2.5.1 Mechanism of internal assessment is transparent and robust in terms of frequency and mode

Examination process aims at measuring the degree of knowledge assimilated by the students during a course of study or training imparted to them. Assessment and evaluation are the major tools to verify the attainment of POs and PSOs of the curriculum. To measure the attainment of POs and PSOs, three internal assessment tests namely 'Continuous Assessment Test1, Test2 & mode l(CAT1, CAT2 & Model)' and model exam are conducted in a centralized manner adhering to the academic calendar

In order to achieve the quality in conducting the continuous assessments, a department CAT Examination coordinator along with one faculty member is formed. CAT Coordinator will prepare Exam Time Table, , Deadline for Question paper submission, Preparation of seating plan, Invigilation duty and Question Paper template , Allotment of invigilation duty, distribution of Question paper & answer books, collection of answer books, Deadline for paper evaluation and Deadline for mark distribution to the HOD. Individual members will be responsible for each 'time-bound' activity and shall monitor the progress.

Implementation

Procedure to Prepare the Internal Question Paper

The Question paper for the Continuous assessment Test is prepared by the subject handling faculty and it is verified by the HOD so that the quality of question paper is ensured. Question papers are prepared in such a way that all questions in the question paper should appropriate to meet the Course Outcomes and develop students' critical thinking skills.

Question papers are prepared to satisfy the following:

- Questions are appropriate and adequate to check the attainment of course outcomes.
- Questions are prepared based on the Blooms taxonomy.
- Questions may require memory recall or direct application of text book material to answer them.
- For some of the questions, the solutions can be arrived by applying basic course knowledge.
- Question papers are prepared based on the previous five years Anna University Question Papers.

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PERI INSTITUTE OF TECHNOLOGY

Mannivakkam, Chennai – 48.

Department of Electronics and Communication Engineering

PERIIT/ECE/CIR-4 /EVEN/ 1DATE:25.5.22

CIRCULAR

Dear all,

The **Model** examination commences on 28.5.22

Exam will be conducted for **100 marks** from **12.45 pm to 3.45 pm**

Faculties handling class for ECE department are requested to send question paper topericatexam2021@gmail.comon or before **27.5.2022**without fail.

QP Pattern for II ,III & IV years

Portion: 5 Units
Max. Marks: 100
Duration: 3 Hours
Part A: 10 Questions (2 marks)
Part B: 5 Questions (13 marks) with choice
PART-C 1 Questions(15 marks) with choice

Encl: 1.Question paper Template.

2.Time table.

Regards

ECE DEPT. CAT CELL

25/5/22

CAT INCHARGE

25/5/22

HOD/ECE

Dr. R. PALSON KENNEDY, M.E., Ph.D.,
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DEPT of Electronics and Communication Engineering

PERI INSTITUTE OF TECHNOLOGY

TIME: 12.45 PM to 3.45 PM

MODEL EXAM-May 2022

Date	II YEAR ECE	III YEAR ECE	IV YEAR ECE A&B
28.5.22 (Saturday)	EC8453-Linear Integrated circuits	EC8652-Wireless communication	GE8076-Professional Ethics in Engineering
1.6.22 (Wednesday)	EC8452-Electronic Circuits II	EC8691-Microprocessor and microcontroller	
4.6.22 (Saturday)	MA8451-Probability and Random Processes	EC8004-Wireless networks	EC8094-Satellite Communication
8.6.22 (Wednesday)	EC8451-Electromagnetic field	EC8651-Transmission lines and waveguides	
11.6.22 (Saturday)	EC8491-Communication Theory	EC8095-VLSI Design	
15.6.22 (Wednesday)	GE8291-Environmental Science and Engineering	MG8591-Principles of management	

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HOD

PERI INSTITUTE OF TECHNOLOGY
DEPARTMENT OF ECE
Model Exam- Invegilation Duty List

DATE	II YEAR	III YEAR	IV YEAR
	AN	AN	AN
28.5.22(SAT)	Ms.Kaleeswari	Ms.Sreedevi	Dr.Durairaj
1.6.22(WED)	Ms.Lakshmipriya	Ms.Lavanya	
4.6.22(SAT)	Ms.Lavanya	Ms.Kaleeswari	Ms.Dhivyabharathi
8.6.22(WED)	Ms.Lakshmi priya,AP/Math	Ms.Dhivyabharathi	
11.6.22(SAT)	Mr.Edward	Ms.Kaleeswari	
15.6.22(WED)	Dr.Charulatha	Ms.Sreedevi	

CAP Incharge

Dr. R. PALSON KENNEDY, M.E., Ph.D.
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HOD 25/5/22

PERI INSTITUTE OF TECHNOLOGY
DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
ACADEMIC YEAR:2021-22
HALL PLAN

Hall no	Year	Register number of students	Number of students	Total number of students
BS 2-II YEAR CLASSROOM	II year	411520106001-6031	29	58
	III YEAR	411519106001-6028,301-303	29	
BS-3-III YEAR CLASS ROOM	II year	411520106032-6048	16	17
	III YEAR	6304	1	
DSP LAB	II year	411520106049,6301-6308	9	9
		Total	84	84

CAT INCHARGE

HOD/ECE

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PERI INSTITUTE OF TECHNOLOGY
DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
ACADEMIC YEAR:2021-22
HALL PLAN

Hall no	Year	Register number of students	Number of students	Total number of students
BS 2-II YEAR CLASSROOM	II year	411520106001-6031	29	58
	IV YEAR	411518106001-6029	29	
BS-3-III YEAR CLASS ROOM	II year	411520106032-6048	16	32
	IV YEAR	411518106030-6033,6035-6046	16	
BS-9-IV-B-YEAR CLASS ROOM	II year	411520106049,6301-6308	9	38
	III YEAR	411519106001-6021	19	
	IV YEAR	411518106047-6052,6054-6057	10	
DSP lab	III YEAR	411519106021-28,6301-6304	11	28
	IV YEAR	411518106058-6072,6301-6303	17	
		Total	**156**	156

CAT INCHARGE

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HOD/ECE

Reg. no.:

PERI
INSTITUTE OF TECHNOLOGY

SET B

MODEL EXAM I: JUNE 2022

GE8291-ENVIRONMENTAL SCIENCE AND ENGINEERING

Year/Sem	: II/IV	Date	: 15.06.2022
Department	: ECE	Duration	: 180 minutes
Faculty	: Dr. J. Edward	Max. Marks	: 100

PART A TWO MARKS (10X2=20)

1.	Define food chain and web.	R	CO1
2.	What are the functions of forest?	R	CO1
3.	What is ecological pyramid?	U	CO2
4.	What is endangered and endemic species in India?	U	CO2
5.	Define thermal pollution.	Ap	CO3
6.	What is flood? What are it causes?	U	CO3
7.	What is nuclear holocaust?	U	CO4
8.	What is noise pollution?	Ap	CO4
9.	What is value education?	R	CO5
10	Name of the test available for HIV infection.	U	CO5

PART B THIRTEEN MARKS (5X13=65)

11(a)	Discuss the concept of ecological pyramid.	Ap	CO1

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SET B

MODEL EXAM I: JUNE 2022

GE8291-ENVIRONMENTAL SCIENCE AND ENGINEERING

Year/Sem	: II/IV	Date	:15.06.2022
Department	: ECE	Duration	: 180 minutes
Faculty	: Dr. J. Edward	Max. Marks	: 100

PART A TWO MARKS (10X2=20)

1.	Define food chain and web.	R	CO1
2.	What are the functions of forest?	R	CO1
3.	What is ecological pyramid?	U	CO2
4.	What is endangered and endemic species in India?	U	CO2
5.	Define thermal pollution.	Ap	CO3
6.	What is flood? What are it causes?	U	CO3
7.	What is nuclear holocaust?	U	CO4
8.	What is noise pollution?	Ap	CO4
9.	What is value education?	R	CO5
10	Name of the test available for HIV infection.	U	CO5

PART B THIRTEEN MARKS (5X13=65)

11(a)	Discuss the concept of ecological pyramid.	Ap	CO1

14/6/22

11(b)	With a neat sketch discuss nitrogen cyle.	U	CO1
12(a)	Discuss the causes effect and control measures of water and air pollution.	U	CO2
12(b).	Explain the role and responsibilities of an individual participating in environmental protection.	An	CO2
13(a)	What is deforestation and over exploitation? Explain its effects	U	CO3
13(b)	Note on mineral resources and food resources.	U	CO3
14(a)	Write about global warming and acid rain	An	CO4
14(b)	Explain about rain water harvesting and water shed management.	An	CO4
15(a)	Write about the effects of population explosion.	E	CO5
15(b)	A explain the role of information technology in protection of environment	C	CO5

'ART C FIFTEEN MARKS (1X15=15)

16(a)	Discuss the impact on modern agriculture on the environment (OR)	Ap	CO4
6(b)	Briefly note on human rights and child welfare.	R	CO5

11(b)	With a neat sketch discuss nitrogen cyle.	U	CO1
12(a)	Discuss the causes effect and control measures of water and air pollution.	U	CO2
12(b).	Explain the role and responsibilities of an individual participating in environmental protection.	An	CO2
13(a)	What is deforestation and over exploitation? Explain its effects	U	CO3
13(b)	Note on mineral resources and food resources.	U	CO3
14(a)	Write about global warming and acid rain	An	CO4
14(b)	Explain about rain water harvesting and water shed management.	An	CO4
15(a)	Write about the effects of population explosion.	E	CO5
15(b)	A explain the role of information technology in protection of environment.	C	CO5

PART C FIFTEEN MARKS (1X15=15)

16(a)	Discuss the impact on modern agriculture on the environment (OR)	Ap	CO4
16(b)	Briefly note on human rights and child welfare.	R	CO5

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PERI INSTITUTE OF TECHNOLOGY
DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
II ECE -MODEL MARKS
ACADEMIC YEAR 2021-22-EVEN SEM

REG NO	Name	EC8451 EMF	EC8452 EC II	EC8453 LIC	EC8491 CT	MA8451 PRP	GE8291 EVS	No of arrears
411520106001	Abinaya M	AB	AB	AB	AB	AB	AB	6
411520106002	Aravinth Sankar P	77	72	73	83	67	85	0
411520106003	Arulmani	75	60	46	AB	37	60	3
411520106004	Arunraj R	77	AB	60	79	AB	74	2
411520106005	Ashwin	AB	AB	46	AB	AB	38	6
411520106006	Balaji S	78	72	68	77	53	73	0
411520106007	Balakrishnan	76	76	64	71	75	76	0
411520106008	Chandana Priya R H	77	82	69	85	59	AB	1
411520106009	Charumathi	85	80	67	AB	56	60	1
411520106010	Deverapalli Vasanth	76	67	57	70	41	66	1
411520106011	Dhomodharan	73	56	70	63	56	AB	1
411520106012	Diviesh	77	60	45	39	16	58	3
411520106013	Elizabeth	AB	57	54	AB	AB	89	3
411520106015	Gomathi	64	35	24	55	14	36	4
411520106016	Gothala Vikash G	55	69	65	70	34	66	1
411520106017	Gowtham S	75	74	74	86	88	75	0
411520106018	Harish Balaji	72	73	50	76	29	AB	2
411520106019	Indujaa R	76	AB	58	67	14	AB	3
411520106020	Jana Ki	AB	62	67	86	28	74	3
411520106021	Jayakumar. M	70	69	53	70	33	44	2
411520106023	Jayasakthi	78	81	67	76	63	72	0
411520106024	Mahesh Babu	86	57	62	60	57	66	0
411520106025	Karthik N	67	56	41	AB	AB	AB	4
411520106026	Kaviya	77	AB	62	74	58	AB	2
411520106027	Manikandan A	77	78	67	41	50	64	0
411520106028	Mugila	AB	AB	AB	AB	AB	AB	6
411520106029	Naveen P	79	69	50	81	31	63	1
411520106030	Nidheesh Raj	79	60	55	81	AB	77	1
411520106031	Pradeep	71	53	55	57	50	64	0
411520106032	Pradeep Kumar	67	60	65	83	51	76	0
411520106033	Prathaba Ruthiran	63	50	65	57	31	AB	2
411520106034	Sabarinathan	76	AB	AB	79	AB	76	3
411520106035	Sanmugapriya	78	63	66	83	50	66	0
411520106036	Sarmitha	81	36	57	AB	33	71	3
411520106037	Shalini	81	61	61	70	64	72	0
411520106038	Siddique	AB	60	66	AB	39	72	3
411520106039	Siva Prakash	85	71	71	AB	AB	AB	3
411520106041	Srinivasan	65	24	AB	28	53	24	3
411520106042	Susmitha	66	72	64	81	39	64	1
411520106043	Thatchayani	77	63	63	82	46	75	1
411520106044	Thavasiram	81	65	69	81	41	AB	2

411520106045	Tholkappiyan	70	37	52	71	33	AB
411520106046	Umamageshwari	80	62	65	75	56	67
411520106047	Uppili	81	63	69	80	40	76
411520106048	Vadlamani Dinesh	69	57	60	68	40	61
411520106049	Vidhya	85	81	82	AB	67	73
411520106305	Sathish	OD	OD	OD	OD	OD	AB
411520106304	Sanjay	41	27	42	57	12	AB
411520106307	Swetha	65	37	50	63	28	38
411520106302	Magimairaj	OD	OD	OD	OD	OD	12
411520106305	Saravana Kumarv	78	53	64	77	57	76
411520106308	Vignesh P	66	19	AB	54	21	64
411520106306	Sandhiya	OD	OD	OD	OD	OD	AB
411520106301	Boopalan	60	AB	50	55	38	62
No of Students attended		45	43	46	40	42	37
No of Students absent		6+3	8+3	5+3	11+3	9+3	15+2
No of students passed		44	36	40	37	19	35
No of students failed(>50)		1	7	6	3	23	6
No of students failed(>60)		2	15	18	9	36	7
PASS PERCENTAGE(>60)		96	65	61	77.5	14	85
PASS PERCENTAGE(>50)		98	84	87	92.5	45	86

CAT.CORDINATOR
29/6/22

HOD 29/

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PERI INSTITUTE OF TECHNOLOGY

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

III ECE MODEL MARKS

ACADEMIC YEAR 2021-22-EVEN SEM

).	REG NO	Name	MG8591 POM	EC8651 TLRF	EC8004 WN	EC8691 MPMC	EC8652 WC	EC8095 VLSI	No of Arrears
	411519106001	AKASH S	34	73	42	52	79	AB	3
	411519106002	BAGAVATH.P	51	62	OD	66	55	61	1
	411519106003	CHANDRU S	55	84	52	62	77	77	0
	411519106004	KODANDARAMI REDDY	50	84	16	50	67	62	1
	411519106005	DINESH V	AB	85	40	59	81	81	2
	411519106006	GOLDA FAITH T	48	AB	54	70	85	76	2
	411519106007	HARISH R	65	77	38	35	43	AB	4
	411519106009	KARTHICKKUMAR M	47	88	29	56	80	82	2
	411519106010	KAVIPRIYA M	45	68	22	75	79	60	0
	411519106011	KAVIYA E S	62	91	54	73	86	AB	1
	411519106012	KEERTHI R	61	91	30	72	82	71	1
	411519106013	KARTHEEK VARMA K	34	80	9	50	60	71	2
	411519106015	MERLIN P	49	AB	32	54	79	AB	2
	411519106016	MUGILAN K	AB	AB	0	0	AB	12	6
	411519106017	PRAKRUTHI M A	65	97	50	94	94	82	0
	411519106018	PRAVEEN RAJ T	67	64	41	42	62	AB	3
	411519106019	RAVI KUMAR V	12	66	OD	30	57	37	4
	411519106020	SANGEETHA V	33	AB	35	60	87	75	3
	411519106021	SARVEPALLI DEEPAK	36	63	14	20	AB	50	4
	411519106022	SASI KUMAR S	33	AB	7	19	58	19	5
	411519106023	SHAJITHABARVEEN S	53	60	40	60	74	AB	2
	411519106024	SHALINI D	61	83	55	80	87	84	0
	411519106025	SNEGA S	56	86	32	55	86	73	1
	411519106026	SWARNA C R	54	57	35	70	75	AB	2
	411519106027	VELAN S	19	AB	OD	25	51	AB	5
	411519106028	VINOTH KUMAR R	41	81	OD	60	66	72	2
	411519106301	ARUN PRASATH V	15	56	OD	52	60	77	2
	411519106302	MATHESH G	28	30	10	26	60	20	5
	411519106303	RAGHUL	AB	AB	AB	AB	AB	AB	6
	411519106304	VISWANATH	25	AB	23	50	61	52	3
	No of Students attended		27	22	24	29	27	21	
	No of Students absent		2+1	8	6	1	2+1	8+1	
	No of students passed		12	7	5	21	22	17	
	No of students failed		15	21	19	8	5	4	
	PASS PERCENTAGE(>60)		22	1	0	41	81	76	
	PASS PERCENTAGE(>50)		44	95	21	72	96	81	

29/6/22

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HOD 29/6/22

PERI INSTITUTE OF TECHNOLOGY

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

IV A ECE -MODEL MARKS

ACADEMIC YEAR 2021-22-EVEN SEM

S.NO.	REG NO	Name	EC8094 SC	GE8076 PE	No of arrears
1	411518106001	ABINAYA S	AB	OD	2
2	411518106002	AJAYKUMAR D	AB	AB	2
3	411518106004	ANGELO JUDE DUMENIL	AB	OD	2
4	411518106007	ASHWINI M	68	53	2
5	411518106008	ASLAM BADUS HA I	AB	AB	2
6	411518106009	BARATHWAJ K R	AB	OD	2
7	411518106011	BEVINA M	39	50	1
8	411518106012	BUDDANNAGARI MADHU	AB	AB	2
9	411518106014	DINESH S	AB	AB	2
10	411518106015	EVANGLIN S	AB	OD	2
11	411518106017	GENJI MUKHESH REDDY	AB	AB	2
12	411518106018	GOKUL KRISHNAN M	AB	AB	2
13	411518106019	HABIBUNNISHA	AB	51	1
14	411518106020	INTHIRAN R	AB	AB	2
15	411518106021	ISHRATH JABEEN S	AB	73	1
16	411518106023	JAYAKAMALA NARAYAN	AB	OD	2
17	411518106024	JEEVA B M	AB	OD	2
18	411518106026	KALAIVANI CHAKKARAPAN	82	54	0
19	411518106028	KAVITHA R	AB	63	1
20	411518106030	KIRUBAKARAN S	AB	OD	2
21	411518106031	KOKILAVANI P	AB	61	1
22	411518106036	MALLAVARAPU SHREYA	AB	AB	2
23	411518106037	MANOJ KUMAR N	AB	57	1
24	411518106038	MIDHUNA VARSHINI J	AB	OD	2
25	411518106039	MOHANKUMAR P	AB	46	2
26	411518106046	NIDHI SELVAN J C	AB	AB	2
27	411518106048	PRASANTH R	AB	OD	2
28	411518106049	PRAVEENA R	93	66	2
29	411518106050	PRAWIN CHANDAR B	AB	AB	2
30	411518106054	RAMESH ARAVIND T	AB	OD	2
31	411518106055	RAYAPATI SOWMYA SU	56	50	0
32	411518106056	RINOZA K	60	52	0
33	411518106059	SANJAI SAIRAM S K	AB	AB	2
34	411518106064	SUNDAR R	AB	AB	2
35	411518106065	SURYA D	18	43	2
36	411518106067	SUVASNA M	92	70	0
37	411518106069	VAKA HARSHITHA	AB	OD	2
38	411518106072	YASER ABDUL RAHEEM	AB	AB	2
Total no of students			38	38	
No of Students attended			9	14	
No of Students absent			29	24	
No of students passed			7	12	
No of students failed			2	2	
PASS PERCENTAGE(>60)			56	35.7	
PASS PERCENTAGE(>50)			78	85.7	

29/6/22

CATCORDINATOR

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HOD 29/6/22

CE8601 Design of Steel Structural Elements

CAT-1 Answer key

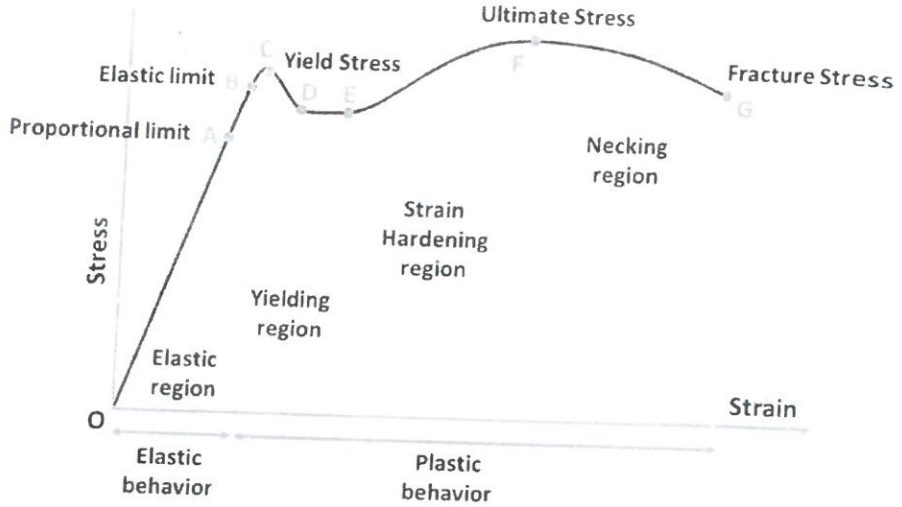
III yr - VI sem

ANSWER KEY

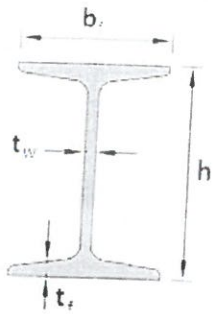
SECTION 1

PART A – TWO MARKS

1. Illustrate with neat sketch the components of Stress Strain curve for Steel. **(Diagram - 2 marks)**



2. Mark the various sectional components of ISMB 450. **(Diagram – 1 mark, Dimensions – 1 mark)**



ISMB 450 @ 72.4 kg/m

450 is Overall Depth in mm, 72.4 kg/m is weight per meter length

h or D = Overall Depth = 450 mm

b or b_f = Breadth of Flange = 150 mm

t_f = Thickness of Flange = 17.4 mm

t_w = Thickness of Web = 9.4 mm

3. What are the advantages of using steel as structural material? **(minimum 4 points – 2 marks)**
   - high strength-to-weight ratio
   - ductile material and hence it does not fail suddenly
   - tough, hence it may be bent, hammered, punched
   - properties of steel mostly do not change with time
   - more elastic and follows Hook's law upto fairly high stresses

4. List the load combinations adopted in Limit State Method of Design. **(2 marks)**

   According to limit state method of design,
   - Dead load + live load + Crane load
   - Dead load + live load + Crane load + Wind or Earthquake load
   - Dead load + Wind or Earthquake load
   - Dead load + Erection load
   - Dead load + Live load + Accidental load

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5. What are the partial safety factors specified in IS 800:2007? **(Load – 1 mark, Material – 1 mark)**

Definition	Symbol	Partial safety factor
Resistance governed by yielding	γ_{mo}	1.10
Resistance governed by buckling	γ_{mo}	1.10
Resistance governed by ultimate stress	γ_{mf}	1.25

Resistance of connection	Symbol	Shop fabrications	Field fabrications
Friction type bolts	γ_{mf}	1.25	1.25
Bearing type bolts	γ_{mb}	1.25	1.25
Rivets	γ_{mr}	1.25	1.25
Welds	γ_{mw}	1.25	1.50

PART B – THIRTEEN MARKS

6. **(i) Explain in detail Working Stress Method of design. (10 marks)**

(Principle – 4 marks, Theory – 3 marks, Advantages and Disadvantages – 3 marks)

Elastic method
stress – strain behavior linear
Working stress < Permissible stress

$$\text{Permissible stress} = \frac{\text{Working stress}}{\text{Factor of Safety}}$$

Stress due to (Dead load + Live load) < Permissible stress
Stress due to (Dead load + Wind load) < Permissible stress
Stress due to (Dead load + Live load + Wind load) < 1.33 x Permissible stress

Advantages

- The working stress method is based on elastic theory and hence it is conceptually simple.
- The serviceability requirements such as deflection which is based on the working loads are satisfied.

Disadvantages

- It results in relatively larger sections which is uneconomical.
- The reserve strength of steel beyond the elastic limit is not utilized and the redistribution of stresses in steel is not accounted.
- The design parameters such as loads, strength, material properties, etc., are assumed to have unique values, though they are variables.
- It does not provide a realistic measure of actual factor of safety underlying a design.
- It fails to discriminate between various loads that act simultaneously and also vary with time. Considering all loads with the same factor of safety would result in very un-conservative design.

(ii) Describe the various forms in which steel is used in Steel structures. (3 marks)

Steel products are available in the following forms based on the cross section:

- Hot formed products
  - Flat products : Bars, Flats, Plates, Strips, Sheets
  - Standard sections : Rolled and Hollow sections
- Cold formed products

7. **(i) Explain in detail Limit State Method of design. (10 marks)**
(Principle – 4 marks, Theory – 3 marks, Advantages – 3 marks)

Limit state is a state of impending failure, beyond which a structure ceases to perform its intended function satisfactorily. The various limit states are grouped into the following two types:

- Limit state of Strength
- Limit state of serviceability

Limit state of Strength

The ultimate or safety or strength limit states are those associated with failures, under the action of probable and most unfavourablecombinations of loads on the structure.

- Loss of equilibrium of the structure as a whole or its components
- Loss of stability of the structure or its components (including overturning, sway)
- Failure by excessive deformation, fatigue, rupture, brittle fracture, etc.

Limit state of Serviceability

- Deformation or deflection which seriously affect appearance or effective use of the structure.
- Vibrations causing any damage to structure or its components or discomfort to the occupants.
- Cracks, Corrosion affecting durability
- Fire

Advantages

- This method overcomes all the disadvantages of working stress method & plastic design method.
- According to this method, the design parameters are variants and not unique values.
- In this method, the partial safety factors used account for uncertainties in loads and material strength.
- This method is rational and practical since different safety factors can be applied to different limit states.

(ii) Describes the various grades in Structural steel. (03 marks)

Hot rolled structural steel sections are generally designated as E 165 (Fe 290), E 250 (Fe 410), E 275, E 300 (Fe 440), E 350 (Fe 490), E 410 (Fe 540), E 450 (Fe 570 D, Fe 590 E), E 550, E 600, E 650.

Eg: E 250 (Fe 410 A)
E 250 (Fe 410 C)
E 250 (Fe 410 WB)

Grade A steel – Used in structures subjected to normal loading conditions

Grade B steel – Used in structures subjected to critical loading applications such as members prone to brittle fracture, severe reversal of stresses as in bridges.

Grade C steel – Used in structures subjected to low temperature and impact effects.

8. **(a) Explain the IS 800:2007 codal specifications for bolted connections (13 marks)**
Specifications Of IS 800: 2007 – Section 10
Cl: 10.2.1 – Bolt Hole Diameter:

Nominal Diameter of bolt Clearance Hole diameter
≤ 14 mm 1 mm Eg: for M14 bolt, do = 15 mm
16 – 22 mm 2 mm Eg: for M20 bolt, do = 20 mm
≥ 24 mm 3 mm Eg: for M24 bolt, do = 27 mm

The hole diameter is larger than the bolt diameter to facilitate erection and allowance for inaccuracies in fabrication.

Hole diameter = Nominal diameter of bolt + Clearance

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Cl: 10.2.2 – minimum pitch distance:

Pitch distance: The centre-to-centre distance between adjacent bolts in the direction of load. It is denoted as p.

Staggered pitch distance: The centre-to-centre distance between adjacent bolts in the direction of load in zig-zag pattern of bolt. It is denoted as p_s.

Minimum pitch distance to be provided is 2.5 times the nominal diameter of bolt. $p = 2.5\ d$

This minimum spacing is to be ensured for the following reasons:

- To prevent bearing failure of member between the two bolts
- To ensure sufficient space to tighten the bolts
- To prevent overlapping of washers
- To provide adequate resistance to tearing out of bolt

Cl: 10.2.3.1 – maximum pitch distance:

Maximum pitch distance to be provided is:

- In all cases – 32 t or 300 mm, whichever is less.
- In Tension members – 16 t or 200 mm, whichever is less.
- In compression members – 12 t or 200 mm, whichever is less.

Cl: 10.2.3.3 – gauge distance:

The centre-to-centre distance between adjacent bolts transverse to the direction of load is called as gauge distance. It is denoted as g.

The distance between the back of the rolled section to the first bolt line is called as gauge distance.

In case of normal bolting, the gauge distance should not exceed 100 mm + 4 t or 200 mm, whichever is less.In case of staggered bolting, the gauge distance should not exceed 75 mm.

Cl: 10.2.4 – edge and end distance:

The distance between the centre of bolt and the adjacent edge, in the direction at right angles to the direction of load is called as edge distance.

The distance between the centre of bolt and the adjacent edge, in the direction of load is called as end distance.

Minimum edge and end distance shall not be less than 1.7 times diameter of the bolt hole. $e = 1.7\ d_o$

The minimum edge and end distance is to be ensured to reduce the bearing and shear failure of the plate at the edge of the connection.

(b) Explain the IS 800:2007 codal specifications for welded connections (13 marks)

Size of Weld: (IS 800:2007, Pg 78, Cl. 10.5.2)

The size of weld is represented by '**s**'.

Minimum size of weld (s_{min}):

The size of weld should not be less than 3 mm i.e. $s \not< 3$ **mm** (Cl. 10.5.2.3)

For the first run of a fillet weld or single run fillet weld, (Table 21)

Thickness of thicker part (t) Minimum size of fillet weld (s_{min})

< 10 mm 3 mm
10 – 20 mm 5 mm
20 – 32 mm 6 mm
32 – 50 mm 10 mm

Maximum size of weld (s_{ma}):

For Filet weld applied to square- edge (Eg: plate) $s_{max} = t - 1.5$ (Cl. 10.5.8.1)

For Filet weld applied to rounded edge (Eg: Rolled section) $s_{max} = ¾\ t$ (Cl. 10.5.8.2)

For Fillet weld applied to members subjected to dynamic loading $s_{max} = t$ (Cl. 10.5.8.4)

Effective throat thickness (t_e)

Fillet Weld: (Cl. 10.5.3.1 and 10.5.3.2)

When fillet weld used to join plates at right angles or overlapped plates, $t_e = 0.7\ s$

The effective throat thickness of fillet weld shall not be less than 3 mm, $t_e = 3$ mm

Under special circumstances, the effective throat thickness shall be taken as $t_e = s$

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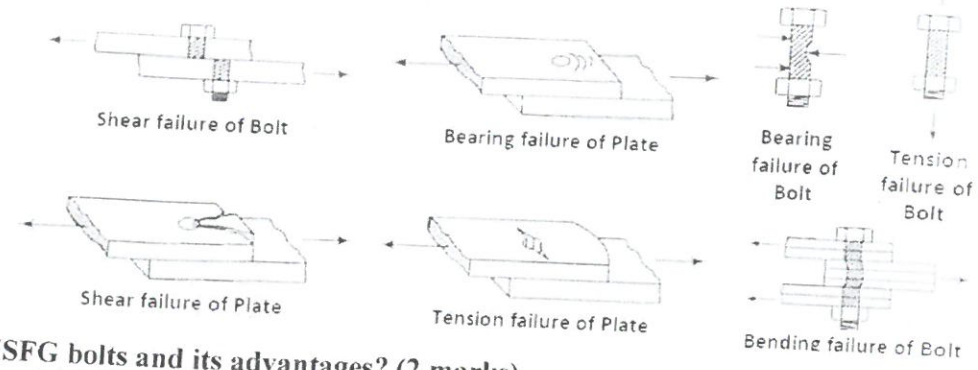
SECTION 2

PART A – TWO MARK

9. **What are the modes of failure in a bolted joint? (2 marks)**

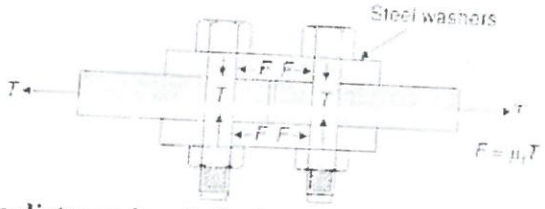


10. **What are HSFG bolts and its advantages? (2 marks)**

The bolts with induced initial tension are called as HSFG bolts.

Special tightening techniques are used to induce sufficient initial tension, which causes friction to be developed between the connecting surfaces.

Due to this friction, slip in the joint is eliminated. Hence the joints are called as non-slip connection or slip-critical connection.



11. **Define Pitch distance and Edge distance in a bolted connection. (Pitch 1 mark, Edge 1 mark)**

The centre-to-centre distance between adjacent bolts in the direction of load is called as **Pitch distance**. It is denoted as p.

The distance between the centre of bolt and the adjacent edge, in the direction at right angles to the direction of load is called as **edge distance**. It is denoted as **e**

12. **What is Effective throat thickness and find value for a 5 mm Fillet weld. (formula 1, Answer 1 mark)**

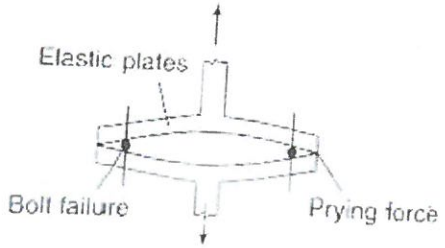
For fillet weld, $t_e = 0.7\ s$

$= 0.7 \times 5$

$= 3.5$ mm

13. **What are Prying forces? (2 marks)**

When a connection is subjected to direct tensile force, and if the connected members are flexible, then there will be additional tension in the bolts due to the deformation of the connected parts. This additional tension on the bolt is called as Prying force.



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14 (a) **Design a bolted bracket connection to connect a bracket plate 10 mm thick to a column section ISHB 150 to support end reaction of 200 kN due to factored load on beam acting at an eccentricity of 250 mm.**

Given: Load on the connection = **200 kN**

Eccentricity **e = 250 mm**= 0.25 m

To Find: Number of bolts (n), Arrangement of bolt group

Solution: Load on one bracket, P = 200 / 2 = 100 kN**P = 100 kN**

Moment, M= P x e = 100 x 0.25 = 25 kNm**M = 25 kNm**

Step 1: Number of Bolts (4 marks)

Assume 20 mm diameter bolts of 4.6 grade,

Pitch distance p = 2.5 d = 2.5 x 20 = 50 mm $\quad A_{nb} = 0.78\,\frac{\pi}{4}d^2 = 0.78 \times \frac{\pi}{4} \times 20^2 = 245\ mm^2$

$$V_{dsb} = \frac{f_{ub}}{\sqrt{3}\gamma_{mb}}(n_n A_{nb} + n_s A_{sb}) = \frac{400}{\sqrt{3} \times 1.25}[(1 \times 245) + 0] = 45.26\ kN$$

V_{dsb} = 45.26 kN

Providing two vertical rows of bolts,

$$\text{Number of bolts} = \sqrt{\frac{6\,M}{p\,n' V_{dsb}}} = \sqrt{\frac{6 \times 25 \times 10^6}{50 \times 2 \times 45.26 \times 10^3}} = 5.76 \approx 6 \text{ bolts}$$

n = 12
two vertical rows
6 bolts in each row

The two vertical rows of bolts are placed at **100 mm** spacing (assume based on width of flange of the I section to which the bracket plate is connected)

Step 2: Horizontal and Vertical distances of Bolts (4 marks)

$$x_1 = x_2 = x_3 = x_4 = x_5 = x_6 = x_7 = x_8 = x_9 = x_{10} = x_{11} = x_{12} = \frac{100}{2} = 50\ mm$$

$$\sum x^2 = x_1^2 + \cdots + x_{12}^2 = 12 \times 50^2 = 30000\ mm^2$$

$y_3 = y_4 = y_9 = y_{10} = 50$ mm

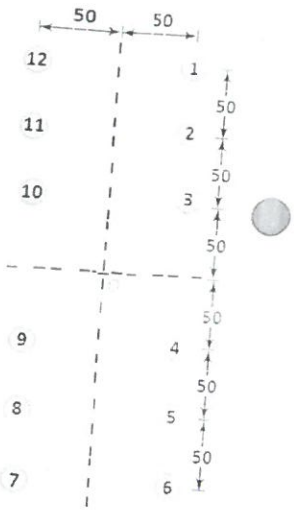
$y_2 = y_5 = y_8 = y_{11} = 50 + 50 = 100$ mm

$y_1 = y_6 = y_7 = y_{12} = 50 + 50 + 50 = 150$ mm

$$\sum y^2 = y_1^2 + \cdots + y_{12}^2 = (4 \times 50^2) + (4 \times 100^2) + (4 \times 150^2)$$

$$= 140000\ mm^2$$

$$\sum x^2 + \sum y^2 = 30000 + 140000 = 170000\ mm^2$$



Step 3Force due to Direct Shear (2 marks)

$$F_s = \frac{P}{n} = \frac{100}{12} = 8.33\ kN$$

F_s = 8.33kN

Step 4: Force due to Torsion (2 marks)

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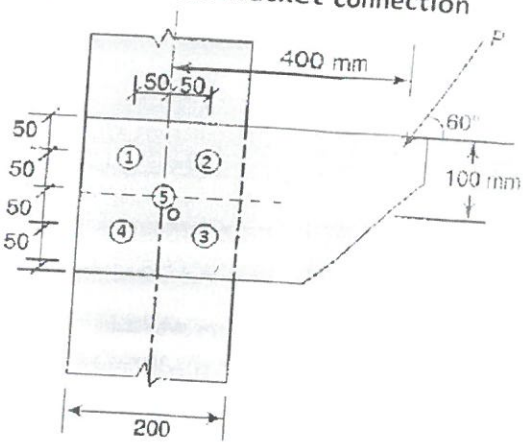
Step 5: Resultant Force in Critical bolt (1 mark)

$$R = \sqrt{(F_s + F_{ty})^2 + (F_{tx})^2} = \sqrt{(8.33 + 7.35)^2 + 22.06^2} = 27.06\text{kN}$$ **R = 27.06kN**

The Resultant force in critical bolt (R = 27.06 kN) is less than Strength of the bolt (V_{dsb} = 45.26 kN)
Hence the designed bolt group is safe

14 (b) **Find the maximum load inclined at 60° to the horizontal which the bracket connection shown in figure can transmit if five bolts of 8.8 grade of diameter 20 mm are used. Determine the load 'P' if the**

(i) joint is slip joint (Bearing joint)
(ii) Non-slip joint (Friction joint)



Given: Grade of Bolt = 8.8, f_{ub} = 800 N/mm²
Diameter of bolt, d = 20 mm
Number of bolts, n = 5
Inclination of load, θ = 60°

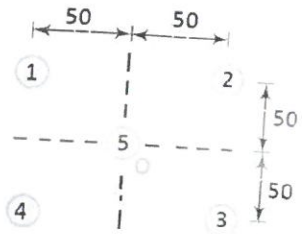
To Find: Safe load on the joint (P)

Solution: The centre of the bolt group is located at 'O'.
The bolt which is nearer to the applied load and farthest from the centre of the bolt group is the critical bolt – **Bolt 2** is the critical bolt
Eccentricity(e) = Centre of bolt group to point of Load applied,
e_x = 400 mm, e_y = 100 mm
Horizontal component of Load, $P_x = P \cos\theta = P \cos 60° = 0.5\ P$
Vertical component of Load, $P_y = P \sin\theta = P \sin 60° = 0.866\ P$

Step 1: Horizontal and Vertical distances of Bolts (3 marks)

$x_1 = x_2 = x_3 = x_4 = 50$ mm and $x_5 = 0$

$\sum x^2 = x_1^2 + x_2^2 + x_3^2 + x_4^2 + x_5^2 = 4 \times 50^2 = 10000\text{mm}^2$



$y_1 = y_2 = y_3 = y_4 = 50$ mm and $y_5 = 0$

$\sum y^2 = y_1^2 + y_2^2 + y_3^2 + y_4^2 + y_5^2 + y_6^2 = 4 \times 50^2 = 10000\ \text{mm}^2$

$\sum x^2 + \sum y^2 = 10000 + 10000 = 20000\text{mm}^2$

Step 2: Force due to Direct Shear (1 mark)

$$F_{sx} = \frac{P_x}{n} = \frac{0.5\ P}{5} = 0.1\ P \qquad F_{sy} = \frac{P_y}{n} = \frac{0.866\ P}{5} = 0.173\ P$$

F_{sx} = 0.1 P **F_{sy} = 0.173 P**

Step 3: Force due to Torsion (2 marks)

Bolt 2 is critical

$x_c = x_2 = 50$ mm

$y_c = y_2 = 50$ mm

$$F_{tx} = \frac{(P_y e_x - P_x e_y) y_c}{\sum(x^2 + y^2)} = \frac{\{(0.866\ P \times 400) - (0.5\ P \times 100)\} \times 50}{20000} = 0.741\ P$$

$$F_{ty} = \frac{(P_y e_x - P_x e_y) x_c}{\sum(x^2 + y^2)} = \frac{\{(0.866\ P \times 400) - (0.5\ P \times 100)\} \times 50}{20000} = 0.741\ P$$

F_{tx} = 0.741 P **F_{ty} = 0.741 P**

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Step 4: Resultant Force in Critical bolt (2 marks)

$$R = \sqrt{(F_{sy} + F_{ty})^2 + (F_{sx} + F_{tx})^2} = \sqrt{(0.173\,P + 0.741\,P)^2 + (0.1\,P + 0.741\,P)^2}$$

$$= 1.24\,P$$

$R = 1.24\,P$

Step 5: Strength of bolt

$$A_{nb} = 0.78 \times \frac{\pi}{4} \times 20^2 = 245\ mm^2 \quad \text{(1 mark)}$$

(i) Slip joint (Bearing type joint) (1 mark)

$$V_{dsb} = \frac{f_{ub}}{\sqrt{3}\gamma_{mb}}(n_n A_{nb} + n_s A_{sb}) = \frac{800}{\sqrt{3} \times 1.25}[(1 \times 245) + 0] = 90.54\ kN$$

$V_{dsb} = 90.54\ kN$

(ii) Non-slip joint (Friction type joint) (1 mark)

$$V_{dsf} = \frac{\mu_f n_e K_h (0.7\, f_{ub}) A_{nb}}{\gamma_{mf}} = \frac{0.55 \times 1 \times 1 \times 0.7 \times 800 \times 245}{1.25} = 60.37\ kN$$

$V_{dsf} = 60.37\ kN$

Step 6: Safe Load on the Connection

By equating, Resultant Force in Bolt = Strength of Bolt

(i) Slip joint (Bearing type joint) (1 mark)

$$1.24\,P = 90.54 \quad \Rightarrow P = \frac{90.54}{1.24} = 73.02\ kN$$

$P = 73.02 kN$

(ii) Non-slip joint (Friction type joint) (1 mark)

$$1.24\,P = 60.37 \quad \Rightarrow P = \frac{60.37}{1.24} = 48.69\ kN$$

$P = 48.69 kN$

15 (a) **Design a high strength bolted lap joint using8.8 S grade bolts of diameter 16 mm in standard clearance hole to connect two plates 10 mm and 12 mm thick carrying a factored tensile force of 200 kN.(i) Slip is not permitted (ii) Slip is permitted.**

Given: Grade of Bolt = 8.8, f_{ub} = **800 N/mm²** Grade of Plate, f_u = **410N/mm²**

Diameter of bolt, **d = 16 mm**

Factored Tensile force, **P = 200 kN**

Thickness of main plates, t = **10 mm** and **12 mm**

To Find: Number of bolts required

Solution: Diameter of Bolt hole, $d_o = d + 2 = 16 + 2 = 18$ **d_o=18 mm**

Net Shear area of bolt, $A_{nb} = 0.78\,\frac{\pi}{4}d^2 = 0.78 \times \frac{\pi}{4} \times 16^2 = 156.83$

Pitch distance, p= 2.5 d = 2.5 x 16 = 40 **p = 50 mm**

Edge distance, e = 1.7 d_o = 1.7 x 18 = 32.4 **e = 40 mm**

A_{nb}= 156.83mm²

Step 1: Slip Resistance of Bolts(IS 800:2007, Pg 76, Cl: 10.4.3) (3 marks)

Slip factor, $\mu_f = 0.55$	For Standard holes, $K_h = 1.0$	No. of Interfaces, $n_e = 1$	For factored design loads, $\gamma_{mf} = 1.25$	$F_o = (0.7\,f_{ub})A_{nb}$ = 0.7 x 800 x 156.83 = **87.82kN**

$$V_{dsf} = \frac{\mu_f n_e K_h F_o}{\gamma_{mf}} = \frac{0.55 \times 1 \times 1.0 \times 87.82}{1.25} = 38.64$$

V_{dsf} = 38.64 kN

Step 2: Shear Capacity of bolt(IS 800:2007, Pg 75, Cl: 10.3.3) (3 marks)

$n_n = 1$, $n_s A_{sb} = 0$

$$V_{dsb} = \frac{f_{ub}}{\sqrt{3}\gamma_{mb}}(n_n A_{nb} + n_s A_{sb}) = \frac{800}{\sqrt{3} \times 1.25}[(1 \times 156.83) + 0] = 57.95$$

V_{spb} = 57.95kN

Step 3: Bearing Capacity of bolt(IS 800:2007, Pg 75, Cl: 10.3.4) (3 marks)

$\frac{e}{3\,d_o} = \frac{40}{3 \times 18} = 0.74$ | $\frac{p}{3\,d_o} - 0.25 = \frac{50}{3 \times 18} - 0.25 = 0.68$ | $\frac{f_{ub}}{f_u} = \frac{400}{410} = 0.98$ | $k_b = 1$ | $\therefore k_b = 0.68$

t = 10 mm $V_{dpb} = \frac{2.5\,k_b d\,t\,f_{ub}}{\gamma_{mb}} = \frac{2.5 \times 0.68 \times 16 \times 10 \times 800}{1.25} = 174$

V_{dpb} = 174kN

Step 4: Tension Capacity of bolt(IS 800:2007, Pg 75, Cl: 10.3.4) (1 mark)

$$T_{db} = \frac{0.9\,f_{ub}A_{nb}}{\gamma_{mb}} = \frac{0.9 \times 800 \times 156.83}{1.25} = 112.9$$

T_{db} =112.9kN

Step 5: Strength of a Bolt (1 mark)

(i) When no slip is permitted: Strength of Bolt = Lesser of **Slip**, Bearing and Tension = **38.64kN**

(ii) When slip is permitted: Strength of Bolt = Lesser of **Shear**, Bearing and Tension = **57.95kN**

Step 6: Bolt Arrangement (2 marks)

(i) No slip permitted: Number of Bolts required = $\frac{\text{Force in member}}{\text{Strength of Bolt}} = \frac{200}{38.64} = 5.18$ = **6 bolts**

(ii) Slip permitted: Number of Bolts required = $\frac{\text{Force in member}}{\text{Strength of Bolt}} = \frac{200}{57.95} = 3.45$ = **4 bolts**

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15 (b) **Calculate the strengthand efficiency of a double cover butt joint to connect two plates that are 10 mm thick using cover plate 4 mm thick each. 4 bolts of 16 mm diameter are provided at a pitch distance of 45 mm and edge distance of 30 mm arranges in the following ways: (i) Single bolted (ii) double bolted.**

Given: Number of Bolts, $n = 4$

Diameter of Bolt, $d = 16$ mm

Grade of Bolt = 4.6, $f_{ub} = 400\ N/mm^2$ (assumed)

Grade of Plate, $f_u = 410 N/mm^2$

Pitch distance, $p = 45$ mm

Edge distance, $e = 30$ mm

Thickness of main plates, $t_{main} = 10$ mm

Thickness of cover plates, $t_{cover} = 4$ mm

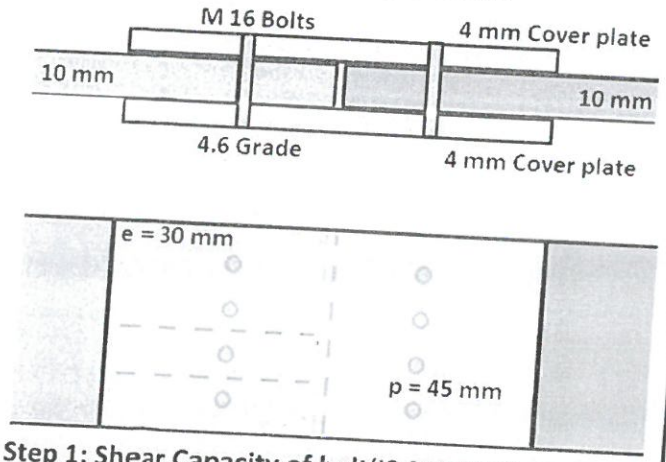
To Find: Strength of Bolt, Strength of Joint and Efficiency of joint

Solution: Factor of safety for bolted connection, $\gamma_{mb} = 1.25$

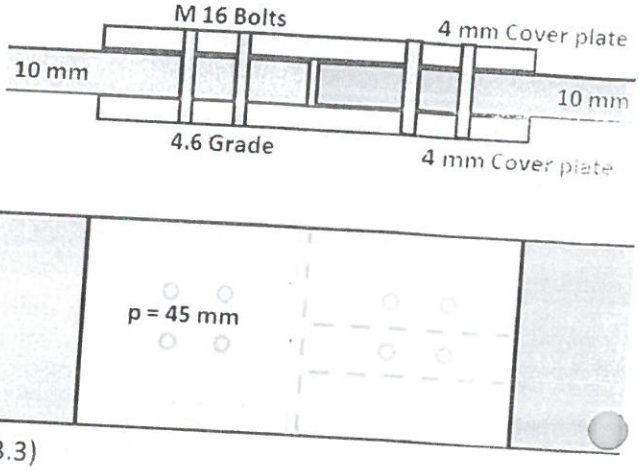
Net Shear area of bolt, $A_{nb} = 0.78\frac{\pi}{4}d^2 = 0.78 \times \frac{\pi}{4} \times 16^2 = 156.83$, $A_{nb} = 156.83 mm^2$

Diameter of Bolt hole, $d_o = d + 2 = 16 + 2 = 18$ $d_o = 18$ mm

(i) Single Bolted



(ii) Double Bolted



Step 1: Shear Capacity of bolt (IS 800:2007, Pg 75, Cl: 10.3.3)

$n_n = 2, \quad n_s A_{sb} = 0$

$$V_{dsb} = \frac{f_{ub}}{\sqrt{3}\gamma_{mb}}(n_n A_{nb} + n_s A_{sb})$$

$$= \frac{400}{\sqrt{3} \times 1.25}[(2 \times 156.83) + 0]$$

$V_{dsb} = 57.95$ kN

$n_n = 2, \quad n_s A_{sb} = 0$

$$V_{dsb} = \frac{f_{ub}}{\sqrt{3}\gamma_{mb}}(n_n A_{nb} + n_s A_{sb})$$

$$= \frac{400}{\sqrt{3} \times 1.25}[(2 \times 156.83) + 0]$$

$V_{dsb} = 57.95$ kN

Step 2: Bearing Capacity of bolt (IS 800:2007, Pg 75, Cl: 10.3.4)

$$\frac{e}{3d_o} = \frac{30}{3 \times 18} = 0.56, \quad \frac{p}{3d_o} - 0.25 = \frac{45}{3 \times 18} - 0.25 = 0.58, \quad \frac{f_{ub}}{f_u} = \frac{400}{410} = 0.98, \quad k_b = 1 \quad \therefore k_b = 0.56$$

$t = 8$ mm

$t = 8$ mm

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$$V_{dpb} = \frac{2.5\, k_b d\, t\, f_{ub}}{\gamma_{mb}}$$

$$= \frac{2.5 \times 0.56 \times 16 \times 8 \times 400}{1.25}$$

V_{dpb} =57.34kN

$$V_{dpb} = \frac{2.5\, k_b d\, t\, f_{ub}}{\gamma_{mb}}$$

$$= \frac{2.5 \times 0.56 \times 16 \times 8 \times 400}{1.25}$$

V_{dpb} = 57.34 kN

Step 3: Tension Capacity of bolt(IS 800:2007, Pg 75, Cl: 10.3.4)

$$T_{db} = \frac{0.9\, f_{ub} A_{nb}}{\gamma_{mb}}$$

$$= \frac{0.9 \times 400 \times 156.83}{1.25}$$

T_{db} =45.17kN

$$T_{db} = \frac{0.9\, f_{ub} A_{nb}}{\gamma_{mb}}$$

$$= \frac{0.9 \times 400 \times 156.83}{1.25}$$

T_{db} = 45.17kN

Step 4: Strength of a Bolt

(5 marks)

Strength of Bolt = Lesser of Shear, Bearing and Tension capacity = **45.17kN**

Strength of Bolt = Lesser of Shear, Bearing and Tension capacity = **45.17kN**

Step 5: Strength of Bolts per pitch distance

Strength of Bolts per pitch distance = Lesser of Shear, Bearing and Tension capacity = **45.17kN**
(one bolt is available per pitch distance)

Strength of Bolts per pitch distance = Lesser of Shear, Bearing and Tension capacity = 2 x 45.17
=90.34kN
(two bolts are available per pitch distance)

Step 6: Rupture strength of plate per pitch distance (IS 800:2007, Pg 32, Cl: 6.3.1)

$$T_{dn} = \frac{0.9\, f_u A_n}{\gamma_{ml}} = \frac{0.9\, f_u [(p - d_o)t]}{\gamma_{ml}}$$

$$= \frac{0.9 \times 410 \times [(45 - 18)10]}{1.25}$$

T_{db} =79.7kN

$$T_{dn} = \frac{0.9\, f_u A_n}{\gamma_{ml}} = \frac{0.9\, f_u [(p - d_o)t]}{\gamma_{ml}}$$

$$= \frac{0.9 \times 410 \times [(45 - 18)10]}{1.25}$$

T_{db} =79.7kN

Step 7: Strength of Joint per pitch distance

(5 marks)

Strength of Joint per pitch distance = Lesser of Strength of bolts per pitch distance and Rupture strength of plate per pitch distance = **56.46 kN**

Strength of Joint per pitch distance = Lesser of Strength of bolts per pitch distance and Rupture strength of plate per pitch distance = 79.7 kN

Step 8: Strength of Solid plate per pitch distance (IS 800:2007, Pg 32, Cl: 6.2)

$$T_{dg} = \frac{A_g f_y}{\gamma_{mo}} = \frac{(p \times t) f_y}{\gamma_{mo}}$$

$$= \frac{(45 \times 10) \times 250}{1.1}$$

T_{dg} =102.27kN

$$T_{dg} = \frac{A_g f_y}{\gamma_{mo}} = \frac{(p \times t) f_y}{\gamma_{mo}}$$

$$= \frac{(45 \times 10) \times 250}{1.1}$$

T_{dg} =102.27kN

Step 9: Efficiency of the Joint

(3 marks)

$$= \frac{\text{Strength of Joint per pitch distance}}{\text{Strength of Solid Plate per pitch distance}} \times 100$$

$$= \frac{56.46}{102.27} \times 100$$

Efficiency of the Joint = **55.2 %**

$$= \frac{\text{Strength of Joint per pitch distance}}{\text{Strength of Solid Plate per pitch distance}} \times 100$$

$$= \frac{79.7}{102.27} \times 100$$

Efficiency of the Joint = **77.9 %**

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16 (a) **A tie member in a bracing system consists of two angles 75 x 75 x 6 mm connected to a 10 mm thick gusset plate to carry 100 kN. Design the end connection using 12 mm diameter 4.6 grade bolts if the (i) angles are connected to same side of gusset plate (ii) angles are connected to either side of gusset plate.**

Given: Grade of Bolt = 4.6, f_{ub} = **400 N/mm²** Grade of Plate, f_u = **410N/mm²**
Diameter of bolt, **d = 12 mm**
Factored load, **P = 250 kN**
Angle section, **ISA 75 x 75 x 6**

To Find: Number of bolts required

Solution:

Step 1: Initial Assumptions

Diameter of Bolt hole, $d_o = d + 2 = 12 + 2 = 14mm$ → d_o=14 mm

Net Shear area of bolt, $A_{nb} = 0.78\frac{\pi}{4}d^2 = 0.78 \times \frac{\pi}{4} \times 12^2 = 88.22$ → A_{nb}= 88.22mm²

Pitch distance, p= 2.5 d = 2.5 x 12 = 30 ≈ 50 mm → p = 50 mm

Edge distance, e = 1.7 d_o = 1.7 x 14 = 23.8≈ 35 mm → e = 35 mm

Step 2: Shear Capacity of bolt(IS 800:2007, Pg 75, Cl: 10.3.3) (3 marks)

$n_n = 1$, $n_s A_{sb} = 0$ | $V_{dsb} = \frac{f_{ub}}{\sqrt{3}\gamma_{mb}}(n_n A_{nb} + n_s A_{sb}) = \frac{400}{\sqrt{3} \times 1.25}[(1 \times 88.22) + 0] = 16.30$ (i) Same side V_{spb} = 16.30kN

$n_n = 2$, $n_s A_{sb} = 0$ | $V_{dsb} = \frac{f_{ub}}{\sqrt{3}\gamma_{mb}}(n_n A_{nb} + n_s A_{sb}) = \frac{400}{\sqrt{3} \times 1.25}[(2 \times 88.22) + 0] = 32.60$ (ii) Either side V_{spb} = 32.60kN

Step 3: Bearing Capacity of bolt(IS 800:2007, Pg 75, Cl: 10.3.4) (3 marks)

$\frac{e}{3\,d_o} = \frac{35}{3 \times 14} = 0.83$ | $\frac{p}{3\,d_o} - 0.25 = \frac{50}{3 \times 14} - 0.25 = 0.94$ | $\frac{f_{ub}}{f_u} = \frac{400}{410} = 0.98$ | $k_b = 1$ | $\therefore k_b = 0.83$

t = 6 mm angle thickness | $V_{dpb} = \frac{2.5\,k_b d\,t\,f_{ub}}{\gamma_{mb}} = \frac{2.5 \times 0.83 \times 12 \times 6 \times 400}{1.25} = 47.81$ | V_{dpb} = 47.81kN

Step 4: Tension Capacity of bolt(IS 800:2007, Pg 75, Cl: 10.3.4) (2 marks)

$T_{db} = \frac{0.9\,f_{ub}A_{nb}}{\gamma_{mb}} = \frac{0.9 \times 400 \times 88.22}{1.25} = 25.41$

T_{db} =25.41kN

Step 5: Strength of a Bolt (2 marks)

Strength of Bolt = Lesser of Shear, Bearing and Tension capacity

(i) Angles on same side, Strength of Bolt = **16.30 kN**

(ii) Angles on same side, Strength of Bolt = **25.41 kN**

Step 6: Number of bolts (3 marks)

(i)Angles on same side: Number of Bolts required = $\frac{\text{Force in member}}{\text{Strength of Bolt}} = \frac{100}{16.30} = 6.13$ = 7 bolts

(ii)Angles on either side: Number of Bolts required = $\frac{\text{Force in member}}{\text{Strength of Bolt}} = \frac{100}{25.41} = 3.94$ = 4bolts

16 (b) **A tie member of a truss consists of an angle section ISA 65 x 65 x 6 mm of Fe410 grade is welded to 8 mm gusset plate. Design a weld to transmit the full strength of the member. Assume shop welding. (i) two sides (ii) three sides**

To Find: Size of weld (s), Length of weld (L_w)

Solution:

$$\text{Strength of the member} = \frac{A_g f_y}{\gamma_{mo}} = \frac{744 \times 250}{1.1} = 169.1 \text{ kN}$$

T= 169.1kN

Step 1: Section Properties (3 marks)

a = 65 mm, t = 6 mm A = 744 mm^2 c_z = 18.1 mm e_z = 65 – 18.1 = 46.9 mm

Step 2: Strength of weld per mm

For Fillet weld, s_{min} = 3 mm

s_{max} = (3/4) t = (3/4) x 6 = 4.5 mm Adopt 4 mm fillet weld s = 4 mm

t_e = 0.7 s = 0.7 x 4 = 2.8 mm t_e = 2.8 mm

$$\text{Strength of weld per mm} = \frac{t_e f_u}{\sqrt{3}\gamma_{mw}} = \frac{2.8 \times 410}{\sqrt{3} \times 1.25} = 530.24 \text{N/mm}$$

530.24 N/mm

Step 3: Force on weld (3 marks)

$$\text{Force on Top weld} = \frac{T c_z}{a} = \frac{169.1 \times 18.1}{65} = 47.09 \text{ kN}$$

F_{top} =47.09 kN

$$\text{Force on Bottom weld} = \frac{T e_z}{a} = \frac{169.1 \times 46.9}{65} = 122.01 \text{ kN}$$

F_{bottom} =122.01 kN

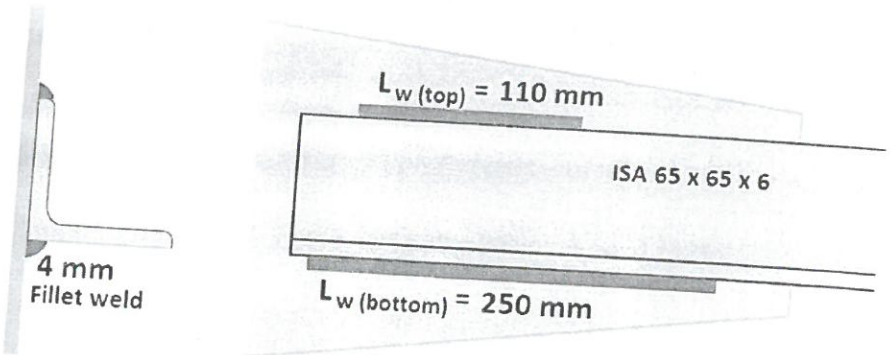
Step 4: Length of weld (2 marks)

$$L_{w\,(top)} = \frac{\text{Force on Top weld}}{\text{Strength of weld per mm}} = \frac{47.09 \times 10^3}{530.24} = 89 \text{ mm}$$

$L_{w\,(top)}$ provided = $L_{w\,(top)}$ + 4 s = 89 + (4 x 4) = 105 mm $L_{w,top}$ =110mm

$$L_{w\,(bottom)} = \frac{\text{Force on Bottom weld}}{\text{Strength of weld per mm}} = \frac{122.01 \times 10^3}{530.24} = 230 \text{ mm}$$

$L_{w\,(bottom)}$ provided = $L_{w\,(top)}$ + 4 s = 230 + (4 x 4) = 246 mm $L_{w,bottom}$ =250mm



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Step 1: Section Properties

a = 90mm, t = 8 mm A = 1137mm^2 c_z = 29.6 mm e_z = 90 – 29.6 = 60.4 mm

Step 2: Strength of weld per mm (2 marks)

For Fillet weld, s_{min} = 3 mm

s_{max} = (3/4) t = (3/4) x 6 = 4.5 mm Adopt 6 mm fillet weld s = 6 mm

t_e = 0.7 s = 0.7 x 6 = 4.2 mm t_e = 4.2 mm

$$\text{Strength of weld per mm} = \frac{t_e f_u}{\sqrt{3}\gamma_{mw}} = \frac{4.2 \times 410}{\sqrt{3} \times 1.25} = 795.36 \text{N/mm}$$

795.36 N/mm

Step 3: Force on weld (3 marks)

F_{side} = Strength per mm x a = 795.36 x 90 = 71.58 kN F_{side} = 71.58 kN

$$\text{Force on Top weld} = \frac{T\,c_z}{a} - \frac{F_{side}}{2} = \frac{250 \times 29.6}{90} - \frac{71.58}{2} = 46.43 \text{ kN}$$

F_{top} = 46.43kN

$$\text{Force on Bottom weld} = \frac{T\,e_z}{a} = \frac{250 \times 60.4}{90} - \frac{71.58}{2} = 131.99 \text{ kN}$$

F_{bottom} = 131.99kN

Step 4: Length of weld (2 marks)

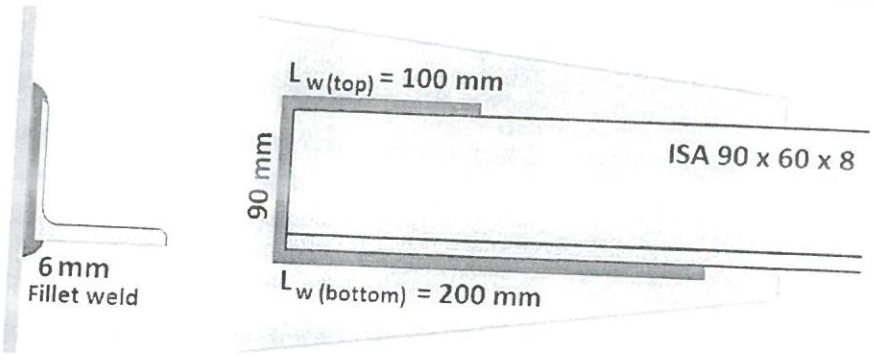
$$L_{w\,(top)} = \frac{\text{Force on Top weld}}{\text{Strength of weld per mm}} = \frac{46.43 \times 10^3}{795.36} = 58 \text{ mm}$$

$L_{w\,(top)}$ provided = $L_{w\,(top)}$ + 4 s = 58 + (4 x 6) = 82 mm $L_{w,top}$ = 100mm

$$L_{w\,(bottom)} = \frac{\text{Force on Bottom weld}}{\text{Strength of weld per mm}} = \frac{131.99 \times 10^3}{795.36} = 166 \text{ mm}$$

$L_{w\,(bottom)}$ provided = $L_{w\,(top)}$ + 4 s = 166 + (4 x 6) = 190 mm $L_{w,bottom}$ = 200mm

$L_{w\,(side)}$ = a = 90 mm $L_{w,side}$ = 90mm



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REG NO: 411519103006

NAME: M. UMANANTHINI

DEPT: CIVIL DEPT

YEAR: III - YEAR

SUB: CE8601 - DESIGN OF STEEL STRUCTURAL ELEMENTS

DATE: 04/04/2022

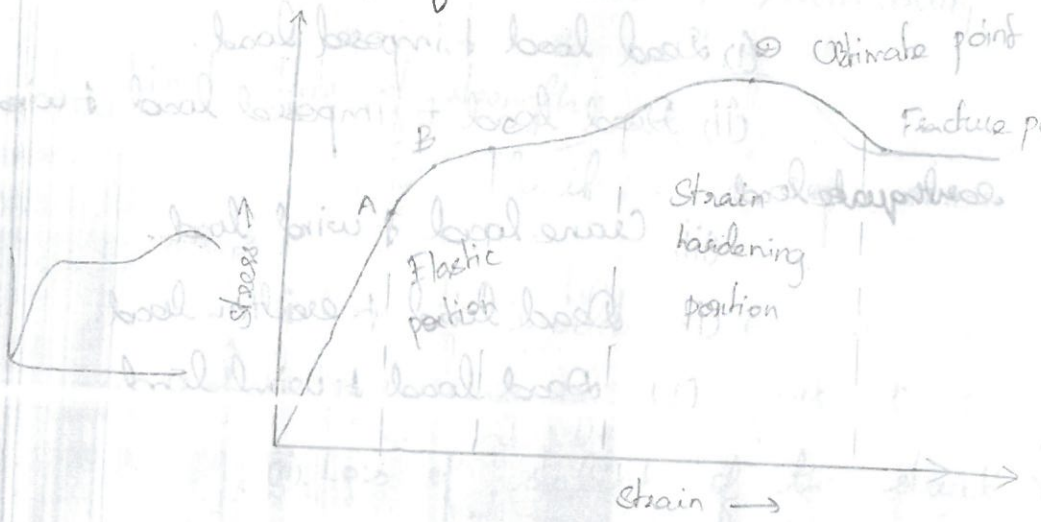
EXAM: CAT I

Section 1		Section 2	
1	2	9	1
2	0	10	2
3	2	11	2
4	2	12	0 (6)
5	2 (8)	13	1
6 (a)	9+3	14	—
6 (b)		15 (a)	12
7 (a)	10 (34)	(b)	12 (24)
8 (a)	12		

SECTION - 1

Attend all the questions
Need to understand diagrams & problems.

1. Stress strain Curve for steel:

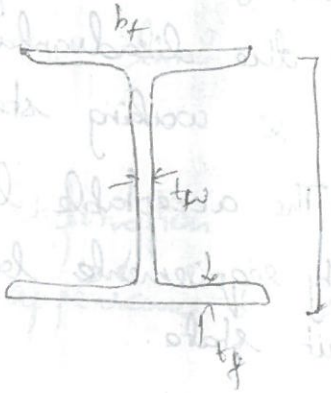


A => limit of proportionality

B => elastic point

2. Sectional Components of ISMB 450:

The various sectional components of IS



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3. Advantages of steel as structural material:

(i). Steels are ductile in nature.

(ii). They are lightweight & easy to transport & fixed.

(iii). It possess high strength & durability.

4. Load combinations in Limit State method of Design:

(i). Dead load + imposed load.

(ii). Dead load + imposed load + wind (or) earthquake load.

(iii) Crane load + wind load.

(iv) Dead load + erection load.

(v) Dead load + wind load.

PART - B

13 Marks:

6.

(B).

(i) Limit State Method of design:

(i). Limit state design method adopted to overcome the disadvantages of ultimate load method & working stress method.

(ii). The acceptable limit for the safety & serviceability requirements before failure occurs is called limit state.

(iii) In this method the structure shall be designed on the basis of the most critical limit state and shall be checked for other limit states.

(iv). Limit states are the states beyond which the structure no longer satisfies requirements specified. The limit states are classified as,

⇒ Limit state of strength.

⇒ Limit state of serviceability.

Limit state of strength:

The limit state of strength includes,

(i) Loss of equilibrium of the structure as whole (ii) any of its parts (or) components.

(ii). Loss of stability of the structure

(iii) Failure by excessive deformation, rupture of structure.

(iv) Fracture due to fatigue.

(v). Brittle fracture.

Limit state of serviceability:

The limit state of servicability includes,

(i). Deformation and deflection which affects the appearance & effective use of structure.

(ii). Vibrations in the structure.

(iii). Repairable damage.

(iv). Crack due to fatigue.

(v). Corrosion, durability.

(vi). Fire.

Advantages:

(i) This method provides both strength and serviceability to the structure.

(ii). Have adequate durability under normal maintenance.

(iii). Does not suffer overall damage or collapse.

(iv). This method makes the structure remain fit with adequate reliability.

(ii). Various grades in structural steel:

The various grades in structural steel are,

⇒ E 165 [Fe 290] E 200, E 275

⇒ E 300

⇒ E 350

⇒ E 410

⇒ E 440

⇒ E 450, E 500

⇒ E 550

⇒ E 600, E 650

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eg: E 410 [Fe 500] WAB

⇒ E indicates the engineering steel

⇒ Fe indicates the steel element

⇒ The value with E indicates yield tensile strength of steel in N/mm^2.

⇒ The value with F indicates the ultimate tensile strength of steel in N/mm^2.

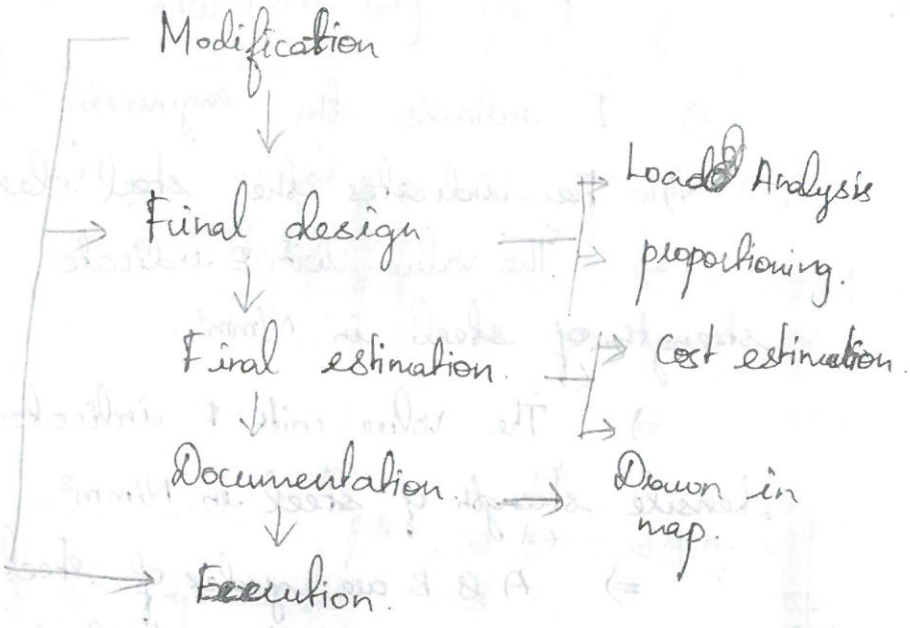
⇒ A & B are grades of steel.

⇒ W indicates the steel is weldable.

7.

(A). Steps involved in the process of design of steel structures:

The various steps involved in the process of design of steel structures are given by the following.



(1). Design procedure:

The first & foremost step is to analysis the objectives & constraint of design procedure.

(2). Alternative method for conceptual designing:

To find the alternative methods available for designing purpose.

(3) Preliminary design:

This step involves to identify the

⇒ load analysis.

⇒ proportioning, etc.

(4). Preliminary estimation:

This step involves to estimate the following,

⇒ Cost estimation.

⇒ Analysis of structures & design.
⇒ Load estimation.

(5). Modification:

The purpose of this step to rectify any mistakes in the preliminary design and preliminary estimation.

(6). Final design:

It is the final design after modification includes load analysis, proportioning.

(7). Final execution:

It is the final step before execution.

(8). Documentation:

This step involves the documentation of the design into a map.

(9). Execution:

It is finale step for the execution of design in the field.

PART - C

14 Marks:

8.

(A). Codal specifications for bolted connections

The codal specification for bolted

connections according to IS 800 : 2007 are given by the following:

(i). When members are connected to the surface of a web (or) the flange of a section, the ability of the web (or) flange to transfer the applied forces locally should be checked.

(ii). Ease of fabrication & erection should be considered in design of connection.

(iii). The ductility of the steel assists the distribution of forces generated with a joint.

(iv). Use of different forms of fastener to transfer the same force should be avoided.

Location detail of fasteners:

Clearance for holes for fasteners:

Nominal size of fastener	Standard clearance	Oversize clearance	Short slot	Long slot
(i). 12 - 14	1	3	4	2.5d
(ii). 16-22	2	4	6	2.5d
(iii). 24	2	6	8	2.5d
(iv). >24	3	8	10	2.5d

Minimum spacing:

The distance between centre of fasteners shall not be less than 2.5 times the nominal diameter of the fastener.

Maximum spacing:

The distance between the centres of any two adjacent fasteners shall not exceed 32t (or) 300 mm.

The distance between the centres of any two consecutive fasteners in a line adjacent & parallel to an edge of an outside plate shall not exceed 100 mm + 4t (or) 200 mm.

Edge & end distance:

The maximum edge & end distance from centre of any hole to the nearest edge of a plate,

⇒ shall not be less than 1.7 times the hole diameter. [in case of sheared]

⇒ 1.5 times the hole diameter [in case of rolled edges].

Tracking fasteners:

* They shall have spacing in a line not exceeding 32 times the thickness of the thinner outside plate or 300 mm.

* For compression members, tracking fasteners in line shall be spaced at a distance not exceeding 600 mm.

Countersunk heads:

For countersunk heads, one half of the depth of the countersinking shall be neglected.

Shear capacity of the bolt:

The shear strength is given by,

$$V_{nsb} = \frac{f_{ub}}{\sqrt{3}\,\gamma_{mb}} \left[n_n A_{sb} + n_s A_{sb} \right]$$

f_{ub} ⇒ ultimate tensile strength.

n_n ⇒ no. of. shear planes.

Bearing capacity of the bolts:

$$V_{dpb} = \frac{2.5 k_b d t f_u}{\gamma_{mb}}$$

e, p ⇒ end & pitch distance of the fastener.

do ⇒ diameter of the hole.

Tension capacity of the bolt:

$$T_{db} = \frac{0.9 f_{ub} A_n}{\gamma_{mb}}$$

Bolt subjected to combined shear & tension:

$$\left(\frac{V_{sb}}{V_{db}}\right)^2 + \left(\frac{T_b}{T_{db}}\right)^2 \leq 1.0$$

V_{sb} = factored shear force

V_{db} = shear capacity, T_b = factored tensile force, T_{db} = tension capacity.

Friction grip type bolting:

$$V_{dsf} = \frac{\mu_f n_e k_h F_o}{\gamma_{mf}}$$

shall not be less than ...

SECTION - 2

13 Marks:

PART - B:

15.

(A). Given data:

$f_{ub} = 800$

$d_b = 16\ mm.$

Thickness of plates $t = 10\ mm$ & $12\ mm.$

Load $= 200\ kN.$

To find:

(i). Slip is permitted.

(ii). Slip is not permitted.

Soln:

(i). Slip is not permitted:

Friction capacity of the bolt:

$$V_{dsf} = \frac{\mu_f\, n_e\, k_h\, F_o}{\gamma_{mf}}$$

$$= \frac{0.55 \times 1 \times 1 \times A_{nb} \times 0.70 \times f_{ub}}{1.25}$$

$$= \frac{0.55 \times 1 \times 1 \times 0.78 \times \pi/4 \times 16^2 \times 0.70 \times 800}{1.25}$$

$$\boxed{V_{dsf} = 38.642\ kN} \rightarrow (1)$$

(ii) Shear capacity of the bolt:

$$V_{dsb} = \frac{f_{ub}}{\sqrt{3}\,\gamma_{mb}} (n_n A_{nb} + n_s A_{sb})$$

$$= \frac{800}{\sqrt{3} \times 1.25} \left[\left(1 \times 0.78 \times \pi/4 \times 16^2 \right) 40 \right]$$

$$\boxed{V_{dsb} = 57.948 \text{ kN}} \rightarrow (2)$$

(iii) Tension capacity of the bolt:

$$T_{db} = \frac{0.90\, f_{ub}\, A_n}{\gamma_{mb}}$$

$$= \frac{0.90 \times 800 \times 0.78 \times \pi/4 \times 16^2}{1.25}$$

$$\boxed{T_{db} = 90.333 \text{ kN}} \rightarrow (3)$$

(iv) Bearing capacity of the bolt:

$$V_{dpb} = \frac{2.5\, k_b\, d_b\, t\, f_{ub}}{\gamma_{mb}}$$

$$k_b = \frac{e}{3d_0} = \frac{1.7 d_0}{3 d_0} = 0.56$$

$$k_b = \frac{p}{3d_0} - 0.25 = \frac{2.5 d_b}{3 d_0} - 0.25 = \frac{2.5 \times 16}{18 \times 3} - 0.25$$

$$= 0.49$$

$$k_b = \frac{800}{410} = 1.95$$

$$k_b = 1$$

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$$\therefore \quad V_{dpb} = \frac{2.5 \times 0.49 \times 16 \times 10 \times 800}{1.25}$$

$$\boxed{V_{dpb} = 125.440 \text{ kN}} \rightarrow (4).$$

From (1) (3) & (4),

the strength of the bolt when slip is not permitted } = 38.64 kN.

From (2), (3) & (4),

the strength of the bolt when slip is permitted } = 57.948 kN

(v) Number of bolts:

No. of. bolts : when slip is not permitted } = $\frac{\text{Load}}{\text{strength of the bolt.}}$

$$= \frac{200}{38.642} \simeq 5.\text{hog.}$$

= 5 nos. (bolts)

No. of. bolts when slip is permitted } = $\frac{200}{57.948} = 3.45 \simeq 4$

= 4 nos.

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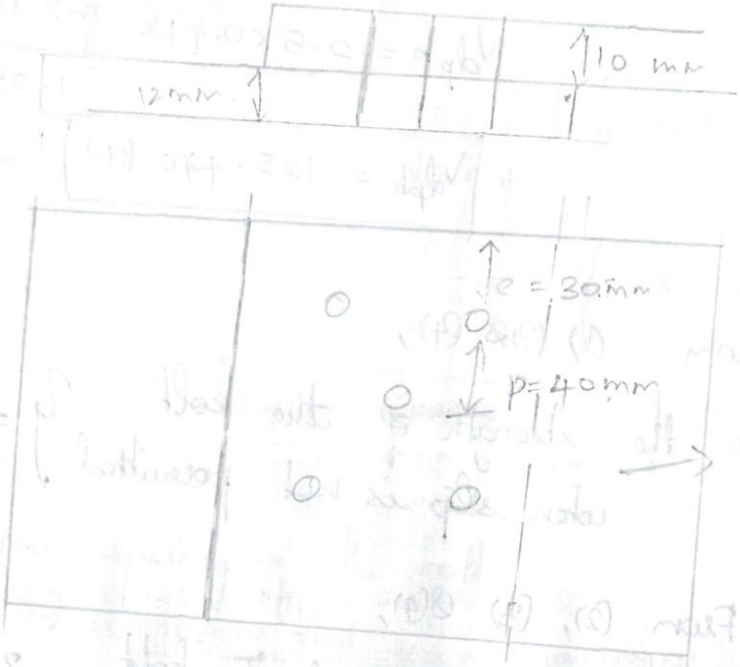
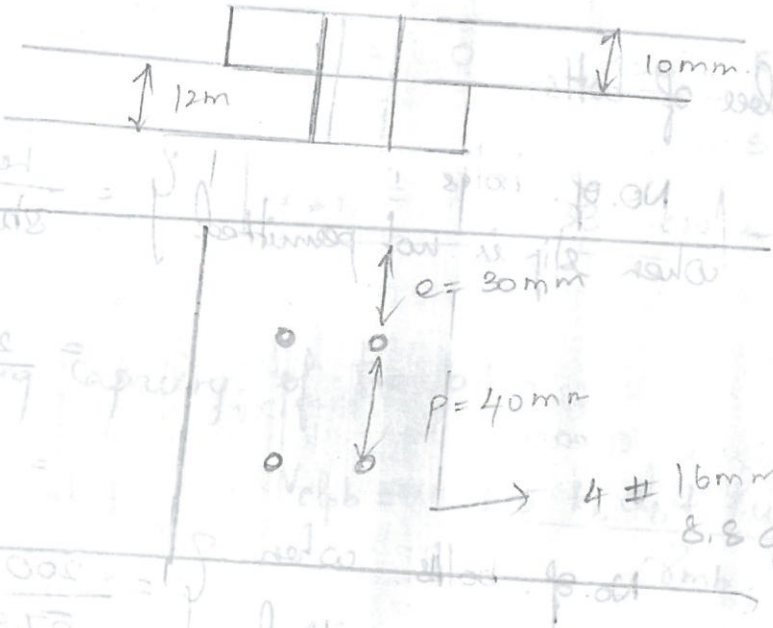
(vi) Slip is not permitted:



e = 30.9
P = 40

Slip is permitted:



PART - C

14 - Marks:

16.

(A) Given data:

thickness of gusset plate = 12mm

Load = 100 kN.

d_b = 12 mm.

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$f_{ub} = 400\ N/mm^2$.

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(i) Shear capacity of the bolt when angle on same side:

$$V_{dsb} = \frac{f_{ub}}{\sqrt{3} \times \gamma_{mb}} [n_n A_{nb} + n_s A_{sb}]$$

$$= \frac{400}{\sqrt{3} \times 1.25} [1 \times \pi/4 \times 0.78 \times 12^2]$$

$$\boxed{V_{dsb} = 16.298\ kN}$$

(ii) Shear capacity of the bolt when angle connected to either side of gusset plate:

$$V_{dsb} = \frac{f_{ub}}{\sqrt{3} \times \gamma_{mb}} [n_n A_{nb} + n_s A_{sb}]$$

$$= \frac{400}{\sqrt{3} \times 1.25} [2 \times \pi/4 \times 0.78 \times 12^2]$$

$$\boxed{V_{dsb} = 32.596\ kN}$$

(iii) Bearing capacity of the bolt:

$$V_{dpb} = \frac{2.5 k_b d_b t f_{ub}}{\gamma_{mb}}$$

$$k_b = \frac{e}{3d_o} = \frac{1.7 d_o}{3d_o} = 0.56$$

$$k_b = \frac{2.5 d_b}{3d_o} - 0.25 = \frac{2.5 \times 12}{3 \times 13} - 0.25 = 0.519$$

$$k_b = \frac{400}{410} = 0.98$$

$$k_b = 1$$

by comparing all the values, taking smaller

[i.e] $k_b = 0.519 = 0.519$

$$V_{dpb} = \frac{2.5 \times 0.519 \times 12 \times 10 \times 400}{1.25}$$

$$\boxed{V_{dpb} = 49.824 \text{ kN}}$$

(iii) Tension capacity of the bolt:

$$T_{db} = \frac{0.9 f_{ub} A_n}{\gamma_{mb}}$$

$$= \frac{0.9 \times 400 \times 0.78 \times \pi/4 \times 12^2}{1.25}$$

$$\boxed{T_{db} = 25.406 \text{ kN}}$$

I ⇒ Angles are connected to same side of gusset plate:

Strength of the plate:

$$T_{dn} = \frac{0.9 \times A_n \times f_{ub}}{\gamma_{m1}}$$

$$= \frac{0.9 \times 0.78 \times \pi/4 \times 12^2 \times 400}{1.25}$$

Strength of the connection = 16.298 kN.

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(A)

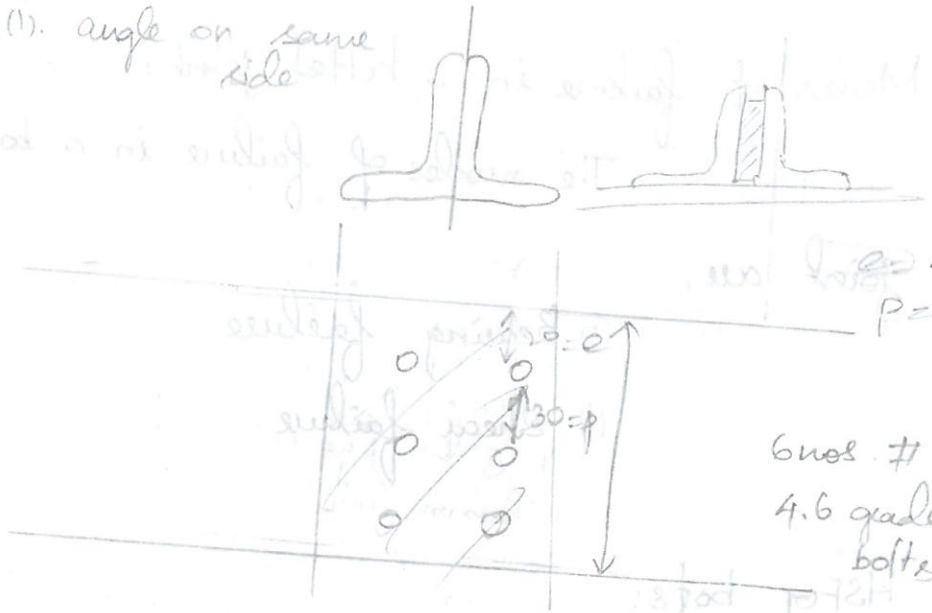
$$\text{No. of bolts} = \frac{100}{16.298} = 6 \simeq 6 \text{ nos.}$$

(II) ⇒ Angles are connected to the either side of the plate.

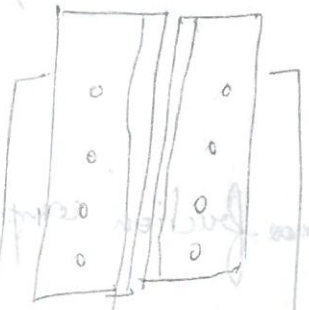
Strength of the connection = 25.406

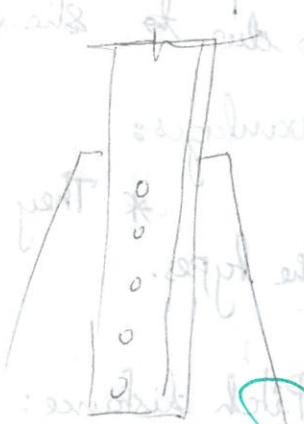
No. of. bolts = $\frac{100}{25.406}$ = 3.9 ≃ 4nos.

(i). angle on same side



(ii). angle on different side.





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SECTION - 2

Two marks:

9. Modes of failure in a bolted joint;

The modes of failure in a bolted joint are,

(i). Bearing failure.

(ii). Shear failure.

10. HSFG bolts:

(i). HSFG are high strength friction grip bolts.

(ii). In this bolts, the initial pretension in bolts developing the clamping force at the interfaces of elements being joined develops friction.

(iii). The frictional resistance to slip between the plate surface subjected to clamping force opposes slip due to shear.

Advantages:

* They resist more friction compared to other types.

11. Pitch distance:

Pitch distance is defined as the distance between two bolts.

$$P = 2.5 d_b$$

where, d_b ⇒ diameter of the bolts.

End distance:

It is defined as distance between the edge of the plate to the bolt.

$e = 1.7 d_o$ [in case of sheared cut edges]

$e = 1.5 d_o$ [in case of rolled, machine-flame cut, sawn & planed edges]

where d_o ⇒ diameter of the hole.

13. Prying force:

Prying force is defined as the extra force offered by the plate due to bending.

SECTION - I

Two Marks:

PART - D

5. partial safety factors specified in IS 800:2007.

Definition	Partial safety factor
(i). Resistance by yielding γ_{mo}	1.10
(ii). Resistance to buckling γ_{mo}	1.10
(iii). Resistance by ultimate stress γ_{m1}	1.25

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Definition	Partial Safety factor	
(iv). Resistance of Connection	shop fabrication	Field fabrication
(a). Bolts friction type.	1.25	1.25
(b). Bolts bearing type		
(c) Rivets	1.25	1.25
(d). Welds.	1.25	1.25
	1.25	1.50

SECTION-2

PART-B

13 Marks:

14. (B).

PERI INSTITUTE OF TECHNOLOGY

DEPARTMENT OF CIVIL ENGINEERING

ACADEMIC YEAR 2021- 2022 (EVEN)

INTERNAL EXAMINATION STUDENT FEEDBACK (CAT 1, CAT 2& MODEL)

Course code & Name: CE 8020 MAINTANENANCE AND REHABILITATION OF STRUCTURES **Exam Date:** 16.5.2022

Year / SEM: IV / VIII

Name of the Student: SURENDRA KUMAR . K

Question Paper Setting			
Description of Criteria	**Yes**	**No**	**Remarks**
Has the faculty framed the question paper in such a way that the given time is sufficient to complete?	✓		
Were the questions asked relevant to the syllabus covered?	✓		
Are the data given in all the questions sufficient?	✓		

Answer Script Valuation			
Description of Criteria	**Yes**	**No**	**Remarks**
Whether the valuation is done in accordance to the answer key?	✓		
Has the faculty suggested any comments/remarks for the improvement?	✓		

General issues			
Description of Criteria	**Yes**	**No**	**Remarks**
Describe any other additional issues faced during CAT exam	✓		Provide water during exam

K. Surendra kumar

Student Signature

PERI INSTITUTE OF TECHNOLOGY

DEPARTMENT OF CIVIL ENGINEERING

ACADEMIC YEAR 2021 - 2022 (EVEN).

INTERNAL EXAMINATION STUDENT FEEDBACK (CAT 1, CAT 2& MODEL)

Course code & Name: CE 8020 MAINTANENCE, REPAIR AND REHABILITATION OF STRUCTURES **Exam Date:** 16.05.2022.

Year / SEM: IV – VIII

Name of the Student: PRAVEEN. D.

Question Paper Setting			
Description of Criteria	**Yes**	**No**	**Remarks**
Has the faculty framed the question paper in such a way that the given time is sufficient to complete?		✓	All questions needed detail explanation so time not sufficient.
Were the questions asked relevant to the syllabus covered?	✓		
Are the data given in all the questions sufficient?	✓		

Answer Script Valuation			
Description of Criteria	**Yes**	**No**	**Remarks**
Whether the valuation is done in accordance to the answer key?	✓		
Has the faculty suggested any comments/remarks for the improvement?		✓	

General issues			
Description of Criteria	**Yes**	**No**	**Remarks**
Describe any other additional issues faced during CAT exam		✓	

Praveen. D.

Student Signature

PERI INSTITUTE OF TECHNOLOGY

DEPARTMENT OF CIVIL ENGINEERING

ACADEMIC YEAR 2021 – 2022 (even)

INTERNAL EXAMINATION STUDENT FEEDBACK (CAT 1, CAT 2& MODEL)

Course code & Name: CE8020 Maintenance, Repair and Rehabilitation of structures. **Exam Date:** 16.5.22

Year / SEM: IV – VIII

Name of the Student: YOGESHWARAN. PT

Question Paper Setting			
Description of Criteria	**Yes**	**No**	**Remarks**
Has the faculty framed the question paper in such a way that the given time is sufficient to complete?	✓		
Were the questions asked relevant to the syllabus covered?	✓		
Are the data given in all the questions sufficient?	✓		

Answer Script Valuation			
Description of Criteria	**Yes**	**No**	**Remarks**
Whether the valuation is done in accordance to the answer key?	✓		
Has the faculty suggested any comments/remarks for the improvement?	✓		

General issues			
Description of Criteria	**Yes**	**No**	**Remarks**
Describe any other additional issues faced during CAT exam	✓		Kindly keep examtime in (FN)

PT. Yogeshwaran.

Student Signature