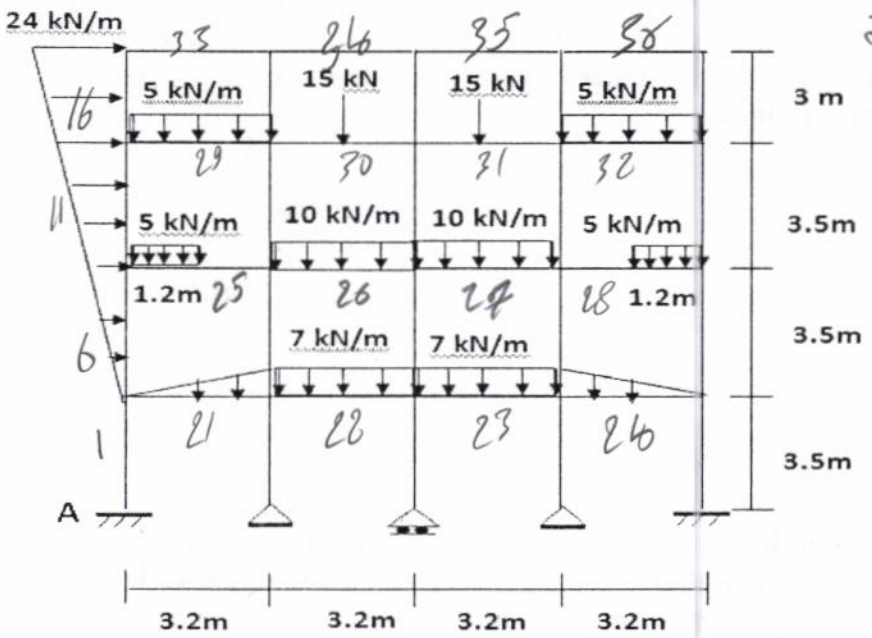


Fig.(3)

Q3: Draw the composite steel structure as shown in the Fig. (4), below with numbering of joints and members are required. The Properties of Columns members are W12x35, horizontal and inclined truss members are double angle L5x5x5/16, Es of horizontal and inclined truss members is 210000 MPa. By using the Staad Pro program, edit the analysis and design commands of structure. Design vertical members by using select optimized section requirements and design horizontal inclined truss members by using code requirements. Print all the design result into output file. for Vertical members, (FY=440 MPa & effect of side sway) horizontal and inclined members (ratio=0.85)

D.L= selfweight of the structure

W=D.L. + L.L.

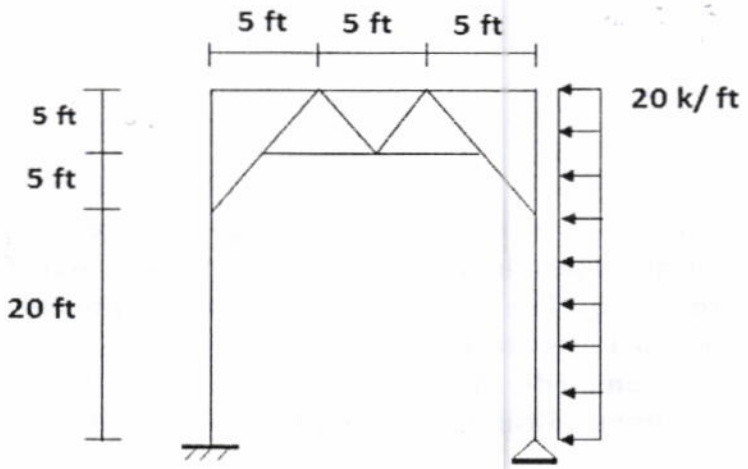


Fig.(4)

الحلول النموذجية للامتحان النهائي الدور الاول للعام الدراسي 2013-2014
المرحلة الرابعة/فرع الطرق والجسور- تطبيقات الحاسوب الجزء الثاني

Q1: A-

```
 sta tru
Uni ft kip
Joi coo
1 0 0; 2 4 0; 3 8 0; 4 12 0; 5 16 0; 6 4 3; 7 8 6; 8 12 3
Mem inc
1 1 2  4 1 1
5 2 6  7 1 1
8 1 6; 9 6 7; 10 7 8; 11 8 5; 12 6 3; 13 3 8
Mem pro
1 To 7  Ta St   w 10x30; 8 To 13 Ta St L 30307
Con
E steel all
Den steel all
Sup
1 fixed but fx mz; 5 pin
Load 1
Selfweight y -1
Joi loa
1 5 fy -25; 6 To 8 fy -50
Per ana
Print mem forc res
Dra ms dra 1 fx value all
Fin
```

Q1:B-

```
Sta pla
Uni meter kns
Joi coo
1 0 0 0   3  0  9  0
Rep 3 3 0 0 ; 4 0 0 ; 3 0 0
Mem inc
1 1 2 2 1 1
Rep 3  2  3
9 2 5   11 1 3
Rep 1 3 1
Mem pro
```

1 to 8 pri YD 0.3; 9 to 14 pri YD 0.5 ZD 0.3
Con
E con all
Sup
1 10 fix; 4 7 pin
Load 1
Mem loa
1 lin y 0 -7.5 0; 2 lin y -7.5 -15 0
9 11 con y -30; 10 con y -25 1; 10 con y -25 3
Per ana
Sta con des
Code ACI
Uni mns
Fymain 400 mem 9 to 14
Fc 35 mem 1 to 8
Rei 1 mem 1 to 8
Uni mms
Minsec 8
Trac 2 all
End con des
fin

Q2:
Sta pla
Uni met kns
Joi coo
1 0 0 0 5 12.8 0 0
Rep 3

0 3.5 0
Rep 1 0 3 0
Mem inc
1 1 6 5 1 1
Rep 3 5 5
21 6 7 24 1 1
Rep 3 4 5
Uni mms
Mem pro
1 to 20 pri yd 400 zd 400
21 to 36 pri yd 750 iz 1.17e10 iy 3.9e9
Con
E con all
Den con all
Sup
1 5 fix; 2 4 pin; 3 fix but fx mz
Uni met
Load 1
Selfweight
Load 2
Mem loa
21 tra y 0 -7; 22 23 uni y -7; 24 tra y -7 0
25 uni y -5 0 1.2; 26 27 uni y -10 ; 28 uni y -5 2 3.2
29 32 uni y -5
30 31 con y -15
Loa 3
Mem loa
6 tra gx 0 8.4; 11 tra gx 8.4 16.8; 16 tra gx 16.8 24
Load com 4
1 1.2 2 1.6 3 0.75
Per ana
Load list 4
Prin ana res
Fin

Q3:
Sta pla
Uni ft kip
Joi coo

1 0 0 0; 2 15 0;3 0 20; 4 15 20; 5 2.5 25; 6 7.5 25; 7 12.5 25
8 0 30; 9 5 30; 10 10 30;11 15 30
Mem inc
1 1 3; 2 3 8 ; 3 2 4; 4 4 11; 5 5 6; 6 6 7
7 8 9 9 1 1
10 3 5; 11 5 9; 12 9 6; 13 6 10;14 10 7; 15 7 4
Mem pro
1 to 4 Ta St w 12x 35; 5 to 15 Ta LD L50505
Uni mns met
Con
E steel mem 1 to 4
E 21000 mem 5 to 15
Den steel all
Mem tru
5 to 15
Sup
1 fix; 2 pin
Load 1
Selfweight y –1
Uni ft kip
Mem loa
3 4 uni gx -20
Per ana
Parameters
Code ASCE
Uni mns met
Fyld 440 mem 1 to 4
Raio 0.85 mem 5 to 15
Tra 2 all
Check code mem 5 to 15
Select mem 1 to 4
fin