MEC (Civil / Structu. Engee). sem - II
Finite Element Analysis.

27/04/15

Bharatiya Vidya Bhavan's

SARDAR PATEL COLLEGE OF ENGINEERING

(An Autonomous Institution Affiliated to University of Mumbai)

Total Marks 100 | Duration : 4 Hours

CLASS/SEM ME (STRUCTURES)/SEM II | SUBJECT : FINITE ELEMENT ANALYSIS

Master

- Attempt any FIVE questions out of SEVEN questions.
- Answers to all sub questions should be grouped together.
- Figures to the right indicate full marks.
- Assume suitable data if necessary and state the same clearly.

Q1 a. Explain the process of discretization. 08

b. Explain the convergence and compatibility requirements 06

c. Explain the use of shape functions in finite element analysis 06

Q2 A pin jointed frame consist of four nodes A(0,6), B(6,6), C(14,6) and D(6,0) and three members AD, BD, and CD. The cross section area of all the members is 1500 mm^2. The material used is steel having modulus of elasticity as 200 GPa. The frame is subjected to load of 100 kN in the downward direction and 40 kN towards right, both acting at point D. Joints A, B and C are hinged supports. Determine, Element stiffness matrices, Structure stiffness matrix, Load vector, Displacement vector, Element forces, Element stresses 20

Q3 A rigid jointed frame consist of three nodes A(0,0), B(6,6) and C(10,6) and two members AB and BC. The moment of inertia of all the members is 8000 cm^4 The material used is steel having modulus of elasticity as 210 GPa. The frame is subjected to a udl of intensity 30 kN per meter in the downward direction over the member BC and a downward point load of 40 kN, acting at point B. Joints A and C are fixed supports. Analyse the rigid jointed frame using Finite Element procedure. 20

Q4 A beam consist of three nodes A(0,0), B(4,0) and C(10,0) and two members AB and BC. The moment of inertia of all the members is 8000 cm^4. The material used is steel having modulus of elasticity as 210 GPa. The beam is subjected to a udl of intensity 30 kN per meter in the downward direction over the member AB and BC and a point load of 40 kN acting at point B. Joints A is hinged and B and C are supported on roller supports. Analyse the beam using Finite Element procedure. 20

Q5 Determine the fundamental frequency of a fixed beam idealized with two elements and distributed masses. The flexural rigidity of left half of the beam is double as that of flexural rigidity of right half of the beam 20

Q6 a. Derive the shape functions for a 8-noded Lagrange element 10

b. Derive the stiffness matrix for a three noded axial element from the first principle. 10

Q7 a. Derive the shape function for the four a CST element starting from the first principle. 08

b. What is geometric stiffness matrix? Determine the buckling load of the column fixed at both ends using finite element approach. 12

ME (Civil / Struct. Engg.), Sem-II.
Theory of plates.

Lib
29-4-15

Bharatiya Vidya Bhavan's

SARDAR PATEL COLLEGE OF ENGINEERING

(An Autonomous Institution Affiliated to University of Mumbai)

Subject : Theory of Plates

CLASS: ME (STRUCT)/SEM II (Civil).
Date: 29/04 /2015

Total Marks : 100
Duration : 4 Hour

Master

- Figures to the right indicate full marks.
- Assume suitable data if necessary and state the same clearly.
- Solve any **Five** questions.

Q. 1 (a) Explain the importance of influence surface in case of plates and write a note on how to plot it. (15)

(b) Explain why the corners of a simply supported laterally loaded square plate is subjected to a reactive force R. (05)

Q. 2 For a square plate of size 5 m x 5 m simply supported on all edges and having thickness as 150 mm determine maximum deflection of plate and bending moment , if it is subjected to UDL of 15 N/ m2 E= 2 x 10^4 N/mm2 and υ = 0.3 . Use **finite difference** method. (20)

Q. 3 A simply supported plate of radius "**a**" has uniformly distributed load of intensity **q** acting on radius "**b**". Derive expression for deflection and maximum moment and moment M_r and M_t. (20)

Q. 4 (a) A solid circular plate of radius 0.40m with its outer edge simply supported is subjected to UDL of 5.0 MPa. If allowable stress in plate is limited to 50 MPa calculate (i) Thickness of plate. And (ii) maximum deflection. (12)
E= 2 x 10^4 N/mm2 and υ = 0.3

(b) Explain the importance of Finite difference method in detail. (08)

Q. 5 (a) Derive equation for deflection of circular plate of radius "**a**" with clamed edges subjected to concentrated load **P** using differential equation of plate. (20)

Q. 6 (a) A simply supported rectangular plate of size $a \times b$ is subjected to $pz = p0(x/a)^2$ lateral load, determine the deflected plate surface $w(x, y)$, the internal moments mx, my, mxy and transverse shear forces qx, qy using Navier's method. (20)

Q. 7 Determine the deflection of a uniformly loaded ($p_z = p_0$) rectangular plate that is simply supported at all four edges using L'evy's method.. (20)

MECCivil), Struct. Engee), Sem-II. Lib 02-05-15.

Bridge Engineering

Bharatiya Vidya Bhavan's

SARDAR PATEL COLLEGE OF ENGINEERING

(An Autonomous Institution Affiliated to the University of Mumbai)

Apr-15

Total Marks: 100 ME (Civil / Structural Engee) Duration: 4 hours

CLASS/SEM: M.E./SEM 2 SUBJECT : BRIDGE ENGINEERING

Figures to the right indicate full marks

Use of codes IRC 5,6,18,21,78 is allowed

Master

I) Answer in brief (any 3) 45

a) Explain the concept of bridge hydraulics.

b) Discuss the factors considered for selection of a bridge site.

c) State the classification of bridges based on their structural arrangement. Explain their suitability w.r.t. the span ranges in bridges.

d) What are the types of bridge foundations?
State the factors where you would recommend their usage.

II) Attempt any one of the following 25

a) Design a R.C. solid slab bridge superstructure for 10 m clear span. The vehicular carriageway width is 7.5m with crash barriers at the edge.
The bridge carries class A loading. (For the purpose of ease of calculation assume two wheel loads of 11.4t per lane). Show the checks for two sections, one at midspan and one near support.(for shear)
Draw a suitable sketch for showing the detailing of reinforcement.

b) Design the R.C. girder brige with R.C. deck slab for a three girder bridge deck .given the following data
Effective span = 20m. carriageway width =7.5. footpath=1.5 m on either side. spacing of the girder =2.7m
The provisions shall be made for the Crash barrier and Precast Hand rail.
The bridge carries class 70 R track loading
Check the external girder at midspan for bending and support for shear
Draw a suitable sketch for showing the detailing of reinforcement.

III) Design the following 30

A girder bridge has 28 m clear span, with a width for two lane carriageway and 1.5m footpath nn either side.
The bridge carries 70 R track loading. Design the bridge as a prestressed concrete girder system with RC deck slab arrangement with thickness 0.24m. Depth of the girder = 2.2m and web thickness = .028m
Assume suitable prestressing arrangment.
Check the external girder for
stresses at various stages of construction and at service stage at midspan. against ther permissible values

Properties of the girder may be assumed as
1) girder - A=0.788 m2, I = 0.414 m4 Zt=0.376 m3 Zb= 0.376 m3, Yt=1.1m, Yb=1.1m
2) composite section - A=1.472 m2, I = 0.963 m4 Zt= 1.244(slab top) Zt=1.804(slab bot) Zb= 0.578 m3 Yt=0.773m Yb=1.666m

Carry out checks for ultimate bending moment.

Page (1)

. ME (Civil / Struct. Engg), sem. II,
. Earthquake Engineering

Lib
05/05/15

Bharatiya Vidya Bhavan's

SARDAR PATEL COLLEGE OF ENGINEERING

(An Autonomous Institution Affiliated to University of Mumbai)

MAY 2015

Total Marks : 100
Duration : 4 Hours

CLASS/SEM : ME CIVIL/SEM II
(With Structural Engg. Subjects)

SUBJECT : EARTHQUAKE ENGINEERING

- Attempt any FIVE questions out of SEVEN questions.
- Answers to all sub questions should be grouped together.
- Figures to the right indicate full marks.
- Assume suitable data if necessary and state the same clearly.

Master

Q.1 **a.** Answer the followings:

(i) What is Random dynamic Load? Briefly explain how the analysis of structure to random of dynamic Load is done. 2

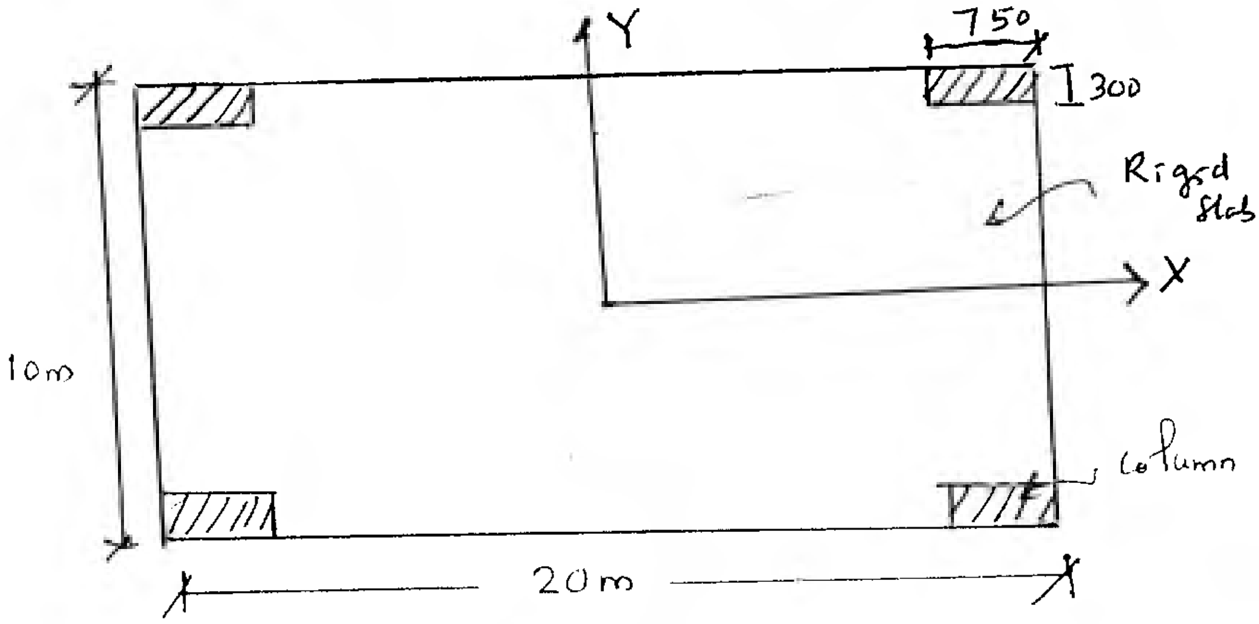
(ii) What is an earthquake? Briefly explain the Elastic Rebound Theory of an earthquake occurrence 5

(iii) Explain the structure of earth. 3

(iv) Explain how the local magnitude of earthquake is measured 2

b. (i) A uniform rigid slab of total mass 30 t is supported by four columns of height 6.0 m. rigidly connected to the top of slab and fixed at bottom. Each column is rectangular section of 750 mm x 300 mm as shown if figure. If the system is subjected to harmonic ground motion of amplitude 0.2g at frequency of 10 rad/sec in Y direction only, calculate the maximum lateral displacement of slab in Y direction and maximum stress in each column $\zeta = 5\%$ and E = 20, 000 MPa. 4

(ii) In the above problem, If the columns are hinged at bottom, then calculate the maximum lateral displacement of slab in Y direction and maximum stress in each column. Comment on the effect of fixity of column on these parameters 4



page (1)

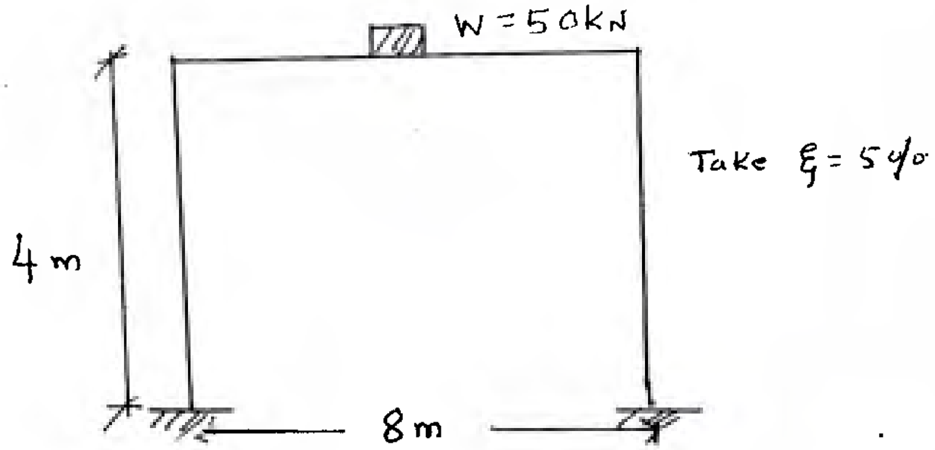
Q.2 a. A platform weighing 2000 N is supported on four columns. The columns are identical and clamped at both ends. It has been determined experimentally that a force of 200 KN horizontally applied to platform produces a displacement of 2.50 mm. Damping is 5%. Determine the following : 5

(i) Stiffness of structure (ii) Damped frequency (iii) Damping coefficient (vi) Logarithmic decrement (v) Number of cycles and time required for the amplitude of motion to be reduced from initial of 2.50 mm to 0.25 mm

b. A one story RCC building is idealized as plane frame as shown in figure. The cross section of columns is 300 mm x 300 mm and E= 20,000 Mpa. If the building is to be designed for ground motion, the response spectrum of which is shown in figure1 but scaled to peak ground acceleration of 0.5g. Determine the design values of lateral deformation and bending moments in the columns for the following two conditions:

(i) The cross section of beam is much larger than that of columns, so the beam may be assumed as rigid. 4

(ii) The beam cross section is much smaller than that of columns, so the beam stiffness can be neglected. Comment on the influence of beam stiffness on deign quantities 4



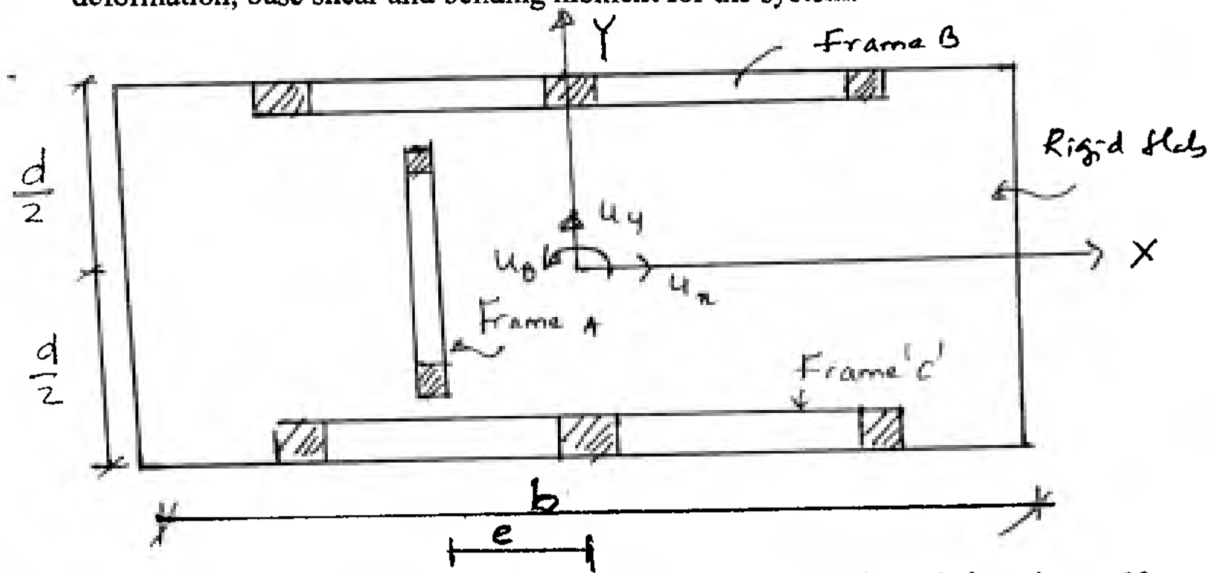
c. A two storey frame with free vibration characteristics as given below is subjected to a harmonic force with amplitude **100 KN** and at frequency of 20 rad/sec. at the 2nd floor level. Calculate maximum displacements of each storey. Take damping ratio as 5%. 7

Floor No.	Mass (t)	Mode No.	ω, rad/sec	Mode shapes	
				Φ_{i1}	Φ_{i2}
1	20	1	14.58	1.0	1.481
2	15	2	38.07	1.0	-0.822

ME (Civil/Struct. Engee) Sem-II, 5/5/15
Earthquake Engineering

Q.3 The plan of one storey building is as shown in figure. The structure consists of a roof idealized as a rigid diaphragm, supported on three frames A, B, and C as shown. The roof weight is uniformly distributed and has magnitude 200 Kg/m^2. The lateral stiffness are K_y = 20000 KN/m for frame A and K_x =25000 KN/m for frames B and K_x = 30000 KN/m for frame C The plan dimensions are b= 30 m d=20m and e – 4.0m. The height of building is 10m. 20

(i) Derive the stiffness matrix and determine the natural frequencies and modes of vibrations of the structure.
(ii) If the structure is subjected to ground motion $\ddot{u}_{gx}$ only in X direction. write down the equations of motion for the system
(iii) As a special case, if K_x = 25000 KN/m for both frames B and C and e = 0, calculate the frequencies and mode shapes. And if and the system is subjected to the ground motion only in X direction, the response spectrum of which is shown in figure1. Determine the design value of lateral deformation, base shear and bending moment for the system.



Q.4 A three storey frame with free vibration characteristics as given below is subjected to a ground motion characterized by the design spectrum given in the figure 1 but scaled to peak ground acceleration of **0.5g**. Calculate the design values of lateral deformation of floors. 20

Storey No.	Mass No.	Mass (t)	ω rad/sec	Mode shapes		
				Φ_{i1}	Φ_{i2}	Φ_{i3}
1	1	36	4.92	0.336	0.759	1.0
2	2	36	13.45	-2.46	-0.804	1.0
3	3	36	18.7	1.58	-1.157	2.58

ME (Civil / Struct. Engg.), Sem II, 5/5/15
Earthquake Engineering

Q.5 **a.** Explain the following :

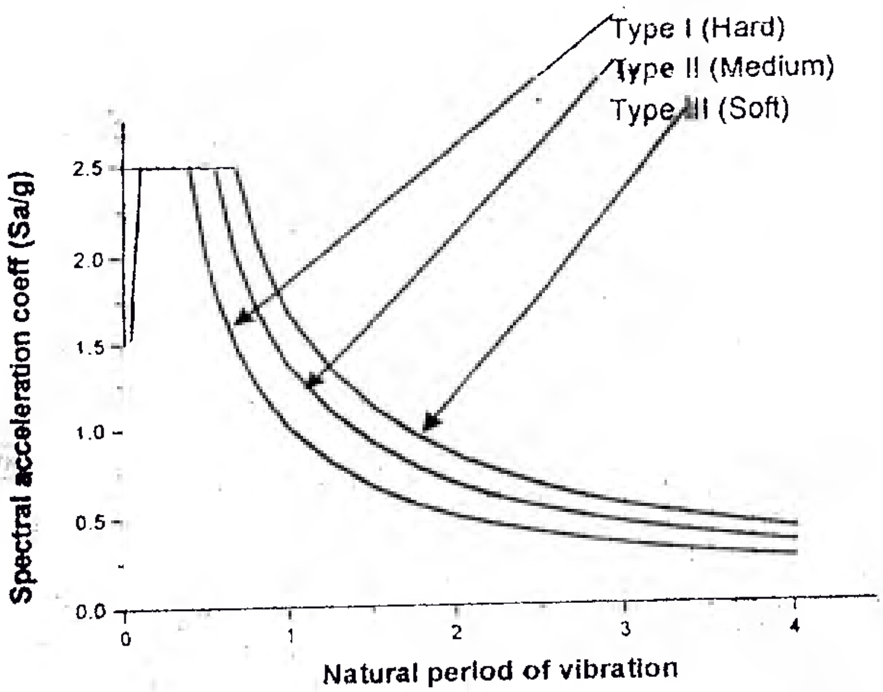
(i) Various types of Irregular Buildings as per IS 1893-2002 2

(ii) Explain provisions of torsion as per IS 1893-2002 2

(iii) What is soft story and explain design provisions for soft story as per IS 1893-2002 4

b. Using response spectrum method, calculate the seismic force on each floor of the frame, whose free vibration characteristics are as given below. Use the following additional data: 12
Z=0.24, I =1.5, R=3.0 and ξ = 5%. Assume foundation strata as soft and use response spectrum given in figure.

Storey No.	Mass No.	Mass (t)	ω rad/sec	Mode shapes		
				Φ_{i1}	Φ_{i2}	Φ_{i3}
1	1	25	15.73	0.399	0.747	1.0
2	2	25	49.85	1.0	0.727	-0.471
3	3	25	77.82	-0.908	1.0	-0.192



Response Spectrum as per IS 1893-2002 for 5 % Damping

MEC (Civil / Struct. Engg.) Sem - II , 5/5/15
Earthquake Engineering

Q.6 **a.** What is response spectrum? Explain the response spectrum characteristics. 4

b. Explain the procedure to construct elastic response spectrum set of recorded ground motions 6

c. (i) Explain the important provisions of IS 13920 for beams 6

(ii) Explain the provisions of IS 13920 for coupling beams connecting two shear walls 4

Q.7 **a.** What is ductility of a structure? Explain the importance of ductility in seismic resistant structures 4

b. (i) Explain how the base isolation helps in reducing the earthquake induced response in building structure 5

(ii) Briefly explain the earthquake design principle as per IS 1893-2002 (i.e. fail safe criteria) 4

(iii) Briefly explain the different types of structural systems used in a building structure to resist lateral loads due earthquake 3

c. Explain the following with reference to SDOF systems: 4

(a) Allowable Ductility

(b) Ductility Demand

ME Civil / Struct. Engg.), Sem-II, 5/5/16
Earthquake Engineering

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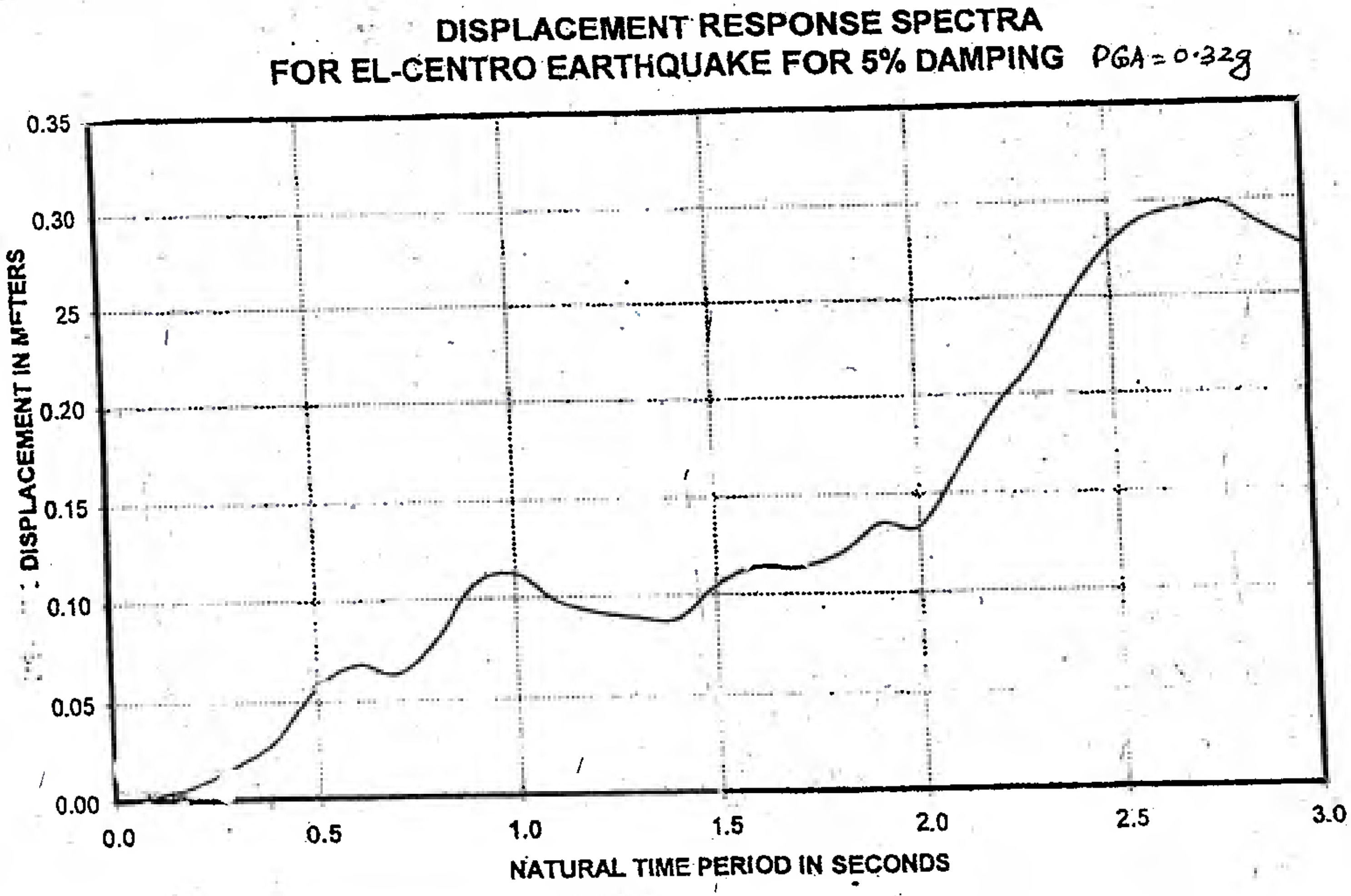


Figure 1. Q no 2(b) Q no 3, Q no 4

ME (Civil / Struc. Engg.)
Elective (CE 665 - CE 668)
Design of prestressed concrete structures

08/5/15

Bharatiya Vidya Bhavan's
SARDAR PATEL COLLEGE OF ENGINEERING
(An Autonomous Institution Affilliated to University of Mumbai)

DESIGN OF PRESTRESSED CONCRETE STRUCTURES

M.E. (STRUCTURES) SEM II

Total Marks : 100

Duration 4hrs.

May 2015

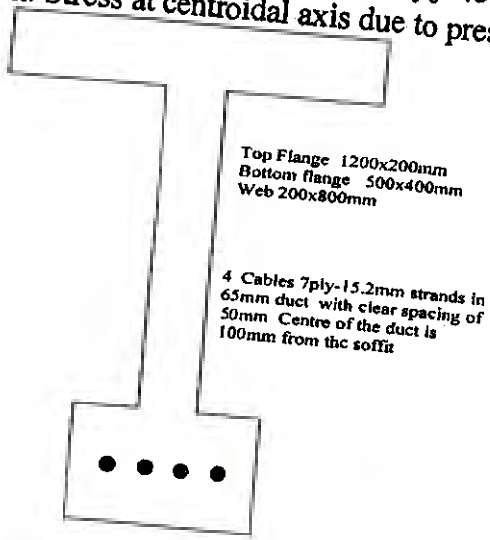
Master

NOTE: 1) Question No 1 is compulsory. Answer any 4 from the remaining
2) Use of IS1343-1980, IRC-6, 18, 20 is permitted.
3) Assume the data wherever required and state it clearly

Q 1 A post tensioned prestressed concrete **bridge girder** of type 1 is shown in the figure. 20

1) Span of the girder is 20m.
2) f_p=1600MPa.
3) f_{ck}=45MPa. f_{ci}=35MPa.
4)4 cables7K-15 i.e. 7strands of 15.2mm diameter From IS-6006-1983, area of single strand is 140mm^2. f_{pe}=.85f_p
5) DL. Bending moment=2500kNm and Shear force=325kN
6) LL. Bending moment=800kNm and Shear force=75kN

Check the ultimate flexural strength, ultimate shear strength (cracked section) and If y_{po}=112.5mm and y_o=450mm design the end block. Stress at centroidal axis due to prestress is 5MPa.



ME (Civil / Structur. Engg), Sem-II, 8/5/15.
(Elective)
Design of Prestressed Concrete Structures

Q 2 a	What would be the deflection caused by the prestressed fou force cable profile is parabolic and the eccentricity of the cable at the support is e1 and that at midspan is e2	06
b	A prestressed concrete beam is 150x300mmand simply supported over a span of 4m.It is prestressed by 6cables of 7mm diameter wires stressed to 1200MPa with an eccentricity of 50mm Ec=35GPa and modulus of rupture is 4MPa. Calculate the maximum deflection of the beam at the following stage: a)Prestress +self weight b) Prestress +self weight + service load of 8.5kN/m c) Cracking load d)2times the working load. e) If the creep coefficient is 2 also calculate the long term deflection	14
Q 3 a	A prestressed concrete beam section is made up of I-section Top flange 2500x500mm,Bottom flange1500x900mm and Web 500x1200mm.It is subjected to shear of 2500kN.The stress Distribution due to prestress is 15Mpa compression at top and 2Mpa tension at bottom. Calculate the principal stress at the junction of the bottom flange and web and cetroid of the beam. If the permissible stress is 1.0MPa design the shear reinforcement	08
b	A rectangular beam400x900mm is prestressed concrete beam.The beam is subjects to dead load moment 180kN.m and live load moment 225kN.m.The permissible compressive stress at transfer and service is 12.5Mpa and11Mpa and permissible stress in tension at service 1MPa. Calculate the range of prestress and eccentricity	12
Q 4 a	Explain concordant cable	06
b	A continuous prestressed concrete beam ABC (AB=BC=15m) simply supported at A,B and C is subjected to a prestress of 1000kN. The eccentricities are: At A 60mm below CG, at 9m from A 240mm below CG, 120mm above CG at B,270mm below CG at mid span of BC and concentric at C. The eccentricity varies linearly in AB and parabolic in span BC. State if the cable is concordant and if not determine the stresses at B. Also draw the pressureline.	14
Q 5 a	A double Tee-section with flange of 1500x150mm has two webs 150mm wide symmetrically placed below the flange. The effective Depth is 1600mm If fck=40MPa and fp=1600MPa Ap=4500 Determine the flexural strength of the beam if the beam is a)pre-tensioned b) post tensioned with the effective depth 1400mm i)bonded ii) unbonded L/d=20	10

ME (Civil / Structur. Engg), Sem-II, 8/05/15
Design of Prestressed Concrete Structure.

TABLE 6.1 Coefficients for Stresses in End Blocks (*Magnel*)

Distance from far end, x/h	K_1	K_2	K_3
0	20.00	−2.000	0.000
0.10	9.720	0.000	1.458
0.20	2.560	1.280	2.048
0.30	−1.960	1.960	2.058
0.40	−4.320	2.160	1.728
0.50	−5.000	2.000	1.250
0.60	−4.480	1.600	1.768
0.70	−3.240	1.080	0.378
0.80	−1.760	0.560	0.128
0.90	−0.520	0.160	0.018
1.00	0	0	0

TABLE 6.2 Vertical Stresses Along Axis at Ends of Prestressed Beams (Guyon)

Distribution Ratio (y_{po}/y_o)	*Position of Zero Stress* $(x/2y_o)$	*Position of Maximum Stress* $(x/2y_o)$	*Ratio of Maximum tensile stress to average stress*
0.00	0.00	0.17	0.50
0.10	0.09	0.24	0.43
0.20	0.14	0.30	0.30
0.30	0.16	0.36	0.33
0.40	0.18	0.39	0.27
0.50	0.20	0.43	0.23
0.60	0.22	0.44	0.18
0.70	0.23	0.45	0.13
0.80	0.24	0.46	0.09

	b	A pretensioned beam 250x300mmis prestressed by 12wires each of 7mmdiameter and the centroid located at 100mm from th soffit Estimate the final loss of stress.Es=210GPa,Ec=35Gpa,creep coeeficient is 1.6,shrinkage strain $3x10^{-4}$,relaxation of steel stress is 90MPa.	10
Q 6		A prestressed concrete composite beam consists of 500x75mm cast in situ flange and 140x250mmdeeprectangular precast prestressed stem.The stress distribution for precast stem section alone due to prestress is zero at top and 16MPa at bottom. Find what UDL live load the composite section can carry on a simply supported beam of 6m span for the condition that stress at the bottom of the perecast unit is zero for the following conditions: a)DL of the slab and the weight of the shuttering are carried by the precast unit during casting and shuttering is removed after the slab concrete has hardened. b) DL of the slab is supported independently at the time of casting. Assume that the shuttering weighs 270kN/m and the ratio of Eslab to Eprecast is 0.65.	20
Q 7a		A prestressing force of 250kN is transmitted through a distribution plate 120x120mm,the centre of which is located at 100mm from bottom of an end block having a sectin of 120mm wide and 300mm deep. Evaluate the position and magnitude of maximum te tress on horizontal section passing through the centre of distrbutior plate using methods of 1) Magnel 2)Guyon and 3)Rowe. Find the area of steel to resist the largest tensile force.Fy=250MPa	10
	b	A Tee beam section has flange 500x200mm. The web is 200x600mm The beam is spanning 16m and carries a prestressing forc of 2000kN.The cable profile is parabolic eccentricity of 300 mm at supports Estimate the ultimate shear	10