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ALVA'S INSTITUTE OF ENGINEERING AND TECHNOLOGY

MOODBIDRI - 574 225

Affiliated to VTU, Belgaum and Approved by A.I.C.T.E., New Delhi

COURSE BOOK

(ACD - 08, ACD - 09, ACD - 10, ACD - 12, ACD - 13)

Period of the Semester (Odd / Even) : From 13-2-2017 to 2-6-2017

Semester : 8th Sem A & B Sec

Subject with Code : Earthquake Resistant Design of Structures (10CV834)

TIME SLOT

Mon :	9:00 am to 9:55 am	Tue :	
Wed :	9:55 am to 10:50 am	Thu :	
Fri :	2:00 pm to 3:00 pm	Sat :	9:00 am to 9:55 am

Name of the Teacher : Nikhil N

Department : Civil Engineering Department

ALVA'S INSTITUTE OF ENGINEERING & TECHNOLOGY
(A Unit of Alva's Education Foundation)
Shobhavana Campus, Mijar-574225, Moodbidri, D.K
Phone: 08258-262725, Fax: 08258-262726

CALENDAR OF EVENTS (EVEN SEMESTER - 2017) BE, M.TECH & MBA

Week	Month	Days							# of working Days	Activities
		Mon	Tue	Wed	Thu	Fri	Sat	Sun		
1	JAN	30	31						02	
2	FEB			1	2	3	4	5	04	4th : Commencement of Sports for staff/students
3		6	7	8	9	10	11	12	05	11th : Sports Day
4		13	14	15	16	17	18	19	06	15th : Commencement of Literary, Fine Arts and cultural activates
5		20	21	22	23	24	25	26	05	24th: Shivaratri
6		27	28						02	27th, 28th :Project Evaluation – Phase-II
6	MARCH			1	2	3	4	5	04	
7		6	7	8	9	10	11	12	06	
8		13	14	15	16	17	18	19	06	
9		20	21	22	23	24	25	26	06	23th, 24th, 25th : I-IA Test
10		27	28	29	30	31			04	29th: Ugadi 30th :Submission of Activities Results 31th :Project Evaluation–Phase-III
10	APRIL						1	2	01	1st :Project Evaluation–Phase-III
11		3	4	5	6	7	8	9	05	7th : Traditional Day
12		10	11	12	13	14	15	16	05	14th: Good Friday
13		17	18	19	20	21	22	23	06	
14		24	25	26	27	28	29	30	06	27th, 28th, 29th : II-IA Test
15	MAY	1	2	3	4	5	6	7	05	1st : May Day 4th : Last date for Project Report Submission 5th : Talents Day, 6th : College Day
16		8	9	10	11	12	13	14	06	13th : Final Year Project Exhibition
17		15	16	17	18	19	20	21	06	
18		22	23	24	25	26	27	28	06	22nd,23rd, 24th : III-IA Test
19		29	30	31					03	

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DEPARTMENT OF CIVIL ENGINEERING

INDIVIDUAL TIMETABLE (EVEN SEMESTER 2017)

Name of the Faculty	**Mr. Nikhil N** Assistant Professor						With Effect From: 13/02/2017			
Period	1	2	TEA	3	4		5	6	7	No. of Units
Time / Day	09.00 – 09.55	09.55 – 10.50		11.10 – 12.05	12.05 – 01.00		02.00 – 03.00	03.00 – 04.00	04.00 - 05.00	
Monday	ERDS (8 A&B)	EXT.SYS :B1 BATCH (6 B)				LUNCH BREAK	PROJECT WORK			6.5
Tuesday	EXT.SYS :A2 BATCH (6 A)						EXT.SYS :B2 BATCH (6 B)			6.0
Wednesday	SEMINAR (8 A)				ERDS (8 A&B)		**CIVIATION – FORUM ACTIVITIES**			3.0
Thursday		SEMINAR (8 B)					PROJECT WORK			2.5
Friday		SEMINAR (8 B)					ERDS (8 A&B)		DEPT. MEETING	3.5
Saturday	ERDS (8 A&B)	EXT.SYS :A1 BATCH (6 A)								5.0
Other Activities: Class Coordinator – 8 A , Survey Camp Officer , Workshop Coordinator										
									Total Units*	**26.5**

* EXCLUDING OTHER ACTIVITIES

HOD
Dept. of Civil Engineering
Alva's Institute of Engg. & Technology
Mijar, Moodbidri - 574 225

PRINCIPAL
PRINCIPAL
Alva's Institute of Engg. & Technology,
Mijar, MOODBIDRI - 574 225, D.K.

Date: 13/02/2017

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DEPARTMENT OF CIVIL ENGINEERING

VIII SEMESTER "A" – SECTION STUDENT LIST (2016 – 17)
Earthquake Resistance Design Structures (10CV835)

Name of Faculty: Mr. Nikhil N

SL. NO.	USN	NAME OF THE STUDENTS
01	4AL13CV001	ABHILASH ✓
02	4AL13CV015	AMBILI M P ✓
03	4AL13CV026	BASANAGOUDA BASARADDI ✓
04	4AL13CV039	HARIKESH S P ✓
05	4AL13CV040	HARSHITH A S ✓
06	4AL13CV050	MANJUNATHA V ✓
07	4AL13CV065	PRANIL KUMAR ✓
08	4AL13CV078	SACHIN KUMAR SINDAGERI ✓

Date: 30/01/2017

HOD 30/01/2017

H.O.D.
Dept. of Civil Engineering
Alva's Institute of Engg. & Technology
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DEPARTMENT OF CIVIL ENGINEERING

VIII SEMESTER "B" – SECTION STUDENT LIST (2016 – 17)
Earthquake Resistance Design Structures (10CV835)

Faculty: Mr. Nikhil N

SL. NO.	USN	NAME OF THE STUDENTS
01	4AL13CV083	SANGMESH
02	4AL13CV085	SANTOSH KAMBLE
03	4AL13CV086	SARFRAZ ALI
04	4AL13CV089	SHASHIKANTH
05	4AL13CV099	SREERAJ S PILLAI
06	4AL13CV103	THOKCHOM SATISH KUMAR
07	4AL13CV107	VIJAYA REDDY
08	4AL13CV115	HEMANTHA KUMAR K R
09	4AL13CV116	JITHIN P
10	4AL13CV124	SNEHA K
11	4AL13CV125	SHINS T WILSON
12	4AL14CV402	CHINIVALARA MANJUNATHA
13	4AL14CV403	GURUBASAVARAJ M
14	4AL14CV407	KALAKALESHWARAYYA GANACHARI
15	4AL14CV408	KIRAN M L
16	4AL14CV409	LAKKAPPA
17	4AL14CV410	LOHITH V
18	4AL14CV411	MAHENDRA SHEENA PUJARI
19	4AL14CV412	MANJUNATH GOUDAR
20	4AL14CV413	MANJUNATH PANCHAMUKHI
21	4AL14CV417	PRAVEENKUMAR B M
22	4AL14CV418	RAVIKIRANA S
23	4AL14CV419	SALIMPASHA
24	4AL14CV421	SHANKAR BADIGER
25	4AL14CV422	SHIVAKUMAR GANTISIDDAPPANAVAR
26	4AL14CV424	SHRAVANAKUMAR SHRIGANNAVAR
27	4AL14CV428	VASANTH KUMAR R S
28	4AL14CV430	VINAY KUMAR
29	4AL14CV432	VINAY K Y

Date: 30/01/2017

HOD 30/01/2017

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DEPARTMENT OF CIVIL ENGINEERING

VIII Semester (A & B Section) – I Internal Assessment Test

EARTHQUAKE RESISTANT DESIGN OF STRUCTURES (10 CV834)

Roll No: [ ] [ ] [ ]

USN: 4 | A | L | | | C | V | | |

Date: 24/03/2017 Timings: 3.00 pm – 04.30 pm Max.Marks:50

Note:

1) Answer **ANY 2 FULL** question from each part.
2) Missing data, if any, may be suitably assumed and indicated.
3) Answers should be specific and precise.
4) Draw neat sketches wherever necessary.

PART -A

1.a. Explain internal structure of earth. 6 marks

b. Explain plate tectonic plate theory. 6 Marks

2.a. What is strong ground motion? How earthquake is classified from strong ground motion point of view. 6 Marks

b. Explain design spectrum for elastic system. 6 Marks

3. What is vertical irregularity? Explain any 2 vertical irregularities. 12 Marks

PART –B

4. The earthquake record obtained at an station shows the amplitude of ground displacement is 5.85 mm. the time interval between the arrival of primary & secondary waves is 5.5 sec. the nominal properties of rock in the locality is estimated to have young's modulus of 140,000 MPa, Poisson's ratio is 0.28 & specific weight is 27 kN/m^3 . Compute epicentral distance, also determine the local magnitude of earthquake. 13 Marks

5.a. Explain magnitude & intensity of earthquake. 6 Marks

b. With neat figure explain seismic instrument. 7 Marks

6. What are elastic waves? Explain. 13 Marks

2

1

ALVA'S INSTITUTE OF ENGINEERING AND TECHNOLOGY: MIJAR, MOODBIDRI

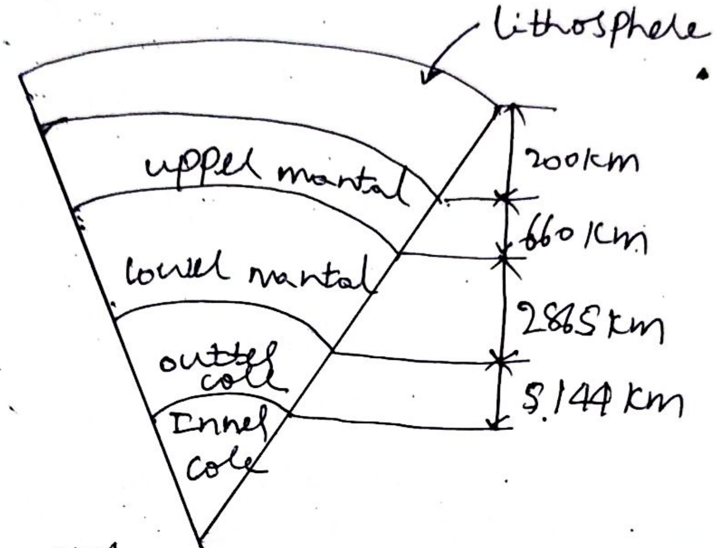
DEPARTMENT OF CIVIL ENGINEERING

SCHEME OF EVALUATION

Subject Title: Ealthquake Resistant Design of Stluctule

Subject code: 10CV834

Q.NO	Description of Answers	Marks
1. a)		



lithosphele → It is also known as clust the li-thosphele is the thinnest outel solid shell. It is 200km thick with a density of 1500 kg/m³ The tempelatule of the clust is about 25°C. 1½ 3

Mantal → It is also known as asthenosphele which is 2685km thick sullounding the cole. It is composed of hot, dense ultlabasic igne-ous lock in a plastic state with a density of 5000-6000 kg/m³ 4½

cole → It is also known as Balysphele, It is the densest centlal palt of the ealth. It has innel & outel coles, The innel cole has a 6

Answer/Solution	Marks
1221km & mainly composed of nickel & iron. Its density is 16,000kg/m³ & it behaves like a solid. The outer core surrounding the inner core has a thickness of 2257 km & composed of nickel & iron alloyed with silica. The temperature at the core is about 2500°C	6
1) Plate tectonic is the movement of 7 major plates of earth crust. Movement of these plates is due to the generation of convective current inside the earth. generation of convenctive current is due to huge temperature differences b/w core & crust. Due to these movement, displacement will take place in the rocks of earth. Due to displacement work has been done & this work will be stored in the rock in the form of energy called as strain energy. Due to this displacement a sudden slip will take place in the faults of rock, length of faults may vary from 1m to many km, due to slip stored energy will be released which will induce	

Answer/Solution	Marks
Violent shaking of earth called earthquake. 99% of EQ's taken place on the boundaries of plates (The countries like Japan, California & San Francisco lies on the border of the plates) such earthquakes are called as interplate EQ's. 1% of EQ's takes place within the plates called as intraplate EQ's (maharashtra EQ in 1993). Bhuj EQ had a magnitude of 6 to 7, energy released was 400 times that of energy relea-sed during atom bomb dropped on Hiroshima.	5
Tectonic plates are:- 1) North American plate 2) South American plate 3) Eurasian plate 4) African plate 5) ~~African~~ Pacific plate 6) Indo-Australian plate 7) Antartic plate	6

).	Answer/Solution	Marks
2. a)	vibration's induced in the earths crust often induce in the ground, Actual movements of acceleration which are generally of short dura-tion, rarely exceeding 1 min. Ground motion's are caused by seismic waves generated by release of strain energy at the focus. These waves travel with different velocities, amplitude, & level of energy. Thus the amplitudes & direc-tion's of these ground motion's randomly vary with time, hence EQ loading is called randomly varying load. Ground shaking increases as magnitude increa-ses & decreases as distance from the hypocen-ter increases, large EQ at great distances can produce weak motion that may not damage structures.	2
	From ground motion point of view EQ can be classified as. 1) Practically a single shock → Motion of this type occurs only at short distances from the epicentre, only on firm ground & only for shallow EQ.	3

Answer/Solution	Marks
2) A modelately long, extlemely irregulal motion → This is associated with modelate distance flom the focus & occuls only on film glound. This EQ ale usually of almost equal severity in all dilections.	4
3) A long Peliod glound motion → Such motion lesu-lts from the filtering of EQ of the pleceedi-ng types thlough layels of soft soil that exhibit lineal ol almost lineal behaviour of soil & folm the successive wave leflections at inte-lfaces of these mantles.	5
4) A glound motion involving lalge scale → pelma-nent defolmation of the glound & at site of inte-lest ~~there~~ may be slides ol soil liqui-faction.	6
2.5) This is constlucted flom estimated peak values fol glound accelelation, glound velocity & groun-d displacement. This spectlum is constlucted because	

Answer/Solution	Marks
1) It is intended for the design of new structures. 2) For evaluation of seismic safety of existing structures to resist future EQ. 3) The major response spectrum for different ground motion recorded at the same site durin-g different EQ contains uneven, but the peak & the vallyes are not same at the same periods.	4

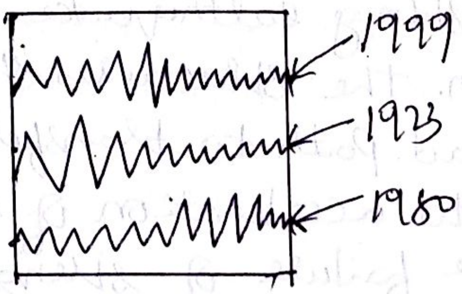


Fig shows the response spectrum for ground motion recorded at same site during past 3 EQ.
Similarly it is not possible to predict the jagged or uneven response spectra in all its details for a ground motion that may occur in the future. Thus the design spectrum sho-uld consists a set of smooth curves or series of straight lines with one curve for each level of damping.

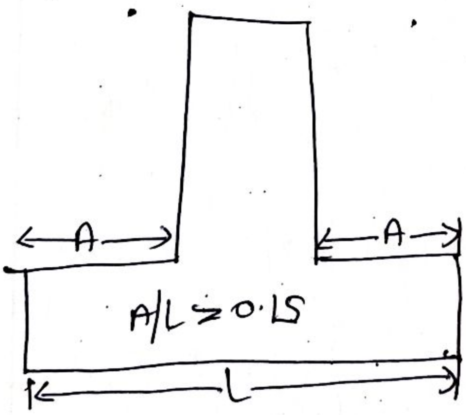
Q. No.	Answer/Solution	Marks
	The design spectrum describes relative strength required at different periods for design purpose, Actual strength specification requires allowable stress values & damping. The design spectrum is derived from smooth spectrum of an assemble of an EQ recordes.	6
3)	1) One of the major contributions for damage of structure during strong earthquake is discontinuity in load path. The structures should contain a continuous load path to transfer seismic load induced due to acceleration of each structural elements. The failure of strength & toughness of individual elements in the system or failure to the individual elements together may lead to complete collapse of structure during ground motion. hence all structural & non-structural elements should be adequately connected together to provide sufficient strength & continues path. The general load path is as follows: EQ forces which originates in all elements of the building are delivered through structural connections to	

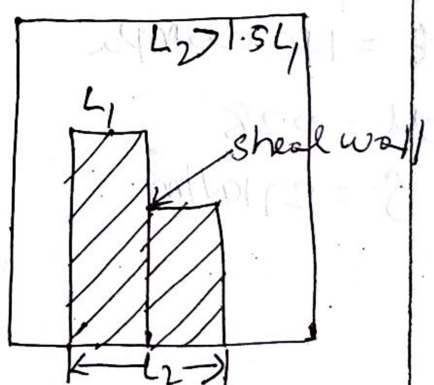
).	Answer/Solution	Marks

to holizontal diaphlagm. The holizontal diaphlagm distributes all this loads to veltical folce lesisting system that is column, sheal wall & othel veltical system which tlansfels load safely to foundation. The examples of load path illegulalities ale dis-continuous columns, sheal wall, blacing flames, that alises a "floating boc constluction. In this case of columns of sheal walls that do not continue up to the glound but end at an uppel level is induced to oveltulning folces to anothel lesisting elements of lowel level. This imposition of oveltulning folces ovelwhelms the columns of lowel level through connecting element

6

2) Veltical geometlic illegulalities





No.	Answer/Solution	Marks
	A veltical set back is a geometly irregulality in veltical plane. It is consideled when holizo-ntal dimension of the latelal folce lesisting system in any stoley is mole than 150% of that in an adjacent stoley. The set back can also visualized as a veltical le-entlant colnes, the genelal solution of set back ploblem is total seismic sepalation in plan through sep-alate S/C. So that poltions of the building ale flee to viblate independently. when the buil-ding is not sepalated, check the latelal folce les-isting elements using dynamic analysis.	12
4)	Given $A = 5.85$ mm $t_s - t_p = 5.5$ sec $E = 140,000$ MPa $\mu = 0.28$ $\rho = 2719N/m^3$	

Answer/Solution	Marks
$t_s - t_p = \frac{\Delta}{V_s} - \frac{\Delta}{V_p}$ 140,000 MPa $= 140{,}000 \times 10^6$ Pa $\rho = 27$ kN/m³ $= 2.7$ g/cm³ $V_s = \sqrt{\frac{G}{\rho}}$	2
w.k.t. $E = 2G(1+\mu)$ $G = \frac{140000 \times 10^6}{2(1+0.25)}$ $G = 5.46 \times 10^{10}$ N/m² $G = 5.46 \times 10^{14}$ N/cm² $G = 5.46 \times 10^{11}$ dynes/cm²	4
$V_s = \sqrt{\frac{5.46 \times 10^{11}}{2.7}} = 4.996$ km/s $V_p = \sqrt{(K + \frac{4}{3}G)/\rho}$ $E = 3K(1-2\mu)$ $K = \frac{E}{3(1-2\mu)}$	7

Answer/Solution	Marks
$K = \frac{140{,}000 \times 10^6}{3(1-(2\times0.28))}$	
$K = 1.06 \times 10^{11}\ N/m^2$	
$K = 1.06 \times 10^{12}$ dynes/cm^2	8
$V_p = \sqrt{\frac{1.06\times10^{12} + \frac{4}{3}(5.46\times10^{11})}{2.7}}$	
$V_p = 813.77 \times 10^3$ cm/s	
$V_p = 8.137$ km/s	10
$t_s - t_p = \frac{\Delta}{V_s} - \frac{\Delta}{V_p}$	
$5.5 = \frac{\Delta}{4.5} - \frac{\Delta}{8.137}$	
$\Delta = 55.263$ km < 100 km	11
Local magnitude, $M_L = \log_{10} A$	
$= \log_{10} 5.85$	
$= 6.7$	13

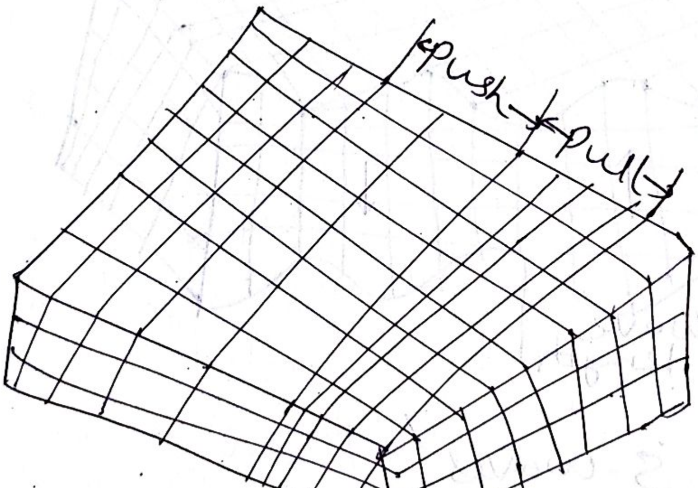
Q. No.	Answer/Solution	Marks
5 a)	Magnitude → The magnitude is a quantitat-ive absolute measure of the size of an earthquake. EQ magnitude is a measure of the amount of energy released during an EQ. Depending on size, nature & location of EQ, sei-smologist use different method to estimate magnitude. There is only one magnitude per EQ. But magnitude value given by differe-nt seismological observers for an event may vary. The uncertainity in an estimate of the magnitude is about ±0.3. There are various magnitude scales in use. These scales differ from each other because, those are derived from different wave component of EQ.	3
	Intensity → Intensity is a qualitative measu-re of the strength of an earthquake. It gives a gradation of strength of earthquake using observed damage to the structure of ground & reaction of humans to the EQ sha-king. An EQ has many intensities. The highest	

).	Answer/Solution	Marks
	is near the epicentre & progressively to lower grade at further away. This measurement is not instrumental. The Popular intensity scale is modified mercallic instrument (MMI) with 12 gradation denoted by roman no from 1 to 12. Another intensity scale developed for central & eastern European states is known as madvedev-sponheuer-karnik (MSK) intensity scale. The 12 gradation MSK scale differ with MMI in details only. In India IS 1893 part-I-2002 also refers MSK.	6
	6) Elastic waves are the earthquake waves which release large strain energy at the focus. These elastic waves are called seismic waves & they travel in all direction's through the earth surface. Seismic waves are classified as:- 1) Body waves 2) Surface waves.	1

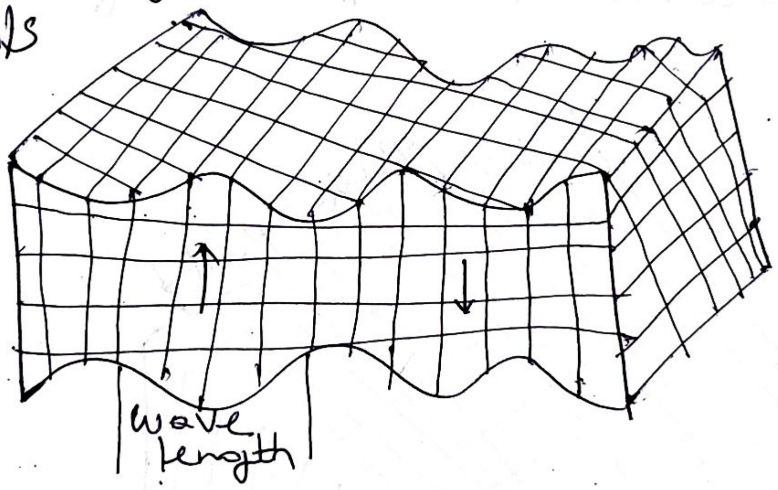
Answer/Solution	Marks
1) Body waves	

i) Plimary waves ii) secondary waves.

i) Plimary waves → These ale longitudinal waves similal to sound waves. These waves ale fastest waves & consequently 1st to allive at a seismic station. P-waves can also move through solid lock & fluids, P-waves ale also known as compressional waves, because of the pushing & pulling they do. velocity of P-waves is 4.8 km/s, somtimes animals can heal the P-waves of an ealthquake.



4

Answer/Solution	Marks
ii) <u>Secondaly waves</u> → This waves ale commonly known as Sheal Waves & also known as tlansvel-se waves. This waves moves in the dilection ⊥lal to the dilection of palticle motion. S-waves can tlavel through solid locks but it cann-ot move through watel ol liquid because liquid do not have any sheal stlength. This waves ale slow in motion compaled to P-wa-ves. They tlavel at a valying velocity thlough the solid palts. S-waves ale mole dangelous type of waves because they ale lalge-l waves. Nolmally S-waves tlavel with a veloci-ty of 3 km/s  <u>S-waves</u>	7

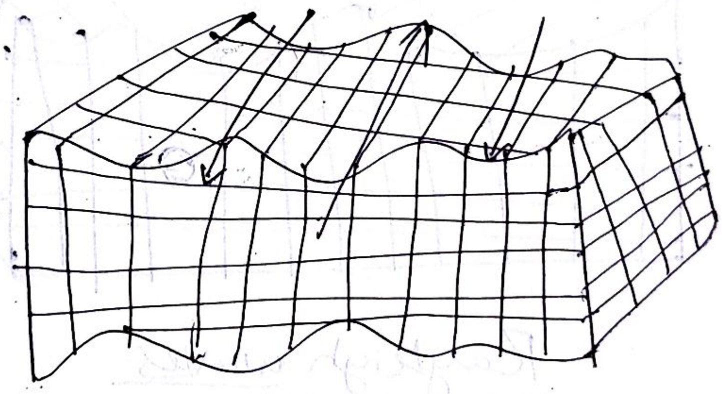
Answer/Solution	Marks

~~2) Bo~~

2) Body waves

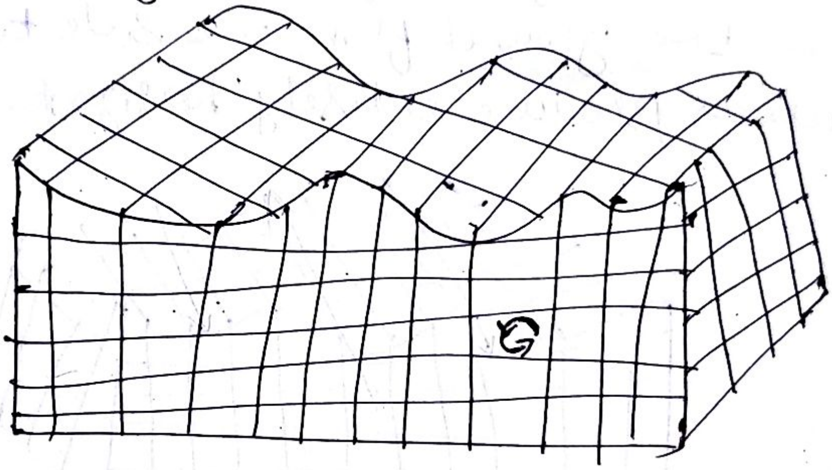
i) love waves ii) Rayleigh waves.

i) love waves → The 1st kind of surface waves are called love waves, Named after A.E.H. Love who explained the mechanism of genera-tion of love waves. These are transverse vib-rations & are confined to the outer skin of the crust. They are fastest surface waves & move the ground from one side to side. love waves produce entirely horizontal motion.



love waves

10

	Answer/Solution	Marks
	11) <u>Rayleigh waves</u> → The other kind of surface waves are the Rayleigh waves, Named for Lord Rayleigh, who described the generation of Rayleigh waves. Rayleigh waves rolls along the ground. hence it moves the ground up & down & side to side in the direction that the wave is moving. Most of the shaking felt from an earthquake is due to Rayleigh waves.  <u>Rayleigh waves</u>	13

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DEPARTMENT OF CIVIL ENGINEERING

VIII Semester (A & B SECTION) – II Internal Assessment Test

EARTHQUAKE RESISTANT DESIGN OF STRUCTURES (10 CV834)

Roll No: ☐☐☐ USN: 4 A L ☐ ☐ C V ☐ ☐ ☐

Date: 27/04/2017 Timings: 3.00 pm – 4.30 pm Max.Marks:50

Note:

1) Answer **ANY 2 FULL** question from each part.
2) Missing data, if any, may be suitably assumed and indicated.
3) Answers should be specific and precise.
4) Draw neat sketches wherever necessary.
5) IS:1893-2002 (part-1) is permitted

PART -A

1. What are horizontal irregularities? Explain. 12 marks

2.a. What is ductility? Explain the role of ductility in earthquake resistant structure. 6 Marks

b. Explain Mode Shapes and Fundamental Period 6 Marks

3. A 4 storey RC frame as shown in fig. Q(3) is in zone IV. The loads are lumped at floors, the soil is assumed to be hard rock & building is to be used as hospital. Determine the base shear & the distribution of storey shear as per IS:1893 . Draw load diagram & also calculate shear force. 12 Marks

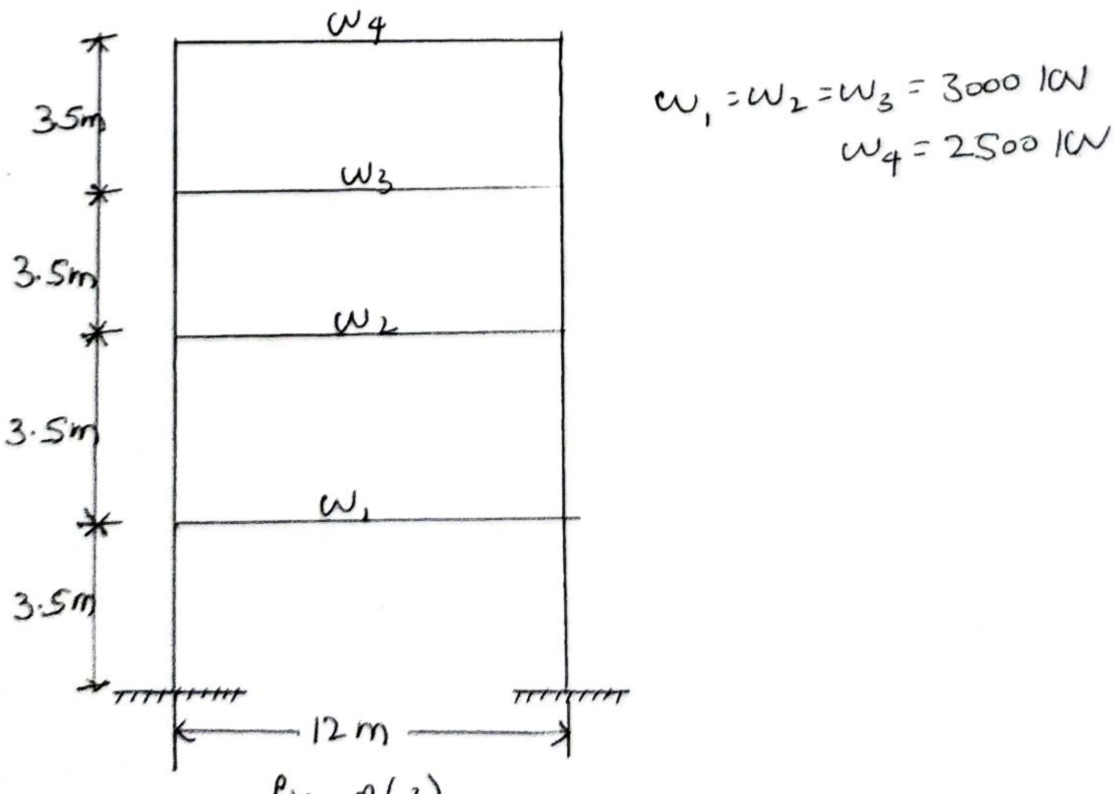

fig. Q(3)

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DEPARTMENT OF CIVIL ENGINEERING

PART –B

4.a. Explain aseismic design philosophy. — 6 Marks

b. Explain 3 advantages of design philosophy and basic assumption made in analysis of earthquake resistant structure. — 7 Marks

5.a. Explain seismic co-efficient method & state assumption made in seismic co-efficient method. — 7 Marks

b. Briefly explain the procedure involved in seismic co-efficient method. — 6 Marks

6. A 4 storey RC frame as shown in fig. Q(6) is in zone IV. The loads are lumped at floors, the soil is assumed to be hard rock & building is to be used for commercial purpose. Determine the base shear & the distribution of storey shear as per IS:1893. Assume SMRF, thickness of infill walls 250mm & 150mm in transverse & longitudinal direction, depth of slab is 100mm, size of column is 250X450 mm, size of beams 250X400mm & 250X350mm in transverse & longitudinal direction, floor height is 3.5m, unit weight of RCC is 25kN/m^3 & unit weight of infill is 20 kN/m^3 — 13 Marks

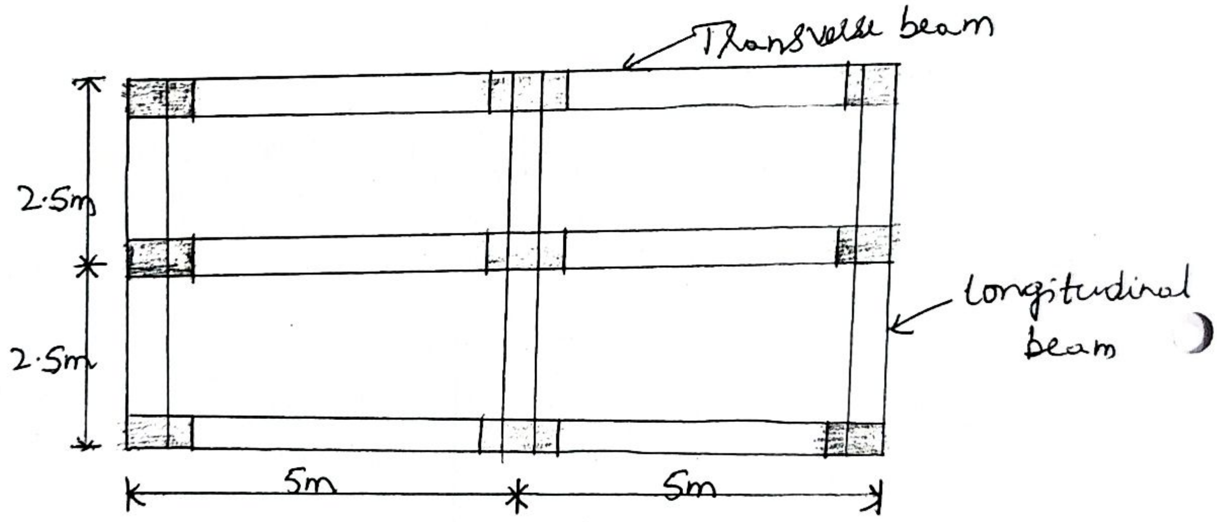


fig. Q(6).

ALVA'S INSTITUTE OF ENGINEERING AND TECHNOLOGY: MIJAR, MOODBIDRI

DEPARTMENT OF CIVIL ENGINEERING

SCHEME OF EVALUATION

Subject Title: Earthquake Resistant Design of Structures. Subject code: 10CV834

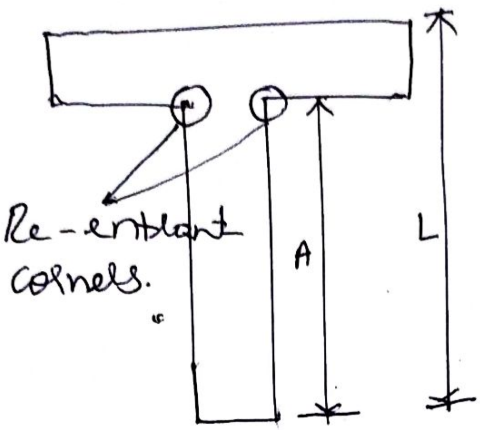
Q.NO	Description of Answers	Marks
1.	Horizontal irregularities are: a) Torsion irregularities.	

Torsion irregularity shall be considered when floor diaphragms are rigid in their own plan in relation to the vertical structural elements that resist the lateral forces. Torsion irregularity is considered to exist when the max storey drift, computed with design eccentricity, at one end of the structure transverse to an axis is more than 1.2 times of the avg storey at the 2 ends of the structures.

The lateral force resisting element should be well balanced system that is not subjected to significant torsion. Significant torsion will be taken as the condition where the distance b/w storey's centre of rigidity & storey's centre of mass is greater than 20% of the width of the structure either in major plan dimension. 3

Answer/Solution	Marks

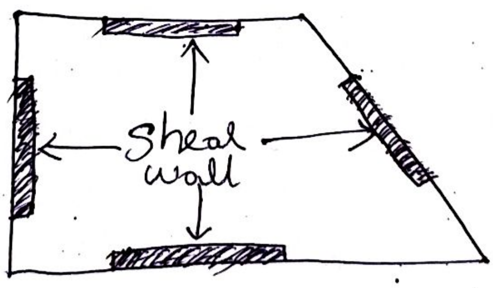
b) Re-entrant corners.

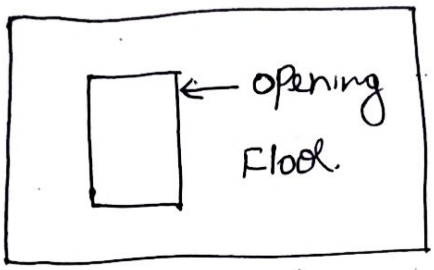


$\frac{A}{L} > 0.15 - 0.20$

The re-entrant corners of the buildings are subjected to two types of problem, building configuration of an L, T, H, + due to lack of tensile capacity & force concentration. According to code, Plan configuration of a structure & its lateral forces resisting system contains re-entrant corners, where both projections of the structure beyond the re-entrant corner are greater than 15% of its plan dimension in the given direction. 6

c) Non-parallel system



Q.	Answer/Solution	Marks
	when vertical load resisting elements are not parallel or symmetrical about the major orthogonal axis of the lateral force resisting system of the building, these situations are often faced by architects. This condition results in high probability of torsional forces under a ground motion, because the centre of mass & centre of rigidity does not coincide. This problem is often exaggerated in the triangular or wedge shaped buildings resulting from street inter-section at an acute angle.	9
	d) Diaphragm discontinuity  The diaphragm is horizontal resistance element that transfers forces b/w vertical resistance element. The diaphragm discontinuity may occur with abrupt variation in stiffness, including those having cut-off or open areas greater than 50% of the gross enclosed diaphragm area, or change in effective diaphragm stiffness of more than 50% from one storey to the next. The diaphragm acts as a horizontal beam & its ends acts as flanges.	12

Q.	Answer/Solution	Marks
2.a)	1) Ductility is defined as the capacity of the materials, systems of structures to absorb energy by deformi-ng in the elastic range. 2) The safety of building from collapse is on the basis of energy, which must be imparted to the structure in order to make it fail. 3) Therefore ductility of a structure in fact is one of the most important factors affecting its EQ performance 4) The primary task of an engineer designing a building to be EQ resistant is to ensure that the building will possess enough ductility. 5) The ductility of a structure depends on the type of material used. 6) It is possible to build ductile structure with RC if care is taken in the design to provide the joints with sufficient abutments that can adequately con-fine the concrete.	6
b)	1) The elastic properties & mass of building cause to develop a vibratory motion when they are subjec-ted to dynamic action. 2) This vibration is similar to vibration of a violin string, which consists of a fundamental tone & the additional contribution of various harmonics. 3) the vibration of a building likewise consists of a fundamental mode of vibration & the additional contribution of various modes, which vibrates at higher frequencies.	3

Answer/Solution	Marks
4) Fundamental period of vibration can be determined by the code-based empirical for the fundamental modes of the building may be determined by any one of several method developed for the dynamic analysis of structures.	
5) on the basis of time period, building may be classified as rigid ($T<0.3$ sec), semi-rigid (0.3 sec $<T<$ 1.0 sec) & flexible structure ($T>1.0$ sec)	
6) Building with higher natural frequencies & a short natural period, tend to suffer higher acceleration but smaller displacement.	6
~~3) Step~~	
3) Step-1 → Determination of natural time period. $T_a = \frac{0.09h}{\sqrt{d}} = \frac{0.09 \times 14}{12} = 0.105$ sec	1
Step-2 → Determination of other important factors.	
1) $\frac{S_a}{g} = 2.5$	
2) $Z = 0.24$	
3) $I = 1.5$	
4) $R = 5$	2

Answer/Solution	Marks
Step-3 → Determination of horizontal seismic co-efficient.	
$A_h = \frac{Z I S_a}{2 R g} = \frac{0.24 \times 1.5 \times 2.5}{2 \times 5}$	
$= 0.09$	4
Step 4 → Determination of design base shear.	
$V_B = A_h W$	
weight of 1st, 2nd & 3rd storey = 3000 KN	
weight of 4th storey = 2500 KN.	
∴ Total weight = (3000×3) + 2500	
= 11,500 KN	8
∴ $V_B = 11{,}500 \times 0.09$	
= 1035 KN	9
Step 6 → Distribution of equivalent lateral load	
$Q_1 = V_B \left[\frac{w_1 h_1^2}{w_1 h_1^2 + w_2 h_2^2 + w_3 h_3^2 + w_4 h_4^2} \right]$	
$= 1035 \left[\frac{3000 \times 3.5^2}{(3000 \times 3.5^2) + (3000 \times 7^2) + (3000 \times 10.5^2) + (2500 \times 14^2)} \right]$	
= ~~270 KN~~ 37.86 KN.	10

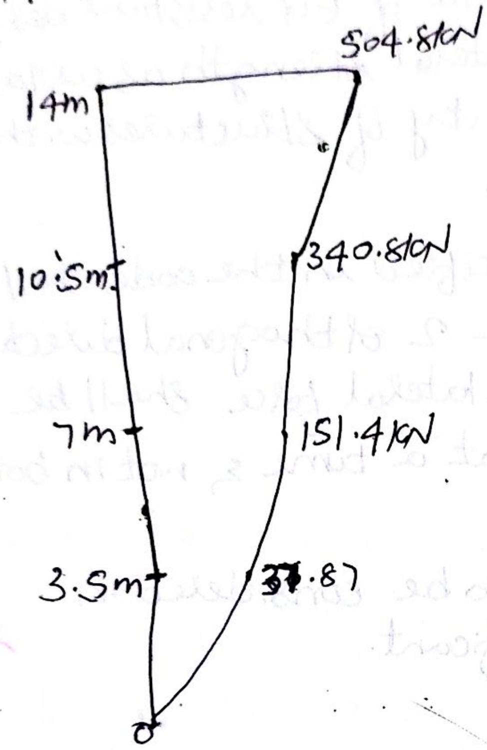
1004500 ~~110250~~ 1428375

Answer/Solution	Marks

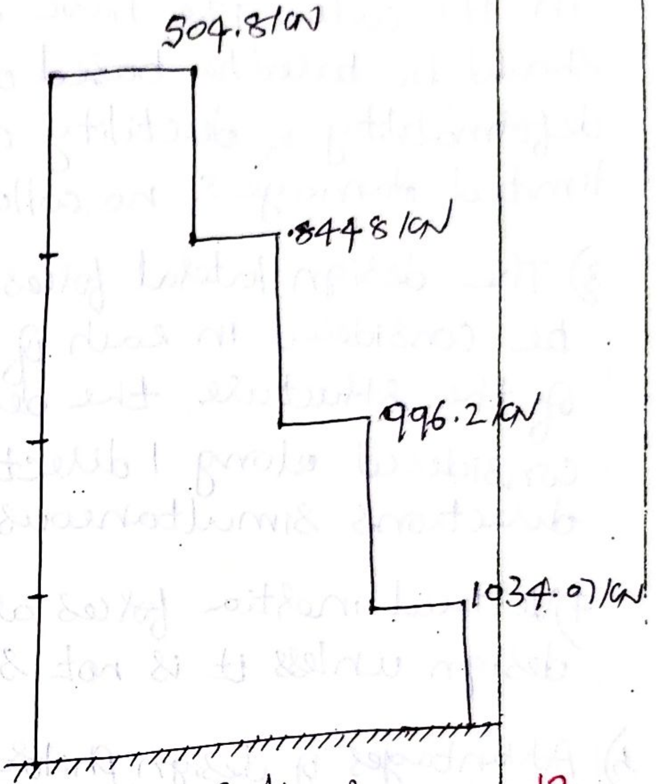
$Q_2 = 151.4\ kN$

$Q_3 = 340.8\ kN$

$Q_4 = 504.8\ kN.$



loading diagram



Shear diagram

12

4a) Seismic design philosophy

1) The design philosophy adapted in the code is to ensure that structure possess atleast a min strength to

a) Resist minor EQ, which may occur frequently without damage.

b) Resist moderate EQ without significant damage through some non-structural damage

Q.	Answer/Solution	Marks
	iii) Resist major EQ without damage.	
	2) Actual forces that appear on structures during EQ are much higher than the design forces that specified in the code. The basic criteria of EQ resistant design should be based be based on lateral strength as well as deformability & ductility capacity of structures with limited damage & no collapse.	
	3) The design lateral forces specified in the code shall be considered in each of the 2 orthogonal direction of the structure, the design lateral force shall be considered along 1 direction at a time & not in both directions simultaneously.	
	4) Vertical inertia forces are to be considered in design unless it is not significant.	6
b)	Advantages of design philosophy	
	1) After minor EQ the building will be fully operational within a short duration of time & retrofitting cost will be small.	
	2) After moderate EQ building will be functional once the retrofitting work of main members are over.	
	3) After strong EQ the building will be functional once the retrofitting work of main members is over.	3

Answer/Solution	Marks
Basic assumptions. 1) An EQ. causes impulsive ground motion which can be complex & irregular in character, with change in period & amplitude lasting for a small duration. 2) EQ is not likely to occur simultaneously with winds or powerful floods & sea waves 3) The value of elastic modulus of materials when ever required may be taken as the one used for static analysis, unless more definite value is availa-ble. 4) The values of modulus of elasticity for various construction materials display large variations.	7
5.a) Seismic analysis of most structures is still carried out on the assumption that the lateral force is equivalent to the actual loading. This method required less effort because shapes of mode of vibration are not required. The base shear is the total horizontal force on the structure is calculated on the basis of the structures mass & its fundamental period of vibration. the base shear is than distributed along the height of structure in terms of lateral forces.	3

).	Answer/Solution	Marks
	Assumptions 1) Assume structure is rigid. 2) Assume there is perfect fixity b/w structure & foundation 3) Every point of structure experience same accelera-tion during ground motion. b) Step 1 → Determination of natural period of Vibration Step 2 → Determination of other importance factors. $\frac{S_a}{g}$, R, I & Z Step 3 → Determination of horizontal seismic co-efficient Step 4 → Determination of design vertical seismic-co-efficient. Step 5 → Determination of design base shear. Step 6 → Distribution of equivalent lateral load	6

Q.	Answer/Solution	Marks
6	Step 1 → Determination of natural period. $T_a = \frac{0.09h}{\sqrt{d}} = \frac{0.09 \times (3.5 \times 4)}{\sqrt{10}} = 0.398$ sec	1
	Step 2 → Determination of other important factors. 1) $\frac{S_a}{g} = 2.5$ 2) $Z = 0.24$ 3) $I = 1$ 4) $R = 5$	3
	Step 3 → Determination of horizontal seismic co-efficient $A_h = \frac{Z I S_a}{2 R g} = 0.06$	4
	Step 4 → Determination of design base shear. $V_B = A_h W$ 1) wt of slab = 125 KN 2) wt of beam = 107.81 KN 3) D.L due to columns = 88.6 KN. 4) D.L due to wall = 682.5 KN. 5) L.L = $\frac{50}{100} \times 3.5 \times 10 \times 5$ = 87.5 KN loads on 1^{st}, 2^{nd}, & 3^{rd} floor = 1190.9 KN. load on roof floor = 618.36 KN.	9

Answer/Solution	Marks
Total Seismic weight = 4191.06 kN.	
$V_B = 0.06 \times 4191.06$ kN	
$= 251.4$ kN	1.0
Step 5 → Distribution of equivalent lateral load	
$Q = V_B \cdot \left[\dfrac{Q_i h_i^2}{Q_1 h_1^2 + Q_2 h_2^2 + Q_3 h_3^2 + Q_4 h_4^2} \right]$	
$Q_1 = 11.27$ kN	
$Q_2 = 45.08$ kN	
$Q_3 = 101.4$ kN	
$Q_4 = 93.65$ kN	13

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DEPARTMENT OF CIVIL ENGINEERING

VIII Semester (A & B SECTION) – III Internal Assessment Test

EARTHQUAKE RESISTANT DESIGN OF STRUCTURES (10 CV834)

Roll No: [ ][ ][ ]

USN: | 4 | A | L | | | C | V | | | |

Date: 29/05/2017 Timings: 3.00 PM – 4.30 PM Max.Marks:50

Note:

1) Answer any 2 full questions from part A & 1 from part B.
2) Missing data, if any, may be suitably assumed and indicated.
3) Answers should be specific and precise.
4) Draw neat sketches wherever necessary.
5) IS:1893-2002 (part-1) is permitted

PART – A

1. a. Explain the procedure for dynamic analysis with formulas. 10.0 marks

   b. What is dynamic analysis? 5 marks

2.a. A 4 storey building storey height is 3m, dead load/ unit area of the floor consisting of floor slab, finishing etc. is 4 kN/m^2, weight of the partitions on the floor can be assumed to be 2 kN/m^2. The intensity of live load on each floor is 3 kN/m^2 & on the roof is 1.5 kN/m^2. The beam size are 300 mm X 600 mm. the column size are 300 mm X 600 mm. the soil below the foundation is hard & the building is located in Delhi. Determine the seismic force at the different floor level & draw load diagram & shear diagram. (fig 2.a) 10.0 Marks

   b. What are reason for poor performance of masonry structure? 5 Marks

3.a Write the procedure for analysis of masonry structure. 5.0 Marks

   b. What are the failures in masonry structure? Explain any 2 failure. 10 Marks

PART -B

4 Determine the design seismic forces for 3 storey building with floor height of 3.5 m using dynamic analysis & show the distribution of lateral force along the height of the building. the building is OMRF, located on hard rock in zone V, I=1.5. consider the free vibrating properties given.

T_1=0.0647 sec, T_2=0.023 sec & T_3=0.016 sec.

W_1=688 kN, W_2=688 kN, W_3= 640 kN.

Storey level	Mode 1	Mode 2	Mode 3
First floor	1	1	1
Second floor	0.802	-0.565	-2.243
Third floor	0.445	-1.246	1.8018

20 Marks

5.a Determine the lateral force on 2 storey unreinforced brick masonry building situated in zone IV for following data.

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1)Plan size= 18X8 m
2)storey height =3.0 m
3)weight of roof=2.5 kN/m²
4)weight of wall=5 kN/m²
5)L.L on roof=0
6)L.L of floor=1 kN/m²
7)response reduction factor=1.5 — 14 Marks
8) consider medium soil type & 7% damping.

b. What are the concepts for earthquake resistance masonry building as per codal provision? — 6 Marks

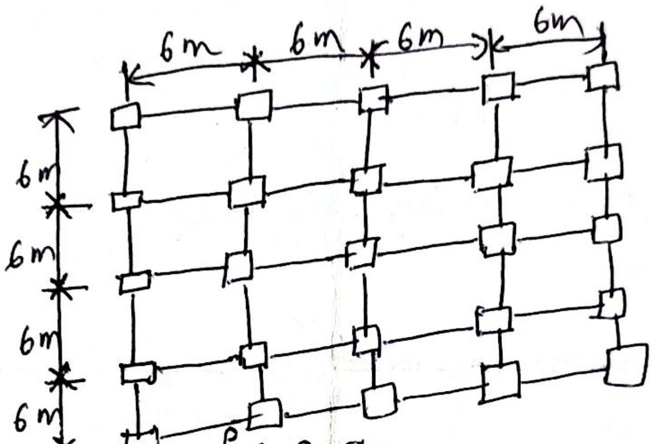

fig 2-a

(1)

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DEPARTMENT OF CIVIL ENGINEERING

SCHEME OF EVALUATION

Subject Title: Earthquake Resistant Design of Structures

Subject code: 10CV834

Q.NO	Description of Answers	Marks
1a)	1) Determination of important factors. 2) Determination of seismic weight of the structure 3) Developing mass [m] & stiffness [K] matrix of the building using system of masses lumped at the floor levels. with each mass having 1 degree of freedom. 4) Determination of modal frequencies ω_n & mode shapes ϕ using [m] & [K] 5) Determination of modal mass M_K, $M_K = \frac{\left[\sum_{i=1}^{n} w_i \phi_{ik}\right]^2}{g \sum_{i=1}^{n} w_i \phi_{ik}^2}$ 6) Determination of modal participation factor P_K of mode K. $P_K = \frac{\sum_{i=1}^{n} w_i \phi_{ik}}{\sum_{i=1}^{n} w_i \phi_{ik}^2}$ 7) calculate design forces at each floor in each mode $Q_{ik} = A_{h(k)} \phi_{ik} P_K w_i$ 8) Calculate storey shear forces in each mode $V_{ik} = \sum_{i+1}^{n} Q_{ik}$ 9) calculate shear forces due to all modes considered.	

Q.NO	Description of Answers	Marks
	1c) Determination of design lateral forces at each storey, $F_i = V_i - V_{i+1}$	10
1.b)	Dynamic analysis shall be performed to obtain design seismic force & its distribution to different levels along the height of the building & to the various lateral load resisting elements for the following buildings.	
	1) Regular buildings → those greater than 40m in height in zone IV & those greater than 90m in height in zone II & III	2.5
	2) Irregular buildings → All framed buildings higher than 12m in zones IV & V & those greater than 40m height in zone II & III.	
	The dynamic analysis may be performed by response spectrum method or time history method, the design base shear V_B shall be compared with a base shear $\bar{V}_B$ calculated using fundamental time period T_a, when V_B is less than $\bar{V}_B$ all the response quantities like member forces, displacement, storey shear shall be multiplied by ratio $\bar{V}_B/V_B$	5

Q. No.	Answer/Solution	Marks
2.a)	$I = 1$ $R = 3$ $Z = 0.24$ $T_a = 0.075 h^{0.75}$ $= 0.075 \times 12^{0.75}$ $= 0.4835$ sec $\frac{S_a}{g} = 2.068 \approx 2.07$	2
	Equivalent load on each floor:- ~~Seismic weight~~ Seismic weight 1) DL of slab = $4(24 \times 24) = 2304$ kN 2) DL of partitions = $2 \times (24 \times 24) = 1152$ kN 3) wt of column = $(0.3 \times 0.6 \times 5) \times 25 \times 25 = 337.5$ kN 4) wt of beams = $(0.3 \times 0.6 \times 24) \times 25 \times 20 = 1080$ kN Total wt of structure = 4873.5 kN. $V = \left[\frac{0.24}{2} \times \frac{1}{3} \times 2.07\right] \times 19471$	6

$= \underline{1612.19 \text{ kN}}$

Answer/Solution	Marks

Equivalent load on each floor $= 4873.5 + 0.25 \times 3 \times 24 \times 24$

$= 5305.5\,kN \approx 5306\,kN$

Equivalent load on roof $= 2304 + 1080 + \frac{337.5}{2}$

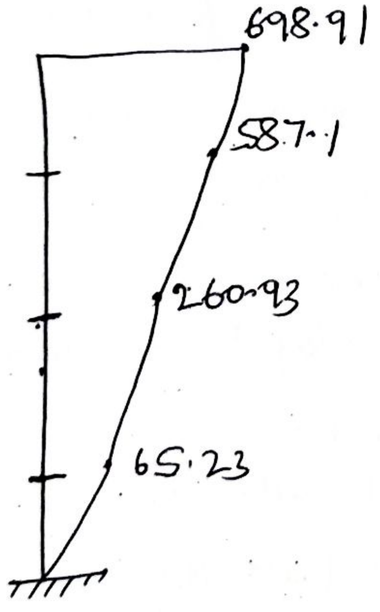
$= 3352.75 \approx 3553\,kN$

$\therefore$ Total load $= W = 19471\,kN$ — 7

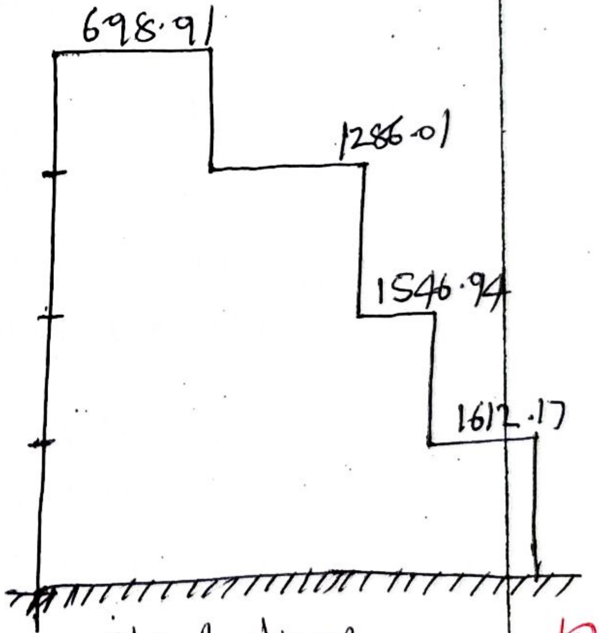
$$Q_1 = \frac{5306 \times 3^2 \times 1612.1}{(5306 \times 3^2) + (5306 \times 6^2) + (5306 \times 9^2) + (3553 \times 12^2)}$$

$Q_1 = 65.23\,kN$ $\quad Q_3 = 587.1\,kN$

$Q_2 = 260.93\,kN$ $\quad Q_4 = 698.91\,kN$ — 8



loading diagram



shear diagram — 10

Answer/Solution	Marks
2.b) 1) The matelial itself is blittle & its stlength deg-ladation due to load lepetition is sevele. 2) Masonly has gleat weight because of thick walls, lesulting in mole inertial folces. 3) No tensile & sheal stlength in moltal. 4) Implopel masonly bonds. 5) lalg slendelness.	5
3.a) Step1 → Detelmination of latelal load based on IS-1893-2002 (Palt-I) Step2 → Distlibution of latelal folces on the basis of flexibility of diaphlagms. Step3 → Detelmination of ligidity of sheal wall by considering the opening. Step4 → Detelmination of dilect sheal folce & tolsional sheal folces in sheal walls. Step5 → Detelmination of inclease in axial load in piels due to over turning. Step6 → check the stability of flexule wall fol out of plane folces.	5

Q. No.	Answer/Solution	Marks
3b)	The type of construction, site of construction, structural typology of masonry building values in different regions. but the damage caused by seismic activities may be identified as uniform. 1) out of plane failure 2) In-plane failure 3) Diaphragm failure 4) Failure of connection 5) Non-structural component failure 6) Pounding.	2
	1. Diaphragm failure → The failure of the diaphragm is a rare phenomenon in the event of seismic motion. Damage to diaphragm never impairs its gravity load carrying capacity. lack of tension anchoring produces a non-bending cantilever action at the base of the wall, resulting from the push of diaphragm against the wall. The inplane rotation of the diaphragm ends & the absence of a good shear transfer b/w diaphragm & reaction walls account for the damage at corner of the wall. This problem is very rare in anchored buildings.	6

).	Answer/Solution	Marks
	$P_1 = \frac{1497.936}{1218.765} = 1.229$ $P_2 = \frac{-599.088}{1920.05} = 0.312$ $P_3 = \frac{333.70}{6347.29} = 0.053$	8
	Step 3 → Modal contribution. $M = 208.35$ $\frac{M_1}{M} = 90\%$ $\frac{M_2}{M} = 9.13\%$ $\frac{M_3}{M} = 0.86\%$	12
	Step 4 → lateral forces. $Q_{ik} = A_{hk} \phi_{ik} P_k w_i$ $Q_{11} = 139.57$ kN $Q_{21} = 120.33$ kN	

Answer/Solution	Marks
$q_{31} = 66.76$ kN $q_{12} = -24.16$ kN $q_{22} = 14.41$ kN $q_{32} = 32.36$ kN $q_{13} = 3.8$ kN $q_{23} = -9.18$ kN. $q_{33} = 7.33$ kN.	16
Shear force $V_{11} = 139.57$ kN $V_{12} = -24.16$ kN $V_{21} = 259.9$ kN $V_{22} = -9.74$ kN $V_{31} = 326.67$ kN $V_{32} = 22.62$ kN $V_{13} = 3.8$ kN $V_{23} = -5.74$ kN $V_{33} = -12.62$ kN.	
Combined shear $V_1 = 141.7$ kN $V_2 = 260.14$ kN $V_3 = 327.7$ kN	20

Q.	Answer/Solution	Marks
5a)	$T = \frac{0.09\,h}{\sqrt{d}}$ $= \frac{0.09 \times 6}{\sqrt{18}} = 0.127\ sec$ From fig 2, $\frac{S_a}{g} = 2.5$ $\frac{S_a}{g} = 2.5$ for 5% damping For 7% damping, from table-3 $\frac{S_a}{g} = 0.9 \times 2.5$ $= 2.25$ Z = 0.16 (Zone III) $A_h = \frac{Z I S_a}{2 R g}$ $= \frac{0.16 \times 1}{2 \times 1.5} \times 2.25$ $A_h = 0.12$ <u>Seismic weight</u> Seismic weight of 1st floor = [wt of roof + wt of wall + L.L] <u>wt</u> of roof = 18 × 8 × 2.5 = 360 kN	2 3 4

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DEPARTMENT OF CIVIL ENGINEERING

SCHEME OF EVALUATION

Subject Title:

Subject code:

Q.NO	Description of Answers	Marks
	wt of wall = (18 × 3 × 5 × 2) + (8 × 3 × 5 × 2) = 780 kN.	
	L.L = $\frac{25}{100}$ × 1 × 18 × 8 = 36 kN.	6
	Seismic wt of roof slab = [wt of roof + wt of wall + LL]	
	wt of roof = 18 × 8 × 25 = 360 kN.	
	wt of walls = 780/2 = 390 kN	
	L.L = 0	8
	Total weight of 1st floor = 780 + 360 + 36 = 1176 kN	
	Total weight of roof = 360 + 390 = 750 kN.	
	∴ Total seismic wt of building = 1926 kN	
	V_B = 0.12 × 1926 = 231.12 kN.	10

ALVA'S INSTITUTE OF ENGINEERING AND TECHNOLOGY: MIJAR, MOODBIDRI

DEPARTMENT OF CIVIL ENGINEERING

SCHEME OF EVALUATION

Subject Title: Subject code:

Q.NO	Description of Answers	Marks
	lateral force at 1st floor, $Q_1 = 231.12 \left[\frac{1176 \times 3^2}{(1176 \times 3^2)+(750 \times 6^2)}\right]$ $Q_1 = 65.08$ kN	12
	lateral force at roof $Q_2 = 231.12 \left[\frac{750 \times 6^2}{(1176 \times 3^2)+(750 \times 6^2)}\right]$ $Q_2 = 166.03$ kN	14
5.b)	1) Building should be light in weight, particularly roof & upper stories 2) Avoid close proximity, use seperation 3) use seperated staircase, otherwise enclose that within rigid walls. If not possible use sliding joint. 4) cement - sand (1:6) & lime - sand (1:3) for good quality stone masonry. 5) min wall thickness of 230mm in single storey & thickness of 350mm in bottom stories. 6) wall should be checked in flexural as a plate or as a vertical strip.	6

Page No:

AIET	Lesson Plan & Execution	Format No. Issue No. Rev. No.	ACD 08 01 00

Name of the faculty	Nikhil. N
Semester and Section	8th Sem A & B Section
Date of Commencement	13-2-2017
Last Working Day of the Semester	2-6-2017
Source Materials List	

1. Earthquake resistant design of structures - pankaj Agarwal
2. Earthquake resistant design of structures - S.K. Duggal.
3. Earthquake resistant design - Anil chopra
4. Earthquake Engineering damage assessment - S.F Borg
5. I.S - 1893 - 2002.

Subject Name: Earthquake Resistant Design of structures - 10CV834

Period	Plan			Execution		
	Date	Topics to be covered	Source Material needed	Topics Covered	Date	Source Material Referred
1	13/2/17	Earthquake ground motion, Engineering seismology.	1 2 3	covered	13/2/17	1 2 3
2	15/2/17	Theory of plates tectonics,	1 2 3	covered	15/2/17	1 2 3
3	17/2/17	seismic waves, magnitude & Intensity of earthquake.	1 2 3	covered	17/2/17	1 2 3
4	18/2/17	local site effects.	1 2 3	covered	18/2/17	1 2 3

Period	Plan			Execution		
	Date	Topics to be covered	Source Material needed	Topics Covered	Date	Source Material Referred
5	20/2/17	Seismic zoning map of India	1 2 3	covered	25/2/17	1 2 3
6	22/2/17	Problems	1 2 3	covered	1/3/17	1 2 3
7	23/2/17	Seismic design Parameters.	2 3 4	covered	3/3/17	1 2 3
8	25/2/17	Types of earthquakes; earthquake ground motion characteristic	2 3 4	covered	4/3/17	1 2 3
9	1/3/17	Respons spectra	2 3 4	covered	6/3/17	1 2 3
10	3/3/17	Design spectrum	2 3 4	covered	10/3/17	2 3 4
11	4/3/17	problems	2 3 4	covered	11/3/17	2 3 4
12	6/3/17	Problems.	2 3 4	covered	13/3/17	2 3 4
13	8/3/17	Structural modelling.	3 4	covered	15/3/17	3 4
14	10/3/17	Code based seismic design methods.	3 4	covered	18/3/17	3 4
15	11/3/17	Response control concepts.	3 4.	covered	20/3/17	3 4
16	13/3/17	Seismic evaluation.	3 4	covered	22/3/17	3 4
17	15/3/17	Retrofitting methods	3 4	covered	31/3/17	3 4

Period	Plan			Execution		
	Date	Topics to be covered	Source Material needed	Topics Covered	Date	Source Material Referred
18	17/3/17	Retrofitting me-thods.	3 4	covered	1/4/17	3 4
19	18/3/17	Effect of struct-ural irregulari-ties on seismic Performance	1 2 3	covered	5/4/17	3 4
20	20/3/17	Vertical irregu-larity	1 2 3	covered	10/4/17	2 3
21	22/3/17	Plan configurati-on problems.	1 2 3	covered	15/4/17	2 3
22	27/3/17	Seismo resistant building architec-ture	1 2 3	covered	17/4/17	2 3
23	30/3/17	lateral load resistant system	1 2 3	covered	19/4/17	2 3
24	3/4/17	Building charact-eristics.	1 2 3	covered	19/4/17	2 3
25	5/4/17	Seismic design philosophy, determ-ination of design lateral forces.	3 4 5	covered	20/4/17	2 3
26	8/4/17	Equivalent later-al force procedure & dynamic analys-is procedure.	3 4 5	covered	21/4/17	2 3
27	10/4/17	Problems	3 4 5	covered	22/4/17	2 3
28	12/4/17	Problems	3 4 5	covered	24/4/17	2 3
29	15/4/17	Problems	3 4 5	covered	26/4/17	2 3
30	17/4/17	Problems.	3 4 5	covered	27/4/17	

27/4

Period	Plan			Execution		
	Date	Topics to be covered	Source Material needed	Topics Covered	Date	Source Material Referred
31	19/4/17	Problems	3 4 5	covered	3/5/17	2 3
32	21/4/17	Problems.	3 4 5	covered	10/5/17	2 3
33	22/4/17	Step by step proce-dure for seismic analysis of R.C buil-dings.	3 4 5	covered	15/5/17	2 3
34	24/4/17	Equivalent static lateral force & responce spectrum methods.	3 4 5	covered	17/5/17	2 3
35	26/4/17	Problems	3 4 5	covered	17/5/17	3 4 5
36	3/5/17	Problems	3 4 5	covered	18/5/17	3 4 5
37	8/5/17	Problems	3 4 5	covered	18/5/17	3 4 5
38	10/5/17	Problems	3 4 5	covered	22/5/17	3 4 5
39	12/5/17	Problems.	3 4 5	covered	22/5/17	3 4 5
40	15/5/17	Earthquake resist-ant analysis & design of RC buildings	3 4 5	covered	24/5/17	3 4
41	17/5/17	load combination analysis & design of subframes.	3 4 5	covered	24/5/17	3 4
42	19/5/17	Problems	3 4 5	covered	25/5/17	3 4
43	20/5/17	Problems	3 4 5	covered	29/5/17	3 4

Period	Plan			Execution		
	Date	Topics to be covered	Source Material needed	Topics Covered	Date	Source Material Referred
44	26/5/17	Problems	3 4 5	Covered	31/5/17	3 4
45	27/5/17	Problems	3 4 5	covered	31/5/17	3 4
46	29/5/17	Problems	3 4 5	I. A	1/6/17	3 4
47	29/5/17	Earthquake resistant design of masonry building - elastic properties	3 4 5	covered	1/6/17	4 5
48	29/5/17	lateral load analysis, Design procedure of masonry building.	3 4 5	covered	1/6/17	4 5
49	31/5/17	Problems	3 4 5	covered	1/6/17	3 5
50	31/5/17	Problems	3 4 5	covered	2/6/17	3 5
51	31/5/17	Problems	3 4 5	covered	2/6/17	3 5
52	2/6/17	Problems.	3 4 5	covered	2/6/17	3 5
				13/06/2017		

Others	Planned	Actual	Remarks :
Special Classes	4	4	
Tutorials			
Assignments	3	2	
Seminars			
IA Tests	3	3	
Portions Covered in the entire Semester	Full 100%		

Course Effectiveness			
Students Feedback			
Students Responce			
Result	No. of Students AP	No. of Students Passed	% of Result

Faculty in Charge

HOD's Signature 16/06/2017

Signature of Principal (& Remarks if any)

ALVA'S INSTITUTE OF ENGINEERING AND TECHNOLOGY

MIJAR, MOODBIDRI - 574 225

ATTENDANCE CUM INTERNAL

Class : 8th Sem A & B section

Subject : ERDS

No. of Classes held : 52

Subject : ERDS

Sl. No.	U.S.N.	Name	1 (13/2)	2 (15/2)	3 (17/2)	4 (18/2)	5 (25/2)	6 (1/3)	7 (3/3)	8 (4/3)	9 (6/3)	10 (10/3)	11 (11/3)	12 (13/3)	13 (15/3)	14 (18/3)	15 (24/3)
1	4AL13CV001	Abhilash	1	2	3	4	5	A	6	7	8	9	10	11	A	A	A (M.C)
2	4AL13CV015	Ambili. M.P	1	2	3	A	4	5	6	7	8	9	10	11	12	13	14
3	4AL13CV026	Basanagouda. B	1	2	3	A	4	5	6	7	8	9	10	11	12	13	14
4	4AL13CV039	Harikesh. S.P	1	2	3	4	A	5	6	7	8	9	10	11	12	13	14
5	4AL13CV040	Harshith. A.S	1	A	2	3	4	5	6	A	A	7	8	9	10	A	A
6	4AL13CV050	Manjunatha. V	1	2	3	4	5	A	6	7	8	A	9	10	11	12	13
7	4AL13CV065	Pranil Kumar.	1	2	3	4	A	5	A (MC)	A (MC)	A (MC)	A (MC)	A (MC)	A (MC)	A (MC)	6	7
8	4AL13CV078	Sachin Sindageli	1	2	3	4	5	6	7	8	9	10	11	12	13	A	14
9	4AL13CV083	Sangmesh	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
10	4AL13CV085	Santosh Kamble	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
11	4AL13CV086	Sarfraz ali	1	2	3	4	A	5	6	7	8	9	10	11	12	13	14
12	4AL13CV089	Shashikanth	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
13	4AL13CV099	Sreeraj Pillai	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
14	4AL13CV103	Thokchom Satish K	1	2	3	A	4	5	6	7	8	9	10	11	12	13	14
15	4AL13CV107	Vijaya Reddy	1	2	3	4	5	6	7	8	A	9	10	11	12	13	14
16	4AL13CV115	Hemanth Kumar. K.R	1	2	3	A	4	5	6	7	8	9	10	11	12	13	A
17	4AL13CV116	Jithin. P	1	2	3	4	5	6	7	8	9	10	11	17	13	14	15
18	4AL13CV124	Sneha. K	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
19	4AL13CV125	Shins T Wilson	1	2	3	A	4	5	6	7	8	9	10	1P	12	13	14
20	4AL14CV401	C. Manjunatha	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
21	4AL14CV402	Gurubasavaraj. M	1	2	3	A	4	5	6	7	8	9	10	11	12	13	14
22	4AL14CV407	Kalakaleshwarayya	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
23	4AL14CV408	Kiran. M.L	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
24	4AL14CV409	Lakkappa	1	2	3	4	5	6	7	A	A	8	9	10	11	12	13
25	4AL14CV410	Lohith V	1	2	A	3	4	5	6	7	8	9	10	11	12	13	14
26	4AL14CV411	Mahendra S Pujali	1	A	2	3	4	5	6	7	8	9	10	11	12	13	14
27	4AL14CV412	Manjunath Gaudar	1	2	3	A	4	5	6	7	8	9	10	11	12	13	14
28	4AL14CV413	Manjunath Panchamukhi	1	2	3	4	A	5	6	7	8	9	10	11	12	13	14
29	4AL14CV417	Praveen Kumar. B.M	1	2	A	3	4	5	6	7	8	9	10	11	12	13	14
30	4AL14CV418	Ravi Kiran S	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Staff Initials																	

Sl. No.	16 (25/3)	17 (31/3)	18 (1/4)	19 (5/4)	20 (10/4)	21 (15/4)	22 (17/4)	23 (19/4)	24 (19/4)	25 (20/4)	26 (21/4)	27 (22/4)	28 (24/4)	29 (26/4)	30 (27/4)	Students Attendence Conducted 48	60	No. of Class Attended	% of Attendance	Internal Assessment (25) I	II	III	Average Marks
1	A (MC)	12	13	14	15	A (MC)	A (MC)	16	17	18	19	20	21	22	23			47	90	AB	23	19	21
2	15	16	17	18	19	A	20	21	22	23	24	25	26	27	28			49	94	23	21	AB	22
3	15	16	17	18	19	A	20	21	22	23	24	25	26	27	28			44	85	15	25	25	25
4	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29			51	98	18	19	19	19
5	11	12	13	14	15	A	16	17	18	19	20	21	22	23	24			46	88	14	20	18	19
6	14	15	16	A	17	A	18	19	20	21	22	23	24	25	26			48	92	20	25	AB	23
7	8	9	10	11	A	12	13	14	15	A (MC)	A (MC)	A (MC)	A (MC)	A (MC)	A (MC)			50	96	17	AB	20	19
8	+	15	16	17	18	A	19	20	21	22	23	24	25	26	27			49	94	5	18	18	18
9	6	A	17	18	19	A	20	21	22	23	24	25	26	27	28			49	94	25	24	AB	25
10	6	17	A	A	18	19	20	21	22	23	24	25	26	27	28			47	90	18	19	AB	19
11	5	16	17	18	19	20	A	21	22	23	A	24	25	26	27			48	92	17	20	20	20
12	6	17	18	A	19	A	20	21	22	23	A	24	25	26	27			48	92	11	18	23	21
13	6	17	18	19	A	A	A	20	21	22	23	24	25	26	27			48	92	17	20	17	19
14	5	16	17	A	18	A	A	A	A	19	20	21	22	23	A			45	86	11	AB	20	16
15	5	16	17	A	18	19	20	21	22	23	24	25	26	27	28			46	88	16	19	24	22
16	4	15	16	17	18	19	20	21	22	23	24	25	26	27	28			48	92	21	23	AB	22
17	[illegible]	17	18	19	20	A	21	22	23	24	25	26	27	28	29			47	90	9	16	20	18
18	6	17	18	19	20	A	21	22	23	24	A	25	26	27	28			47	90	18	22	25	24
19	[illegible]	16	17	18	19	A	A	20	21	22	23	24	25	26	27			48	92	20	22	22	22
20	[illegible]	16	17	A	18	A	A	19	20	21	22	23	24	25	26			47	92	1	15	21	18
21	5	16	17	18	19	A	20	21	22	23	A	24	25	A	26			47	92	11	21	AB	16
22	6	A	17	18	A	A	19	20	21	22	A	23	24	25	26			47	92	3	21	18	20
23	6	17	18	A	19	20	A	21	22	23	24	25	A	A	26			47	92	11	0	23	17
24	4	15	16	17	A	A	18	19	20	21	22	23	24	25	26			48	92	8	20	20	20
25	5	A	16	A	17	18	19	20	21	22	23	24	25	26	27			48	92	13	20	23	22
26	5	16	17	18	19	20	21	22	23	24	A	25	26	27	28			49	94	21	24	AB	23
27	[illegible]	A	16	17	18	A	19	20	21	22	23	24	25	A	26			47	92	6	19	19	19
28	5	A	A	16	17	A	18	19	20	21	22	23	24	A	25			46	88	15	20	20	20
29	5	16	17	18	19	20	21	22	23	24	25	26	27	28	29			45	86	7	21	22	22
30	[illegible]	17	18	19	20	A	21	22	23	24	25	26	27	28	29			49	94	11	22	16	19
Staff Initials																							

20/3/17

2/4

ALVA'S INSTITUTE OF ENGINEERING AND TECHNOLOGY

MIJAR, MOODBIDRI - 574 225

ATTENDANCE CUM INTERNAL

Class : 8th sem A & B Sec

Subject : ERDS

No. of Classes held : 52

Subject : ERDS

Sl. No.	U.S.N.	Name	1 (13/2)	2 (15/2)	3 (17/2)	4 (18/2)	5 (25/2)	6 (1/3)	7 (3/3)	8 (4/3)	9 (6/3)	10 (10/3)	11 (11/3)	12 (13/3)	13 (15/3)	14 (18/3)	15 (20/3)
1	4AL14CV419	Salim Pasha	1	2	3	4	5	6	7	A	A	8	9	10	11	12	13
2	4AL14CV421	Shankar Badiger	1	2	3	4	A	5	6	7	8	9	9	10	11	12	13
3	4AL14CV422	Shiva Kumar. G	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
4	4AL14CV424	Shravan Kumar. S	1	2	3	A	4	5	6	A	A	7	8	9	10	11	12
5	4AL14CV428	Vasanth Kumar. R.S	1	2	3	A	A	4	5	6	7	8	9	10	11	12	13
6	4AL14CV430	Vinay Kumar	1	A	2	3	A	4	5	6	7	8	9	10	11	12	13
7	4AL14CV432	Vinay. K.Y	1	A	2	A	4	5	6	7	8	9	10	11	12	13	14
8																	
9																	
10																	
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29																	
30																	
Staff Initials																	

Sl. No.	16 (24/3)	17 (31/3)	18 (1/4)	19 (5/4)	20 (10/4)	21 (15/4)	22 (17/4)	23 (19/4)	24 (19/4)	25 (20/4)	26 (21/4)	27 (22/4)	28 (24/4)	29 (26/4)	30 (27/4)	Students attendence conducted 48	60	No. of Class Attended	% of Attendance	Internal Assessment (25) I	II	III	Average Marks
1	4	15	A	16	A	A	17	18	19	20	21	22	23	24	25			46	88	11	19	18	19
2	4	A	A	15	16	A	17	18	19	20	A	21	22	A	23			44	85	8	15	20	18
3	6	17	18	19	20	A	21	22	23	24	25	26	27	28	29			49	94	8	16	24	20
4	3	14	15	16	A	A	17	18	A	20	21	22	23	A	24			41	79	7	19	24	22
5	4	15	16	A	17	A	A	18	19	20	21	22	23	A	24			46	88	19	16	25	22
6	4	15	A	16	17	18	19	20	21	22	23	24	25	A	26			47	90	15	22	AB	19
7	5	A	A	A	16	17	18	19	20	21	22	23	24	25	26			48	92	17	24	AB	21

AIET	ASSIGNMENTS	Format No.	ACD 10
		Issue No.	01
		Rev. No.	00
		Academic Year	2017
Department	Civil Engineering	Semester	8th A & B

Sl.No.	Title	Books / Journals / Magazines referred	Date of Announcement	Date of Submission	Signature of the faculty
1	Response Spectrum		20/3/17	29/3/17	[signature]
2	Seismic co-eff - cient method		1/4/17	8/4/17	[signature]

AIET	INTERNAL EXAM RESULT ANALYSIS	Format No.	ACD 12
		Issue No.	01
		Rev. No.	00
Department	Civil Engineering	Semester	8th Sem A & B Sec
		Subject Code	10CV834
Total No. of Students	37	Academic Year	2017

Test	Date	Number of Students				Signature		Remarks
		Attended	0-14	15-20	21-25	Faculty	HOD	
T_1	24/3/17	36	18	15	3	[signature]	[signature]	
T_2	27/4/17	35	1	18	16	[signature]	[signature]	
T_3	29/5/17	28	0	16	12	[signature]	[signature]	
T_4								
T_5								

Signature of Staff in - charge [signature]

HOD's Signature [signature] 16/09/2017

USN | | | | | | | | | | |

06CV834

Eighth Semester B.E. Degree Examination, June/July 2013
Earthquake Resistant Design of Structures

Time: 3 hrs. Max. Marks:100

Note: *1. Answer FIVE full questions, selecting at least TWO questions from each part.*
2. Use of IS-1893, IS-13920 and SP-16 are permitted.

PART – A

1 a. Differentiate between magnitude and intensity of earthquake. Explain briefly first five intensities of earthquakes. **(10 Marks)**

b. Explain seismic zones of India, their characteristics and basis on which the seismic zoning is done. **(10 Marks)**

2 a. Explain principal ground motion (strong motion) characteristics. **(10 Marks)**

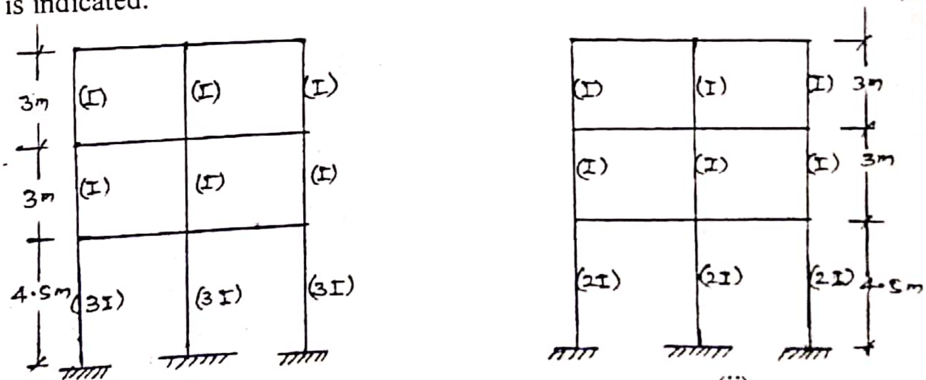
b. Differentiate between response history and response spectrum. Explain with diagrams. On what factors, the response acceleration (s_a/g) depends. **(10 Marks)**

3 a. What are the requirements of building structures for good earthquake resistance? **(10 Marks)**

b. Explain response control concepts (damping and base isolation) in earthquake resistant design of building structures. **(10 Marks)**

4 a. Explain the plan irregularity (configuration) problems when does torsional irregularity occurs. **(10 Marks)**

b. For the moment resistant frames idealized as shear buildings, investigate the building structures shown in Fig.Q.4(b)(i) and (ii) has soft storey or extreme soft storey. MI of each column is indicated. **(10 Marks)**



(i) (ii)

Fig.Q.4(b)

PART – B

5 a. What are the seismic and structural parameters influencing the horizontal seismic acceleration coefficient, A_h. Explain in detail. **(10 Marks)**

b. For the residential RCC (special moment resisting frame, SMRF) building shown in Fig.Q.5(b). Compute the seismic forces by equivalent static procedure. Building is founded on hard soil (rock) and situated in zone IV. Given: W_1 = 294.3 kN, W_2 = 1863.9 kN, W_3 = 1079.1 kN. **(10 Marks)**

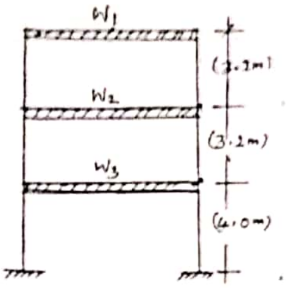


Fig.Q.5(b)

6 a. What are the different load combinations to be accounted for in the seismic design of RC structures, as per IS-1893? **(05 Marks)**

b. For the residential, RCC (special moment resisting frame, SMRF) building shown in Fig.Q.6(b). Compute the seismic forces by dynamic analysis (response spectrum) procedure. The building is founded on hard soil (rock) and situated in zone IV. Given: the free vibration results. The frequencies W_1 = 10.035 rad/s, W_2 = 40.347 rad/s and W_3 = 64.148 rad/s.

Modes: $\{\phi\}_1$ = {1.00 0.970 0.760}

$\{\phi\}_2$ = {1.00 0.511 -1.311}

$\{\phi\}_3$ = {1.00 -0.235 0.075} **(15 Marks)**

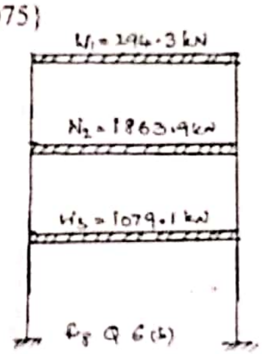


Fig.Q.6(b)

7 a. Explain the importance of confinement of concrete for ductility. What are the provision for special confining reinforcement in Indian standard? **(10 Marks)**

b. Design and detail the beam conforming to ductile detailing provisions of IS-13920 for flexure only (design for shear not required).

The max forces in beam AB are given below.

Maximum bending moment, at A = (+ 280 kNm and -369 kNm)

Maximum bending moment, at B = (+ 236 kNm and -371 kNm)

Maximum bending moment at centre = 65 kNm.

Use M20, Fe415, **(10 Marks)**

8 a. What is slenderness of the masonry wall? What are the measures to improve the slenderness of masonry walls? **(10 Marks)**

b. What are the different failure modes of masonry structures? Explain with sketches. **(10 Marks)**

* * * * *

USN | | | | | | | | | | |

10CV834

Eighth Semester B.E. Degree Examination, June/July 2015
Earthquake Resistant Design of Structures

Time: 3 hrs. Max. Marks:100

Note: 1. *Answer FIVE full questions, selecting at least TWO questions from each part.*
2. *Use of IS1893-2002 permitted.*

PART – A

1 a. Explain the earth and its interior. (06 Marks)
b. What is the plate tectonics? What are the major tectonic plates on the earth's surface? (06 Marks)
c. Compare the seismic waves in terms of particle motion, typical velocity and other characteristics. (08 Marks)

2 a. Explain the different earthquake ground motion characteristics. (06 Marks)
b. What is response spectra? Explain design spectrum and its different regions. (06 Marks)
c. Explain the construction procedure of elastic and inelastic design spectrum. (08 Marks)

3 a. Explain the different structural modellings. (06 Marks)
b. Explain the code-based methods for seismic design. (06 Marks)
c. What are the earthquake protective systems? Explain any one control device in detail. (08 Marks)

4 a. Explain the different vertical irregularities. (06 Marks)
b. What are the major aspects involved in seismo resistant building constructions and explain lateral load resisting systems. (06 Marks)
c. Explain building configuration problems and solutions. (08 Marks)

PART – B

5 A four story reinforced concrete for hospital building is situated in Zone-IV. The heights between the floors is 3 m and total height of building is 12 m. The total lumped load on roof floor is 2500 kN and total lumped loads on First, Second and Third floor is 3000 kN each. The soil below the foundation is to be hard rock. Determine the total base shear and horizontal lateral forces on each floors as per IS: 1893-2002 codal provisions. (20 Marks)

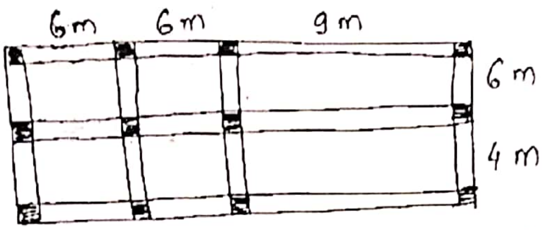
6 For the 3-storey RCC (special moment resisting frame with importance factor = 1) building frame founded on soft soil and situated in zone – V. Determine the seismic forces by dynamic analysis procedure for the following data:
$\omega_3(\text{roof}) = 392\text{kN}$, $\omega_2 = 784\text{kN}$, $\omega_1 = 1568\text{kN}$
The mode shapes and natural periods are, (20 Marks)

Natural period (Second)	Mode-1	Mode-2	Mode-3
	0.883	0.404	0.302
	Mode shapes		
Roof	1	1.0	1.00
Second floor	0.791	0.00	– 0.791
First floor	0.250	–1.00	0.250

7 a. What are the different load combinations as per 1893-2002 to be used for seismic analysis of RCC-buildings. (05 Marks)

b. What are the steps involved in analysis and design of sub-frames? (05 Marks)

c. The plan of a simple one-storeyed building as shown in Fig. Q7 (c). All the columns have the same dimensions and hence the same cross-sectional area. Obtain the centre of stiffness. (10 Marks)



Plan of Building
Fig. Q7 (c)

8 a. Explain the elastic properties of masonary. (06 Marks)

b. Determine the lateral forces on a two-storey unreinforced brick masonary buildings situated in zone-III for the following data:
Plan size = $18\text{m} \times 8\text{m}$
Total height of building = 6.2 m
Storey height = 3.1 m
Weight of roof = 2.5 kN/m^2
Weight of wall = 5 kN/m^2
Live load on roof = 0
Live load on floor = 1 kN/m^2
Response reduction factor = 1.5
Consider, medium soil type. (14 Marks)

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10CV834

Eighth Semester B.E. Degree Examination, June/July 2016
Earthquake Resistant Design of Structures

Time: 3 hrs. Max. Marks: 100

Note: *1. Answer any FIVE full questions, selecting atleast TWO questions from each part.*
2. Use of 1893 – 2002 is permitted.

PART – A

1 a. Explain the seismic zoning of India and the basis on which the seismic zoning is done. **(10 Marks)**
b. Explain the difference between magnitude and intensity of an earthquake. **(10 Marks)**

2 a. Explain the principal ground motion (strong motion) characteristics. **(10 Marks)**
b. Differentiate between response history and response spectrum. Explain with diagrams what factors, the response acceleration $\left(\frac{Sa}{g}\right)$ depends. **(10 Marks)**

3 a. What are the requirements of building structures for good earthquake resistance? **(10 Marks)**
b. What are the different seismic retrofitting techniques? Explain in detail. **(10 Marks)**

4 a. Explain the vertical irregularity (configuration) problems. When does torsional irregularity occurs? **(10 Marks)**
b. A building having a non –uniform distribution of mass is shown in Fig. Q4(b). Locate its centre of mass. **(05 Marks)**

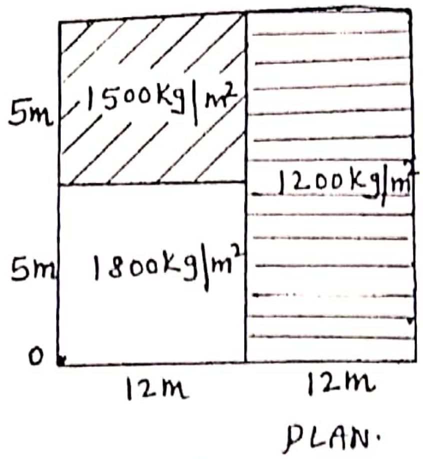

Fig. Q4(b)

c. For the moment resisting frames idealized as shear buildings. Investigate the building structures shown in Fig Q4(c) has soft storey or extreme soft storey, MI of each column is indicated. **(05 Marks)**

PART – B

5 a. Summarize the philosophy of seismic design. (05 Marks)

b. The plan and elevation of a three – storey RCC school building is shown in Fig. Q5(b). The building is located in seismic zone V. The type of soil encountered is medium stiff and is proposed to design the building with a special moment resisting frame. The intensity of dead load is 10 kN/m^2 and the floors are to cater with an imposed load of 3 kN/m^2. Determine the design seismic loads on the structure by static analysis. Refer Fig. 5(b). (15 Marks)

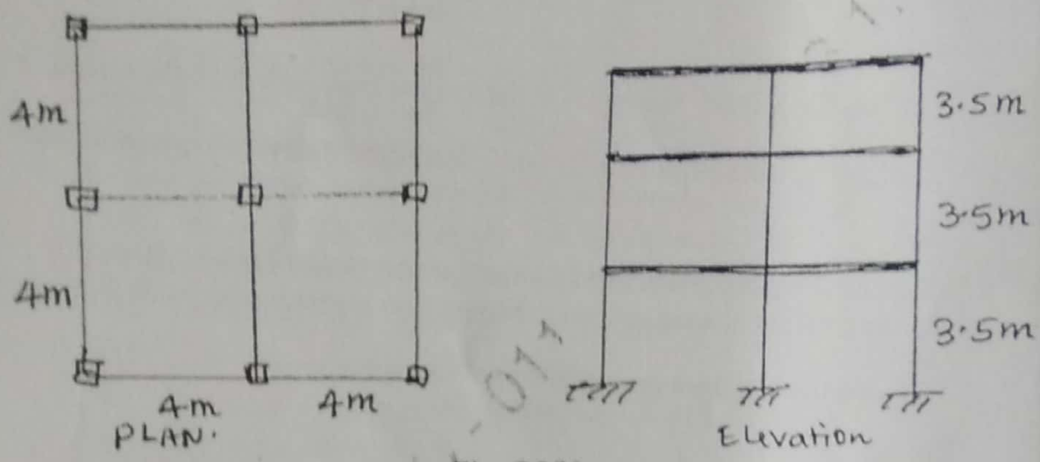

Fig. Q5(b)

6 For the RCC (SMRF, with importance factor = 1) building founded on soft soil and situated in zone V. Determine the seismic forces by dynamic analysis procedure for the following free vibration results of the building having weight of roof w_3 = 392 kN, 2nd floor w_2 = 784 kN, and first floor w_1 = 1568 kN.

Natural	Mode – 1	Mode – 2	Mode – 3
Period (s)	0.883	0.404	0.302
Roof	1.000	1.000	1.000
Second floor	0.791	0.000	–0.791
First floor	0.250	–1.000	0.250

(20 Marks)

7 a. What are the different load combinations as per IS 1893 – 2002 to be used for seismic analysis of RCC buildings? (08 Marks)

b. What are the ductile detailing provisions for beams (for flexure and shear). Explain with neat sketches. (12 Marks)

8 a. Explain various modes of failure of masonry buildings with neat sketches. (10 Marks)

b. What are the recommendations for improving the seismic resistance of masonry structures? Explain. (10 Marks)

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