KSRM College of Engineering (Autonomous)

(Approved by AICTE, Affiliated to JNTUA, Ananthapuramu, Accredited by NAAC)

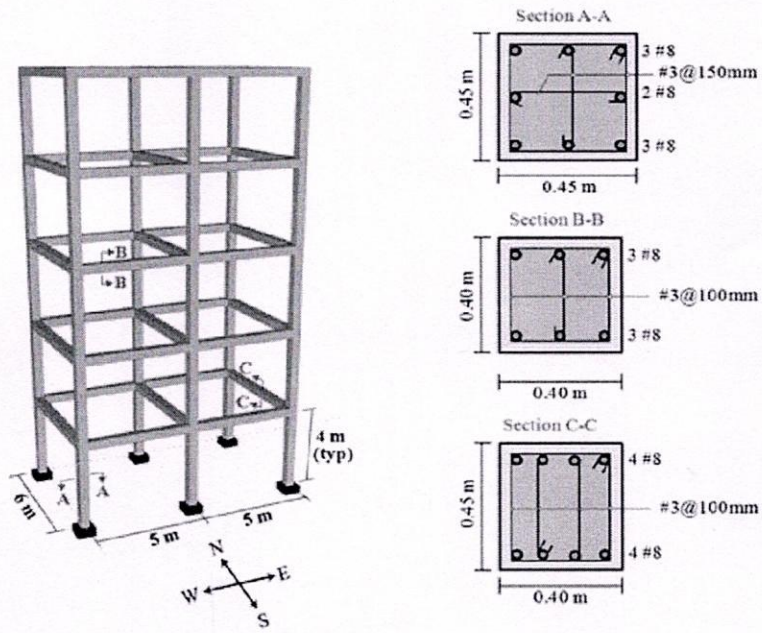
(An ISO 9001-2008 Certified Institution)

Department of Civil Engineering

Certification Course

on

Design of Compression members Using Microsoft Excel



Course Instructor: Prof. A. Mohan, Professor, CED, KSRMCE

Course Coordinators: Sri G. Venkata Raghu and Sri A. Anil Kumar, Assistant Professor, CED, KSRMCE

Dates: 22/03/21 to 09/04/21

K.S.R.M. COLLEGE OF ENGINEERING

(UGC-AUTONOMOUS)

Kadapa, Andhra Pradesh, India– 516 003

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Approved by AICTE, New Delhi & Affiliated to JNTUA, Ananthapuramu.

An ISO 14001:2004 & 9001: 2015 Certified Institution

Lr./KSRMCE/CE/2020-21/ Date: 10-03-2021

From
Sri G. Venkata Raghu and Sri A. Anil Kumar Asst. Professor
Dept. of Civil Engineering
KSRMCE
Kadapa.

To
The Principal
KSRMCE
Kadapa.

Sub: Permission to Conduct Certificate Course – Reg.

Respected Sir,

The Department of Civil Engineering is planning to offer a certification course on "Design of Compression members using Microsoft Excel" to UG students of Civil Engineering. The course will start on 22nd March 2021 to 09th April 2021. The course duration is 30hrs. In this regard, I request you to accept the certificate course proposal.

Thanking you

Yours faithfully

(Sri G. Venkata Raghu and Sri A. Anil Kumar)

Permitted
V. S. S Murthy

Cr./KSRMCE/CE/2020-21/ Date: 20/04/2021

Circular

The Department of Civil Engineering is offering a certification course on "Design of Compression members using Microsoft Excel". The course will start on 22nd March 2021 and the course will run for a total number of 30 hours. In this regard, all interested students of Civil Engineering are required to register for the Certificate Course. The registration link is given below.

https://docs.google.com/forms/f/g/1MDHpPLSxJmLMShZPPcJBvAnJYjl22pjWfgxXXVc5CKnG8sR2GfNdT9w/viewform

For any information regarding the workshop contact,

The Course Coordinators
Sri G. Venkata Raghu and Sri A. Anil Kumar,
Assistant Professor,
Dept. of Civil Engineering
KSRMCE.

V. S. S. Murthy

Principal

PRINCIPAL
K.S.R.M. COLLEGE OF ENGINEERING
KADAPA - 516 003. (A.P.)

Cc to:

The Director, KSRMCE

The HoD-Civil, KSRMCE

IQAC-KSRMCE

K.S.R.M. COLLEGE OF ENGINEERING

(UGC-AUTONOMOUS)

Kadapa, Andhra Pradesh, India– 516 003

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Department of Civil Engineering

Registration list of Certification course

on

Design of Compression members Using Microsoft Excel

Sl. No.	Reg. No.	Name	Section	Mail. ID
1	199Y1A0108	Anusha Dhamerla	A	199Y1A0108@ksrmce.ac.in
2	199Y1A0109	Chennakeshava Dirasantha	A	199Y1A0109@ksrmce.ac.in
3	199Y1A0116	Venkata Sai Janapati	A	199Y1A0116@ksrmce.ac.in
4	199Y1A0122	Nagarathna Kumbhagiri	A	199Y1A0122@ksrmce.ac.in
5	199Y1A0133	Venkata Siva Pagidi	A	199Y1A0133@ksrmce.ac.in
6	199Y1A0136	Arfathulla Khan Phatan	A	199Y1A0136@ksrmce.ac.in
7	199Y1A0141	Divya Ragi	A	199Y1A0141@ksrmce.ac.in
8	199Y1A0143	Hima Bindu Ravella	A	199Y1A0143@ksrmce.ac.in
9	199Y1A0144	Sadamini Sake	A	199Y1A0144@ksrmce.ac.in
10	199Y1A0146	Mahammad Salivemula	A	199Y1A0146@ksrmce.ac.in
11	199Y1A0147	Sudharshan Sandella	A	199Y1A0147@ksrmce.ac.in
12	199Y1A0159	Venkata Sai Pavan Sravanaboina	B	199Y1A0159@ksrmce.ac.in
13	199Y1A0163	Zareena Tasneem Syed	B	199Y1A0163@ksrmce.ac.in
14	199Y1A0164	Anil Kumar Reddy Thummala	B	199Y1A0164@ksrmce.ac.in

15	199Y1A0166	Venkata Sai Yeshaswini Uppu	B	199Y1A0166@ksrmce.ac.in
16	199Y1A0167	Chandrasekhar Vadde	B	199Y1A0167@ksrmce.ac.in
17	199Y1A0170	Prathyusha Yambadi	B	199Y1A0170@ksrmce.ac.in
18	209Y5A0101	Supraja Amarai	B	209Y5A0101@ksrmce.ac.in
19	209Y5A0102	Mahesh Amruthapuri	B	209Y5A0102@ksrmce.ac.in
20	209Y5A0103	Pavan Tej B Pavan Tej	B	209Y5A0103@ksrmce.ac.in
21	209Y5A0104	Surendra B	B	209Y5A0104@ksrmce.ac.in
22	209Y5A0105	Chinna Obulesu Bandela	B	209Y5A0105@ksrmce.ac.in
23	209Y5A0106	Sreehari Battena	B	209Y5A0106@ksrmce.ac.in
24	209Y5A0108	Pavan Kumar Reddy Bhumireddy	B	209Y5A0108@ksrmce.ac.in
25	209Y5A0109	Vishnu Vardhan Reddy Bollavaram	B	209Y5A0109@ksrmce.ac.in
26	209Y5A0110	Venkata Harsha Vardhini Boreddy	B	209Y5A0110@ksrmce.ac.in
27	209Y5A0111	Rupesh C	B	209Y5A0111@ksrmce.ac.in
28	209Y5A0112	Upendra Chakali	B	209Y5A0112@ksrmce.ac.in
29	209Y5A0113	Naga Venkata Tharun Kumar Chavidi	B	209Y5A0113@ksrmce.ac.in
30	209Y5A0114	Prudhviswar Reddy Chinnapareddy	B	209Y5A0114@ksrmce.ac.in
31	209Y5A0117	Jayadev Doppani	B	209Y5A0117@ksrmce.ac.in
32	209Y5A0118	Surekha Duggireddy	B	209Y5A0118@ksrmce.ac.in
33	209Y5A0119	Sandhya Erasala	B	209Y5A0119@ksrmce.ac.in
34	209Y5A0120	Harini G	B	209Y5A0120@ksrmce.ac.in

35	209Y5A0122	Santhosh Giddaluru	B	209Y5A0122@ksrmce.ac.in
36	209Y5A0123	Veera Chandana Giddaluru	B	209Y5A0123@ksrmce.ac.in
37	209Y5A0124	Geetha Nandini Gorige	B	209Y5A0124@ksrmce.ac.in
38	209Y5A0126	Venkata Sai Prasanna Jandlamaram	B	209Y5A0126@ksrmce.ac.in
39	209Y5A0127	Boya Kondaiah Jeripiti	B	209Y5A0127@ksrmce.ac.in
40	209Y5A0128	Kalinga Jukuru	B	209Y5A0128@ksrmce.ac.in
41	209Y5A0129	Guru Vinod Kaluva	B	209Y5A0129@ksrmce.ac.in
42	209Y5A0130	Kesava Rao Kanigiri	B	209Y5A0130@ksrmce.ac.in
43	209Y5A0131	Dharmateja Kathi	B	209Y5A0131@ksrmce.ac.in
44	209Y5A0132	Jyothi Sujatha Kodivalasa	B	209Y5A0132@ksrmce.ac.in
45	209Y5A0134	Ramakrishna Kondapuram	B	209Y5A0134@ksrmce.ac.in
46	209Y5A0135	Mallikarjuna Kummara	B	209Y5A0135@ksrmce.ac.in
47	209Y5A0136	Pushpalatha Kurra	B	209Y5A0136@ksrmce.ac.in
48	209Y5A0137	Dwarakanath Reddy Levaku	C	209Y5A0137@ksrmce.ac.in
49	209Y5A0139	Venkata Naveen Kumar Maduru	C	209Y5A0139@ksrmce.ac.in
50	209Y5A0141	Venkata Siva Mandem	C	209Y5A0141@ksrmce.ac.in
51	209Y5A0142	Sneha Mandugundu	C	209Y5A0142@ksrmce.ac.in
52	209Y5A0143	Ganesh Matamkari	C	209Y5A0143@ksrmce.ac.in
53	209Y5A0145	Venkata Jagadeeshwar Reddy Mudamala	C	209Y5A0145@ksrmce.ac.in
54	209Y5A0146	Kirankumar Reddy Mudiveti	C	209Y5A0146@ksrmce.ac.in

55	209Y5A0147	Jithendra Reddy Mule	C	209Y5A0147@ksrmce.ac.in
56	209Y5A0148	Hari Krishna Mutta	C	209Y5A0148@ksrmce.ac.in
57	209Y5A0149	Gopinath N	C	209Y5A0149@ksrmce.ac.in
58	209Y5A0150	Suneel Kumar Nandyala	C	209Y5A0150@ksrmce.ac.in
59	209Y5A0151	Muneendra Naripoyina	C	209Y5A0151@ksrmce.ac.in
60	209Y5A0152	Pavan Kalyan Reddy Nimmakayala	C	209Y5A0152@ksrmce.ac.in
61	209Y5A0153	Sowjanya Nimmakayala	C	209Y5A0153@ksrmce.ac.in
62	209Y5A0154	Ammeer Basha Pagadala	C	209Y5A0154@ksrmce.ac.in
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67	209Y5A0160	Madhusudhana Peyala	C	209Y5A0160@ksrmce.ac.in
68	209Y5A0161	Lakshmana Pillagowla	C	209Y5A0161@ksrmce.ac.in
69	209Y5A0162	Narendra Reddy Ponnapureddy	C	209Y5A0162@ksrmce.ac.in
70	209Y5A0163	Pavan Post	C	209Y5A0163@ksrmce.ac.in
71	209Y5A0164	Mohanbabu Pothuganti	C	209Y5A0164@ksrmce.ac.in
72	209Y5A0166	Obulesu Puli	C	209Y5A0166@ksrmce.ac.in
73	209Y5A0168	Mabujan Rayapati	C	209Y5A0168@ksrmce.ac.in
74	209Y5A0169	Deepak Sambu	C	209Y5A0169@ksrmce.ac.in

75	209Y5A0170	Jaya Simha Santolla	C	209Y5A0170@ksrmce.ac.in
76	209Y5A0171	Fareed Ahmed Shaik	C	209Y5A0171@ksrmce.ac.in
77	209Y5A0174	Sohail Shaik	C	209Y5A0174@ksrmce.ac.in
78	209Y5A0176	Parthasarathi Reddy Thammireddy	C	209Y5A0176@ksrmce.ac.in
79	209Y5A0180	Vinod Kumar Uppara	C	209Y5A0180@ksrmce.ac.in
80	209Y5A0181	Gayathri Vanthatipalli	C	209Y5A0181@ksrmce.ac.in
81	209Y5A0182	Venkataramana Vasi	C	209Y5A0182@ksrmce.ac.in
82	209Y5A0183	Sai Kumar Velligaram	C	209Y5A0183@ksrmce.ac.in
83	209Y5A0184	Jagan Mohan Reddy Vennapusa	C	209Y5A0184@ksrmce.ac.in
84	209Y5A0186	Madhava Reddy Vundela	C	209Y5A0186@ksrmce.ac.in
85	209Y5A0187	Hemadri Yatagiri	C	209Y5A0187@ksrmce.ac.in
86	209Y5A0188	Venugopal Yenumula	C	209Y5A0188@ksrmce.ac.in
87	209Y5A0189	Naga Mahendra Yerragorla	C	209Y5A0189@ksrmce.ac.in

Coordinator

HoD-Civil Engg.

Head
Department of Civil Engineering
K.S.R.M. College of Engineering
(Autonomous)
KADAPA 516 003. (A.P.)

Syllabus of Certification Course

Course Name: Design of Compression members using Microsoft Excel.

Duration: 30 Hours **Start Date: 22nd March 2021**

Module I:

Review of Limit State Method- Limit state of Collapse, Limit State of Flexure, Limit State of Serviceability

Module II:

Design of Axially loaded short columns

Module III:

Analysis and Design of short columns with Uniaxial Bending

Module IV:

Analysis and Design of short columns with Biaxial Bending

Text Books:

1. N. Subramanian, Design of Reinforced Concrete Structures; Oxford University Press, 2014
2. S Unnikrishna Pillai & Devdas Menon, Reinforced Concrete Design, McGraw Hill, 2021

Head
Department of Civil Engineering
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V. S. S. Murthy
PRINCIPAL
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KADAPA - 516 003. (A.P.)

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Department of Civil Engineering

Certification course

on

Design of Compression members using Microsoft Excel

Date	Timing	Course Instructor	Topic to be covered
22/03/21	4 PM to 6 PM	Prof. A. Mohan	Types of Limit states and its applications
23/03/21	4 PM to 6 PM	Prof. A. Mohan	Design Curves for grades of steels
24/03/21	4 PM to 6 PM	Prof. A. Mohan	Stress block parameters
25/03/21	4 PM to 6 PM	Prof. A. Mohan	Usage of IS456 in the design of Compression member
26/03/21	4 PM to 6 PM	Prof. A. Mohan	Design of axially loaded compression member
27/03/21	4 PM to 6 PM	Prof. A. Mohan	Analysis steps for a given strain profile
29/03/21	4 PM to 6 PM	Prof. A. Mohan	Analysis steps for a given strain profile
30/03/21	4 PM to 6 PM	Prof. A. Mohan	Interaction curve and its usage
01/04/21	4 PM to 6 PM	Prof. A. Mohan	Design f Section using SP16
02/04/21	4 PM to 6 PM	Prof. A. Mohan	Simplified Code Procedure for design of columns
6/04/21	4 PM to 6 PM	Prof. A. Mohan	Design of uniaxial compression members
7/04/21	4 PM to 6 PM	Prof. A. Mohan	Analysis of uniaxial compression members
8/04/21	4 PM to 6 PM	Prof. A. Mohan	Design of biaxial compression members
9/04/21	4 PM to 6 PM	Prof. A. Mohan	Analysis of biaxial compression members

Principal

PRINCIPAL
K.S.R.M. COLLEGE OF ENGINEERING
KADAPA - 516 003. (A.P.)

Instructor:

Coordinators:

Report

of

Certification Course on Design of Compression members using Microsoft Excel

From 22/03/2021 to 09/04/2021

Target Group	:	**Students**
Details of Participants	:	**87 Students**
Co-coordinator(s)	:	**Sri G. Venkata Raghu & Sri A. Anil Kumar**
Organizing Department	:	**Civil Engineering**
Venue	:	**Online (google meet)**

Link: https://meet.google.com/lookup/tj9rb1hrf

Description:

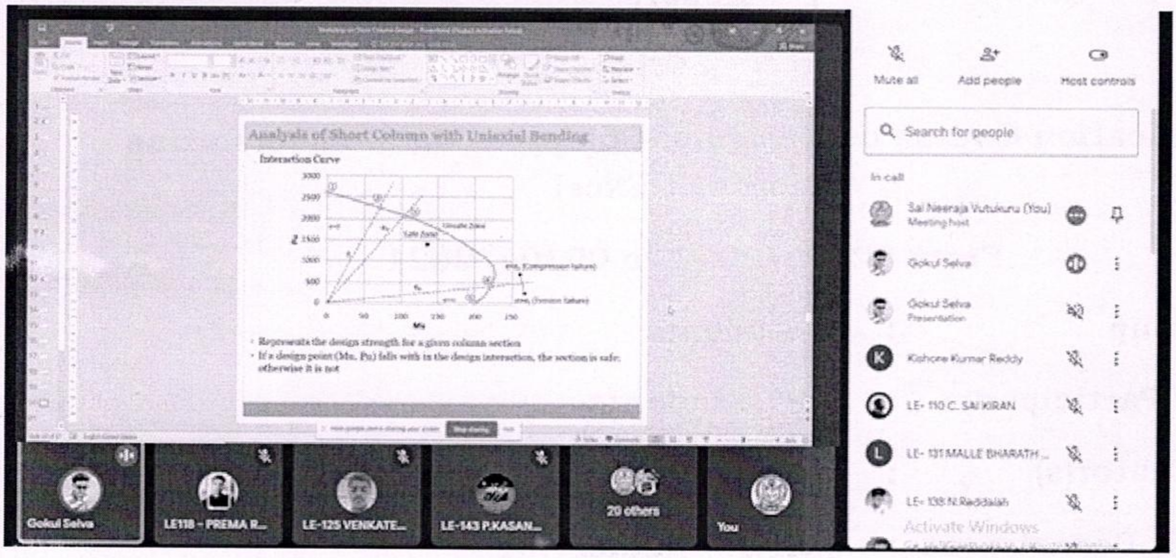
The Department of Civil Engineering conducted a certification course on "Design of Compression members using Microsoft Excel" from 22nd March 2021 to 9th April 2021. The course duration was 30 hours and the session on every day is from 4PM-6PM. The course instructor is Prof. A. Mohan, Professor, Department Civil Engineering and Coordinator are Sri G. Venkata Raghu and Sri A. Anil Kumar, Assistant Professor, Department of Civil Engineering.

The main design criteria for the compression members are effective cross sectional area and slenderness ratio of the members. Failure criteria such as buckling or crushing was also depending on the above two parameters. Instead of relying on the design software output for both steel and concrete quantities, it is better to design own economical sections using Microsoft excel by taking required data from design software.

The course was designed by considering the students have basic knowledge in Microsoft Excel. The course covered all types of compression member i.e. axially loaded members, members subjected to uniaxial bending and biaxial bending. Design was performed using both SP16 Code and interaction curve in IS 456.

Photo:

The picture taken during the course are given below:



(Course Instructor) (HoD, Civil Engg.) Principal

Head
Department of Civil Engineering
K.S.R.M. College of Engineering
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K.S.R.M. COLLEGE OF ENGINEERING

(UGC-AUTONOMOUS)

Kadapa, Andhra Pradesh, India- 516 003

Approved by AICTE, New Delhi & Affiliated to JNTUA, Ananthapuramu

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ESTD: 1980

DEPARTMENT OF CIVIL ENGINEERING

Certificate Course

On

"Design of compression members Using Microsoft Excel"

Resource Person

Prof. A. Mohan

Department of Civil Engineering

Coordinator:

Sri G. Venkata Raghu, Sri A. Anil Kumar
Assistant Professor, CED, KSRMCE

22-03-2021
to
09-04-2021

Department of Civil Engineering

Attendance sheet of Certification course on "Design of Compression members using Microsoft Excel"

Sl. No..	Student Roll No.	Student Name	22/03	23/03	24/03	25/03	26/03	27/03	29/03	30/03	01/04	02/04	06/04	07/04	08/04	09/04
1	199Y1A0108	Anusha Dhamerla	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		A
2	199Y1A0109	Chennakeshava Dirasantha	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A	✓
3	199Y1A0116	Venkata Sai Janapati	✓	✓	A	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
4	199Y1A0122	Nagarathna Kumbhagiri	✓	✓	A	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
5	199Y1A0133	Venkata Siva Pagidi	✓	✓	✓	A	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
6	199Y1A0136	Arfathulla Khan Phatan	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A	A	✓
7	199Y1A0141	Divya Ragi	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
8	199Y1A0143	Hima Bindu Ravella	✓	✓	✓	A	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
9	199Y1A0144	Sadamini Sake	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
10	199Y1A0146	Mahammad Salivemula	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
11	199Y1A0147	Sudharshan Sandella	A	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
12	199Y1A0159	Venkata Sai Pavan Sravanaboina	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A	✓	✓
13	199Y1A0163	Zareena Tasneem Syed	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A
14	199Y1A0164	Anil Kumar Reddy Thummala	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A	✓

15	199Y1A0166	Venkata Sai Yeshaswini Uppu	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
16	199Y1A0167	Chandrasekhar Vadde	✓	✓	✓	✓	✓	✓	✓	✓	✓	A	✓	✓	✓	✓
17	199Y1A0170	Prathyusha Yambadi	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
18	209Y5A0101	Supraja Amarai	✓	A	✓	✓	✓	✓	✓	✓	✓	✓	✓	A	✓	✓
19	209Y5A0102	Mahesh Amruthapuri	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
20	209Y5A0103	Pavan Tej B Pavan Tej	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
21	209Y5A0104	Surendra B	✓	A	✓	✓	✓	A	✓	✓	✓	✓	✓	✓	✓	✓
22	209Y5A0105	Chinna Obulesu Bandela	✓	✓	✓	✓	✓	A	✓	✓	✓	✓	✓	✓	✓	✓
23	209Y5A0106	Sreehari Battena	✓	✓	✓	✓	✓	✓	A	✓	✓	✓	✓	✓	✓	✓
24	209Y5A0108	Pavan Kumar Reddy Bhumireddy	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
25	209Y5A0109	Vishnu Vardhan Reddy Bollavaram	✓	✓	✓	✓	A	✓	✓	✓	✓	✓	✓	✓	✓	✓
26	209Y5A0110	Venkata Harsha Vardhini Boreddy	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A
27	209Y5A0111	Rupesh C	✓	✓	A	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
28	209Y5A0112	Upendra Chakali	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
29	209Y5A0113	Naga Venkata Tharun Kumar Chavidi	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A	✓
30	209Y5A0114	Prudhviswar Reddy Chinnapareddy	A	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
31	209Y5A0117	Jayadev Doppani	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

32	209Y5A0118	Surekha Duggireddy	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A	✓	✓	✓
33	209Y5A0119	Sandhya Erasala	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
34	209Y5A0120	Harini G	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
35	209Y5A0122	Santhosh Giddaluru	✓	✓	✓	✓	✓	A	✓	✓	✓	✓	✓	✓	✓	✓
36	209Y5A0123	Veera Chandana Giddaluru	✓	✓	✓	✓	✓	✓	✓	A	✓	✓	✓	✓	✓	A
37	209Y5A0124	Geetha Nandini Gorige	✓	✓	✓	A	✓	✓	✓	✓	✓	✓	✓	A	✓	✓
38	209Y5A0126	Venkata Sai Prasanna Jandlamaram	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
39	209Y5A0127	Boya Kondaiah Jeripiti	✓	✓	✓	✓	✓	✓	A	✓	✓	✓	✓	✓	✓	A
40	209Y5A0128	Kalinga Jukuru	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
41	209Y5A0129	Guru Vinod Kaluva	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				A
42	209Y5A0130	Kesava Rao Kanigiri	✓	✓	✓	✓	✓	✓	✓	✓	✓	A	✓	✓	✓	✓
43	209Y5A0131	Dharmateja Kathi	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
44	209Y5A0132	Jyothi Sujatha Kodivalasa	✓	✓	✓	A	✓	✓	✓	A	✓	✓	✓	✓	✓	✓
45	209Y5A0134	Ramakrishna Kondapuram	✓	✓	✓	A	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
46	209Y5A0135	Mallikarjuna Kummara	✓	A	✓	✓	✓	A	✓	✓	✓	✓	✓	✓	✓	✓
47	209Y5A0136	Pushpalatha Kurra	✓	✓	✓	✓	✓	✓	A	✓	✓	✓	✓	✓	✓	✓
48	209Y5A0137	Dwarakanath Reddy Levaku	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A

49	209Y5A0139	Venkata Naveen Kumar Maduru	✓	✓	✓	✓	A	✓	✓	✓	✓	✓	✓	✓	✓	✓
50	209Y5A0141	Venkata Siva Mandem	✓	✓	A	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
51	209Y5A0142	Sneha Mandugundu	✓	A	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
52	209Y5A0143	Ganesh Matamkari	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
53	209Y5A0145	Venkata Jagadeeshwar Reddy Mudamala	✓	✓	✓	✓	✓	A	✓	✓	✓	✓	✓	✓	✓	✓
54	209Y5A0146	Kirankumar Reddy Mudiveti	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
55	209Y5A0147	Jithendra Reddy Mule	✓	A	✓	✓	✓	✓	✓	✓	✓	✓	A	✓	✓	✓
56	209Y5A0148	Hari Krishna Mutta	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A	✓	✓	✓
57	209Y5A0149	Gopinath N	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
58	209Y5A0150	Suneel Kumar Nandyala	✓	✓	✓	✓	✓	✓	✓	A	✓	✓	✓	✓	✓	✓
59	209Y5A0151	Muneendra Naripoyina	✓	✓	✓	A	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
60	209Y5A0152	Pavan Kalyan Reddy Nimmakayala	✓	✓	A	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
61	209Y5A0153	Sowjanya Nimmakayala	✓	✓	✓	✓	✓	A	✓	✓	✓	✓	✓	✓	A	✓
62	209Y5A0154	Ammeer Basha Pagadala	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
63	209Y5A0156	Asma Paidepalli	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
64	209Y5A0157	Ramakumar Palla	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A	✓	✓
65	209Y5A0158	Obula Reddy Pasam	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A

66	209Y5A0159	Ajay Kumar Pesala	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
67	209Y5A0160	Madhusudhana Peyala	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
68	209Y5A0161	Lakshmana Pillagowla	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
69	209Y5A0162	Narendra Reddy Ponnapureddy	A	✓	A	✓	✓	✓	✓	✓	A	✓	✓	✓	✓	✓
70	209Y5A0163	Pavan Post	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
71	209Y5A0164	Mohanbabu Pothuganti	✓	✓	✓	✓	✓	✓	A	✓	✓	✓	✓	✓	✓	✓
72	209Y5A0166	Obulesu Puli	✓	A	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
73	209Y5A0168	Mabujan Rayapati	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
74	209Y5A0169	Deepak Sambu	✓	A	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
75	209Y5A0170	Jaya Simha Santolla	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
76	209Y5A0171	Fareed Ahmed Shaik	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
77	209Y5A0174	Sohail Shaik	A	✓	✓	✓	✓	✓	✓	✓	✓	✓	A	✓	✓	✓
78	209Y5A0176	Parthasarathi Reddy Thammireddy	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A	✓
79	209Y5A0180	Vinod Kumar Uppara	✓	A	✓	✓	✓	✓	✓	A	✓	✓	✓	✓	✓	✓
80	209Y5A0181	Gayathri Vanthatipalli	✓	✓	✓	A	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
81	209Y5A0182	Venkataramana Vasi	✓	✓	✓	✓	✓	A	✓	✓	✓	✓	✓	✓	✓	✓
82	209Y5A0183	Sai Kumar Velligaram	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A
83	209Y5A0184	Jagan Mohan Reddy Vennapusa	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	A	✓	✓	✓
84	209Y5A0186	Madhava Reddy Vundela	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

85	209Y5A0187	Hemadri Yatagiri	✓	✓	✓	✓	✓	✓	✓	A	✓	✓	✓	✓	✓	✓
86	209Y5A0188	Venugopal Yenumula	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
87	209Y5A0189	Naga Mahendra Yerragorla	✓	✓	A	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

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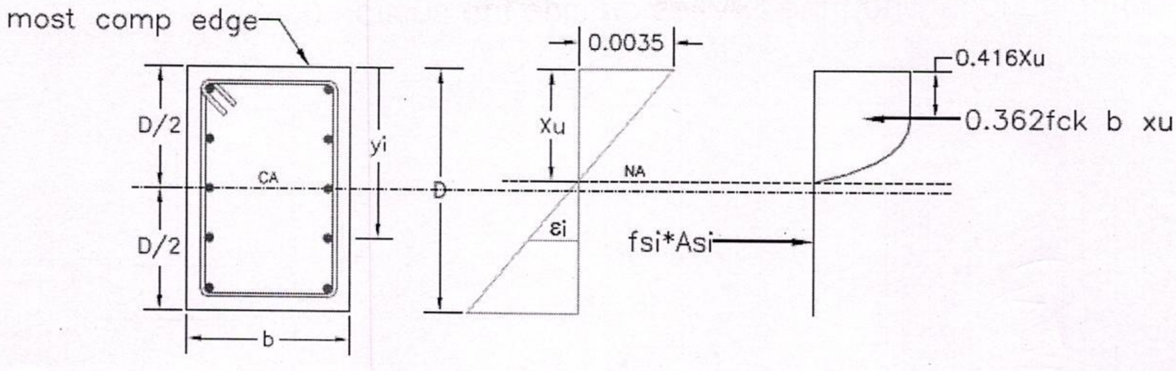
Computations when the NA lies inside the section (k≤1)



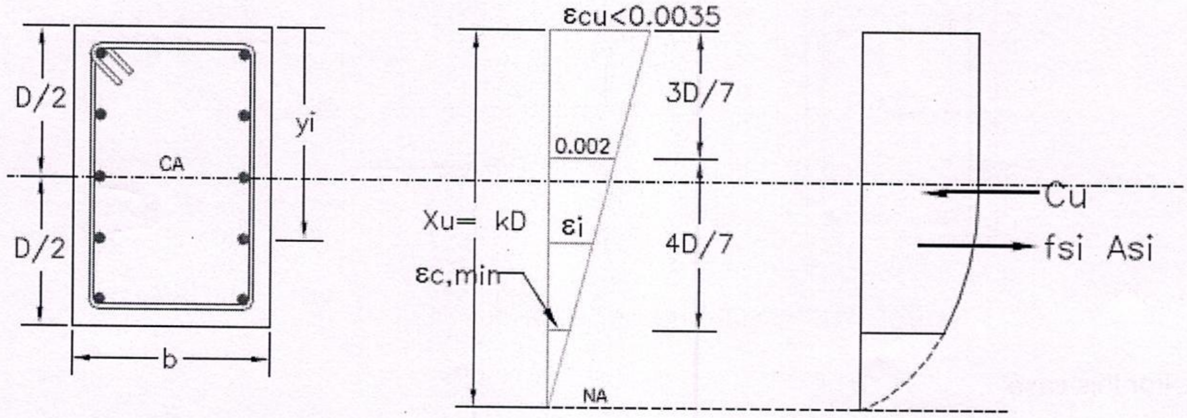
Neural Axis Inside the Section

For this case:

1. Both tension and compression exist in the section
2. Ratio $k = x_u/D \le 1$
3. Maximum strain in concrete $\varepsilon_{CU} = 0.0035$
4. The condition ε_{CU}=0.0035 and maximum $\varepsilon_{Si} = 0.002+0.87f_y/E_S$ is balanced failure for which $X_U = (0.0035/(0.0055+0.87f_y/E_S)(D-c')$; c' is effective cover
5. $X_U \ge X_{UMIN}$, otherwise column will under tensile force. X_{MIN} is found by trials
6. The condition $X_U = X_{UMIN}$ is pure flexure failure $\Rightarrow P_U = 0$, $e = \infty$

Depth of NA	X_U (known or assumed)	
Force in concrete	$C_{UC} = 0.362\, f_{CK}\, b\, X_U$	
Moment of C_{uc} about CA	$M_{UC} = C_{UC}\,(½D - 0.416\, X_U)$	
Strain in concrete/steel in layer i	$\varepsilon_i = 0.0035\left(\dfrac{x_u - y_i}{x_u}\right)$	
Stress in concrete in layer i	$f_{Ci} = 0$	if $\varepsilon_i < 0$
	$f_{ci}=0.447f_{CK}\left[2\left(\dfrac{\varepsilon_i}{0.002}\right)-\left(\dfrac{\varepsilon_i}{0.002}\right)^2\right]$	if $0\le \varepsilon_i \le 0.002$
	$f_{Ci} = 0.447\, f_{CK}$	if $\varepsilon_i > 0.002$
Stress in Steel in layer i	Read f_{Si} from corresponding stress-strain curve	
Force in Steel in layer i	$C_{Si} = (f_{Si} - f_{Ci})\, A_{Si}$	
Moment of C_{Si} about CA	$M_{Si} = C_{Si}\,(½D - y_i)$	
Ultimate Axial load capacity	$P_U = C_{UC} + \Sigma C_{Si}$	
Ultimate Moment capacity	$M_U = M_{UC} + \Sigma M_{Si}$	

Computations when the NA lies outside the section (k>1)



Neutral Axis Outside of Section (0<e<eD)

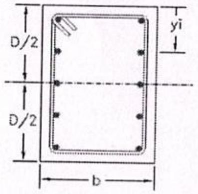
For this case:

1. Entire section is in compression
2. Ratio $k = x_u/D > 1$
3. Maximum strain ε_{CU} in concrete is such that $0.0020 \le \varepsilon_{CU} \le 0.0035$
4. The condition $\varepsilon_{CU} = 0.002$ is pure axial compression $\Rightarrow M_U = 0$, $e = 0$ & $X_U = \infty$

Description	Equation/Symbol	
Factor	$k = X_U/D$	
Force in concrete	$C_{UC}=0.447\left[1-\frac{4}{21}\left(\frac{4}{7k-3}\right)^2\right] f_{CK}bD$	
Moment of C_{UC} about CA	$M_{UC}=C_{UC}\left[0.5-\frac{0.5-\frac{8}{49}\left(\frac{4}{7k-3}\right)^2}{1-\frac{4}{21}\left(\frac{4}{7k-3}\right)^2}\right]D$	
Strain in concrete/steel in layer i	$\varepsilon_i=0.002\left(\frac{x_u-y_i}{x_u-\frac{3}{7}D}\right)$	
Stress in concrete in layer i	$f_{Ci} = 0$	if $\varepsilon_i < 0$
	$f_{Ci}=0.447f_{CK}\left[2\left(\frac{\varepsilon_i}{0.002}\right)-\left(\frac{\varepsilon_i}{0.002}\right)^2\right]$	if $0 \le \varepsilon_i \le 0.002$
	$f_{Ci} = 0.447\, f_{CK}$	if $\varepsilon_i > 0.002$
Stress in Steel in layer i	Read f_{Si} from corresponding stress-strain curve	

Force in Steel in layer i	$C_{Si} = (f_{Si} - f_{Ci})\ A_{Si}$
Moment of C_{Si} about CA	$M_{Si} = C_{Si}\ (½D - y_i)$
Ultimate Axial load capacity	$P_U = C_{UC} + \Sigma C_{Si}$
Ultimate Moment capacity	$M_U = M_{UC} + \Sigma M_{Si}$

Analysis and Design of RCC Column
Case: Axial load with Uniaxial moment
Configuration: Equal on Two faces

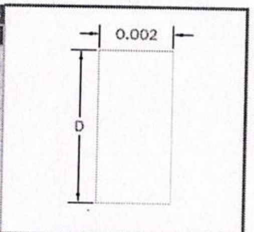


Section Properties			
Width	b=	300	mm
Depth	D=	500	mm
Clear Cover	c=	40	mm
Tie Diameter	Φv=	8	mm
Main Bar Diameter	Φ=	25	mm
Effective Cover	d'=	60.5	mm
Ratio	d'/D=	0.12	

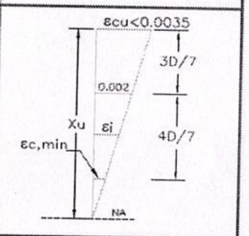
Materials and Design Loads			
Concrete Grade	fck=	25	MPa
Steel Grade	fy=	415	MPa
Factored Load	Pu=	1400	kN
Factored Moment	Mu=	135	kN
Eccentricity	e=	96	mm

Reinforcement			
% Steel	p=	1.90	%
No. of Layers	n=	3	
No. of Bars		6	

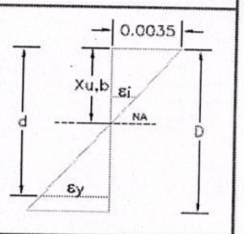
Case 1: Pure Axial Load Condition				xu=	∞	k=	∞
Layer	Yi	As	ε	fs	fc	P	M
1	60.5	950.0	0.002	327.7	11.2	300.7	57.0
2	250.0	950.0	0.002	327.7	11.2	300.7	0.0
3	439.5	950.0	0.002	327.7	11.2	300.7	-57.0
In Steel						902.2	0.0
In Concrete						1676.3	0.0
Total						2578.5	0.0



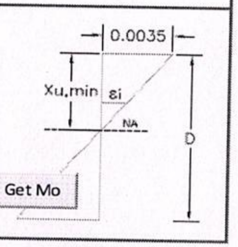
Case 2: NA outside section				xu=	650.0 mm	k=	1.300
Layer	Yi	As	ε	fs	fc	P	M
1	60.5	950.0	0.00271	350.4	11.2	322.3	61.1
2	250.0	950.0	0.00184	319.6	11.1	293.0	0.0
3	439.5	950.0	0.00097	193.7	8.2	176.2	-33.4
In Steel						791.6	27.7
In Concrete						1539.0	24.5
Total						2330.5	52.2



Case 4: Balanced Condition				xu,b=	210.6 mm	k=	0.421
Layer	Yi	As	ε	fs	fc	P	M
1	60.5	950.0	0.00249	345.0	11.2	317.1	60.1
2	250.0	950.0	-0.00066	-131.4	0.0	-124.8	0.0
3	439.5	950.0	-0.00381	-360.9	0.0	-342.9	65.0
In Steel						-150.6	125.1
In Concrete						571.7	92.8
Total						421.1	217.9



Case 5: Pure Flexure Condition				xu,min=	139.0 mm	k=	0.278
Layer	Yi	As	ε	fs	fc	P	M
1	60.5	950.0	0.00198	326.9	11.2	299.9	56.8
2	250.0	950.0	-0.00279	-352.1	0.0	-334.5	0.0
3	439.5	950.0	-0.00757	-360.9	0.0	-342.9	65.0
In Steel						-377.4	121.8
In Concrete						377.4	72.5
Total						0.0	194.3



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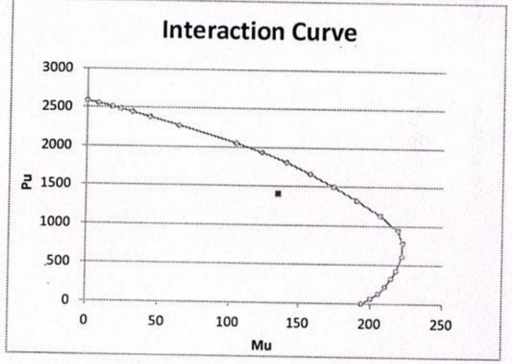
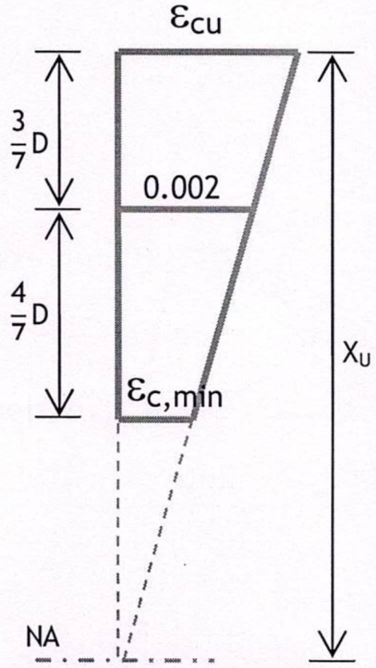
Interaction Curve						
P	M	e	k	x	Remark	
0.0	194.3	∞	0.278	139.0	Flexure	Tension->
59.7	200.3	3352.3	0.307	153.3		
124.6	205.6	1649.9	0.335	167.6		
214.3	210.3	981.5	0.364	181.9		
322.8	214.4	664.4	0.393	196.3		
421.1	217.9	517.5	0.421	210.6	Balanced	
605.6	222.0	366.6	0.479	239.5		<-Compression
775.3	222.4	286.9	0.537	268.5		
938.5	219.0	233.4	0.595	297.4		
1128.2	206.5	183.0	0.653	326.3		
1320.8	190.1	143.9	0.711	355.3		
1496.3	173.8	116.2	0.768	384.2		
1658.4	157.4	94.9	0.826	413.2		
1801.4	140.3	77.9	0.884	442.1		
1929.1	122.9	63.7	0.942	471.1		
2048.4	104.3	50.9	1.000	500.0	e=eD	
2268.3	64.0	28.2	1.200	600.0		
2376.3	43.3	18.2	1.400	700.0		
2439.0	31.1	12.7	1.600	800.0		
2479.7	23.1	9.3	1.800	900.0		
2507.7	17.5	7.0	2.000	1000.0		
2550.6	7.9	3.1	3.000	1500.0		
2578.5	0.0	0.0	∞	∞	Axial	



$$f_c = 0.447 f_{CK}\left[2\left(\frac{\varepsilon}{0.002}\right) - \left(\frac{\varepsilon}{0.002}\right)^2\right] \quad 0 \le \varepsilon \le 0.002$$

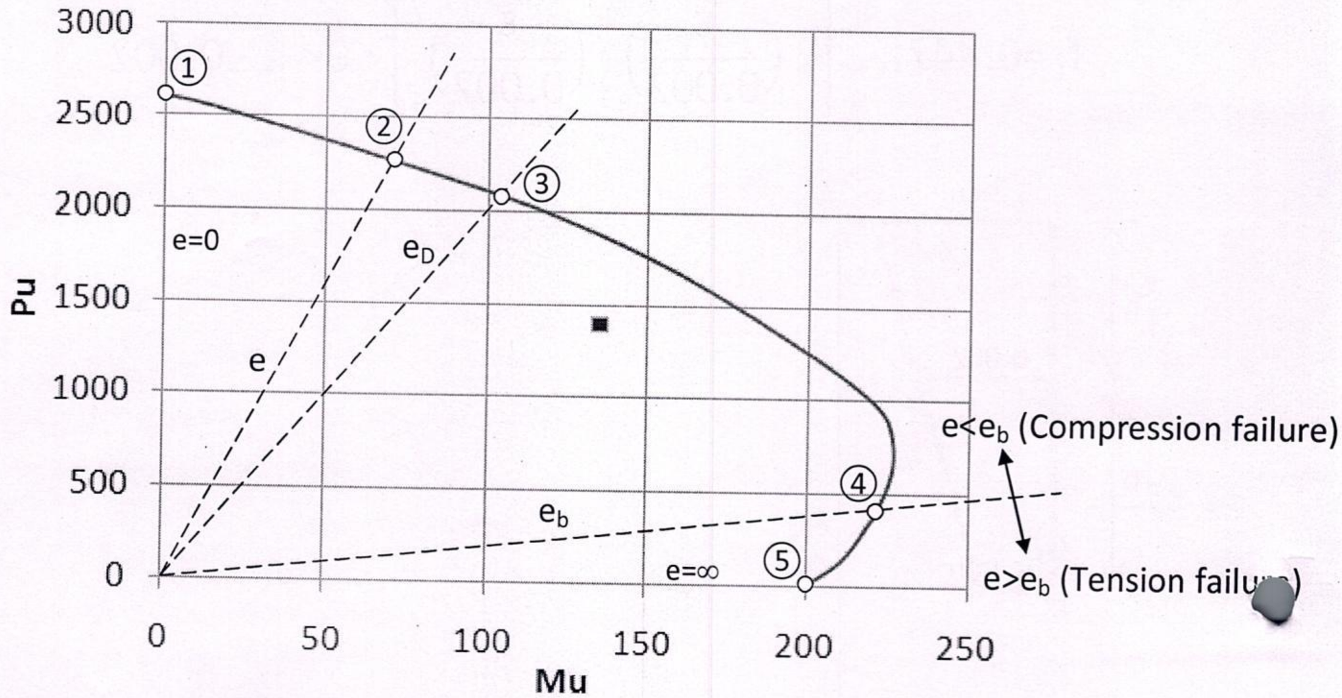


The strain ε at any depth y from the most compressed edge is

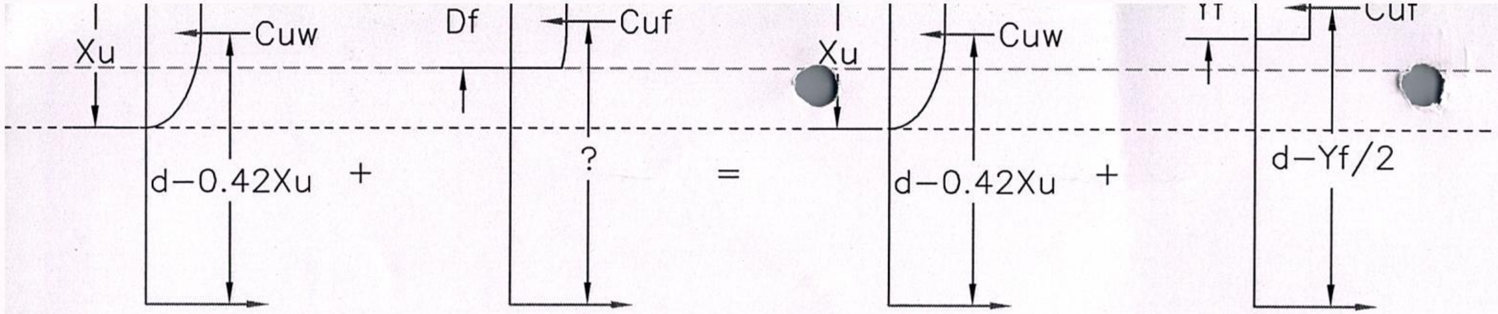
$$\varepsilon = \varepsilon_{cu} - \frac{\varepsilon_{cu} - \varepsilon_{c,min}}{D} y$$

$$\varepsilon = \varepsilon_{cu} - \left[\frac{7}{3}\varepsilon_{cu} - \frac{4}{3}\,0.0035\right]\frac{y}{D}$$

$$\varepsilon = 0.002 \;\; at \; y = \frac{3}{7}D$$

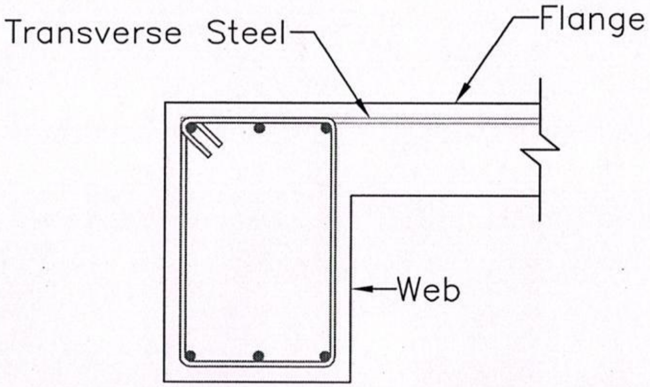


3000
2500
2000
1500
1000
500
0
Pu
0
50
100
150
200
250
Mu
①
②
③
④
⑤
e=0
e
e_D
e_b
e=∞
e<e_b (Compression failure)
e>e_b (Tension failure)

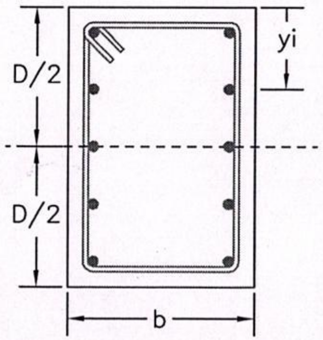


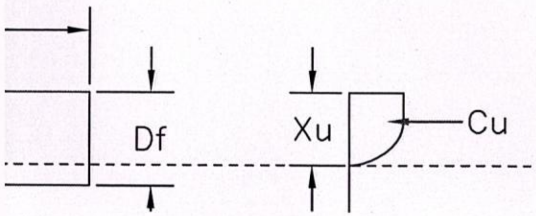
Actual Stress on Web width=bw | Actual Stress on Flange width=(bf−bw) | Actual Stress on Web width=bw | Equi. Stress on Flange width=(bf−bw)

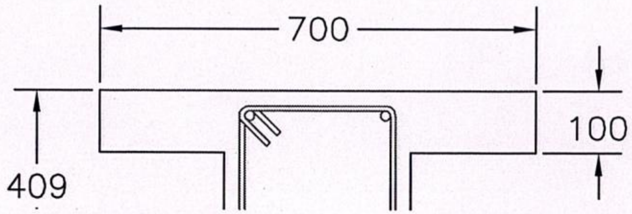
erse Steel



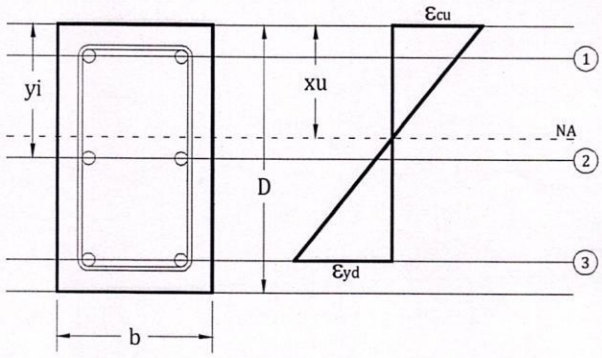
L−Section







A 300x500 mm column is reinforced with 6-25ϕ bars. Find the design strength components Pu and Mu corresponding to the condition of balanced failure. Use M25 concrete and Fe415 steel. Consider the loading eccentricity with respect to major axis. Assume 40 mm clear cover to ties. Diameter of ties is 8 mm.



1. Given data
   a. Section properties

Width	=b	=	300 mm
Depth	=D	=	500 mm
Clear cover	=c	=	40 mm
Main bar size	=ϕ	=	25 mm
Size of tie	$=\phi_T$	=	8 mm

   b. Material properties

Concrete strength	$=f_{ck}$	=	25 MPa
Steel strength	$=f_y$	=	415 MPa

2. Analysis
   a. Depth of neutral axis

   For balanced failure condition:

Strain in most compressive conc fibre	$=\varepsilon_{cu}$	=	0.0035
Strain in most tensile steel layer	$=\varepsilon_{st}=0.002+0.87f_y/E_s$	=	0.0038
Depth to most tensile steel layer	$=d=D-c-\phi_T-\phi/2$	=	439.5 mm
Depth of neutral axis	$=x_u=d(\varepsilon_{cu}/(\varepsilon_{cu}+\varepsilon_{st}))$	=	210.6 mm

   b. Force and moment due to concrete (moment about centroidal axis)

Compressive force in concrete	$=C_c=0.362f_{ck}bx_u$	=	571.7 kN
Moment of C_c about centroidal axis	$=M_c=C_c(0.5D-0.416x_u)$	=	92.8 kNm

c. Force and moment due to steel (moment about centroidal axis)

Let y_i=depth to steel layer from most compressed fibre. Then at layer i

Strain in steel $\varepsilon_{si}=0.0035(1-y_i/x_u)$; is +ve if compression

Stress in steel f_{si} is read from design stress-strain curve

Stress in concrete $f_{ci} = 0.447 f_{ck}\left[2\left(\frac{\varepsilon_i}{0.002}\right)-\left(\frac{\varepsilon_i}{0.002}\right)^2\right]$ for $\varepsilon_{si}>0$ else $f_{ci}=0$

Force in steel $C_{si}=(f_{si}-f_{ci})A_{si}$

Moment of f_{si} $M_{si}=f_{si}(0.5D-y_i)$

Design axial load $P_u=C_c+\Sigma C_{si}$

Design moment $M_u=M_c+\Sigma M_{si}$

The calculations are given in the following table

Layer	y_i mm	A_{si} mm^2	ε_{si}	f_{si} MPa	f_{ci} MPa	C_{si} kN	M_{si} kNm
1	60.5	981.7	0.00249	345.0	10.5	328.4	62.2
2	250.0	981.7	-0.00066	-131.4	0.0	-129.0	0.0
3	439.5	981.7	-0.00381	-360.9	0.0	-354.3	67.1
					Sum	-154.9	129.4

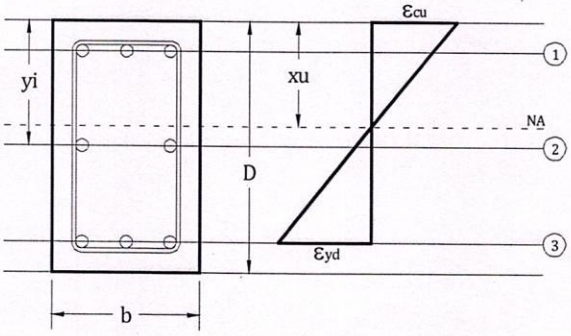
d. Balanced failure design forces

Axial load capacity $P_u=C_c+\Sigma C_{si}$ = 416.7 kN

Moment capacity $M_u=M_c+\Sigma M_{si}$ = 222.2 kNm

Balanced failure eccentricity $e_b=M_u/P_u$ = 533.2 mm

A, 4 m long, 300x500 mm column is subjected to a factored load of 1400 kN and factored moment of 280 kNm with respect to major axis. Design the longitudinal .reinforcement. Use M25 concrete and Fe415 steel. Assume effective length coefficient as 0.8.



1. Given data
   a. Section properties

Width	=b	=	300 mm
Depth	=D	=	500 mm
Length	=l	=	4000 mm
Let effective cover	=c'	=	50 mm

   b. Material properties

Concrete strength	=f_{ck}	=	25 MPa
Steel strength	=f_y	=	415 MPa

   c. Factored forces

Factored axial load	=P_u	=	1400 kN
Factored moment	=M_{u1}	=	280 kNm

2. Design forces

Effective length	=l_e	=	3200 mm
Slenderness ratio	=λ	=	6.4 <12

Hence, consider minimum eccentricity and neglect slenderness effects

Minimum eccentricity	=e_{min}=l_e/500+D/30>=20 mm	=	23.1 mm
Moment due to e_{min}	=M_{umin}	=	32.3 kNm
Hence, design moment	=M_u=Max(M_{u1}, M_{umin})	=	280.0 kNm
Arrangement of steel	=equally distributed on four faces		
No of bars	=8		

3. Design procedure
   a. Assume a suitable value of A_{sc} and x_u
   b. Estimate force capacity P_u' and M_u'
   c. If P_u=P_u' goto step (e) else revise x_u & goto step (b)
   d. If M_u=M_u' goto step (f)
   e. If Mu>Mu' increase A_{sc} else decrease A_{sc} & goto step (b)
   f. Required A_{sc} is obtained

4. Formulae for estimating P_u' and M_u' (in 3(b))

Concrete force and moment =

Total compressive force $C_c = a f_{ck} b D$

Moment of C_c about centroidal axis $M_c = C_c\left(\frac{D}{2} - \bar{x}\right)$

$$\text{where } a = 0.362\frac{x_u}{D} \quad \text{for } x_u \le D$$

$$= 0.447\left(1 - \frac{4g}{21}\right) \quad \text{for } x_u > D$$

$$\bar{x} = 0.416 x_u \quad \text{for } x_u \le D$$

$$= \frac{\left(0.5 - \frac{8g}{49}\right)}{\left(1 - \frac{4g}{21}\right)} D \quad \text{for } x_u > D$$

$$\text{and } g = \frac{16}{\left(\frac{7x_u}{D} - 3\right)^2}$$

Steel force and moment =

Total compressive force $C_s = \sum (f_{si} - f_{ci}) A_{si}$

Moment of C_s about centroidal axis $M_s = \sum (f_{si} - f_{ci}) A_{si}\left(\frac{D}{2} - y_i\right)$

$$\text{where } f_{ci} = 0 \quad \text{for } \varepsilon_{si} \le 0$$

$$= 0.447 f_{ck} \quad \text{for } \varepsilon_{si} \ge 0.002$$

$$= 0.447 f_{ck}\left[2\left(\frac{\varepsilon_{si}}{0.002}\right) - \left(\frac{\varepsilon_{si}}{0.002}\right)^2\right] \quad \text{otherwise}$$

$$\text{and } \varepsilon_{si} = 0.0035\left(1 - \frac{y_i}{x_u}\right) \quad \text{for } x_u \le D$$

$$= 0.002\left(1 + \frac{\frac{3}{7}D - y_i}{x_u - \frac{3}{7}D}\right) \quad \text{for } x_u > D$$

5. Calculation (final iteration)

Assumed percentage steel	=p	=	2.96 %
Area of steel	$=A_{sc}$	=	4440 mm^2
Assumed neutral axis depth	$=x_u$	=	350 mm

Layer	y_i mm	A_{si} mm^2	ε_{si}	f_{si} MPa	f_{ci} MPa	C_{si} kN	M_{si} kNm
1	50.0	1665.0	0.00300	353.9	11.2	570.6	114.1
2	250.0	1110.0	0.00100	200.5	8.4	213.2	0.0
3	450.0	1665.0	-0.00100	-200.5	0.0	-333.8	66.8
					Sum	450.1	180.9

Compressive force in concrete	$=C_c$	=	950.3 kN
Moment of C_c about centroidal axis	$=M_c$	=	99.2 kNm
Axial load capacity	$P_u'=C_c+\Sigma C_{si}$	=	1400.3 kN
Moment capacity	$M_u'=M_c+\Sigma M_{si}$	=	280.1 kNm

Hence calculated P_u'=given P_u and calculated M_u'=given M_u

Required steel	$=A_{sc}$	=	4440 mm^2
Required diameter of each bar	$=\phi$	=	26.6 mm
Hence provide 8-28ϕ bars giving	$=A_{sc}$	=	4926 mm^2
Percentage steel	=p	=	3.3 %
			>0.8%
			<4% Hence Ok

CERTIFICATE COURSE ON

Design of Compression members

Course Instructor: Prof. A. Mohan

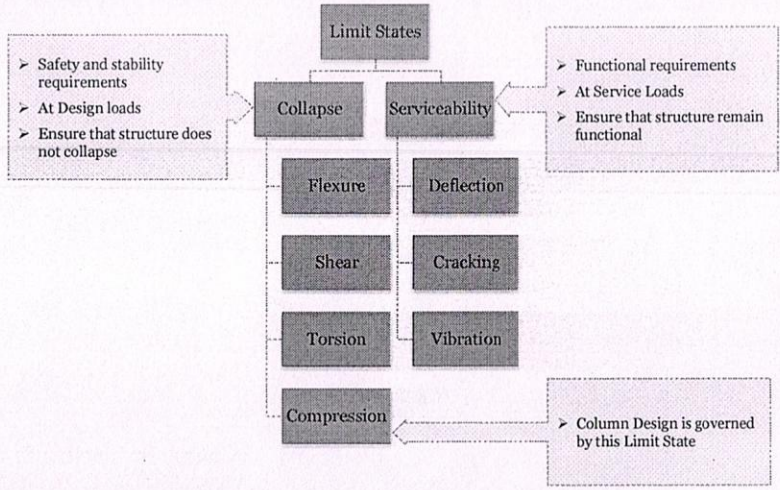
Review – What is a Limit State?

1. A Limit State is a state of impending failure, beyond which a structure ceases to perform its intended function in terms of safety and serviceability
2. On attainment of a Limit State a structure may either collapse or become unserviceable
3. Types of Limit States
   i. Limit States of Collapse
   ii. Limit States of Serviceability

In This Workshop

- Review of Limit State Method
- Design of Short Axially Loaded Columns
- Analysis of Short Columns with Uniaxial Bending
- Analysis of Short Columns with Biaxial Bending

Review – Types of Limit States



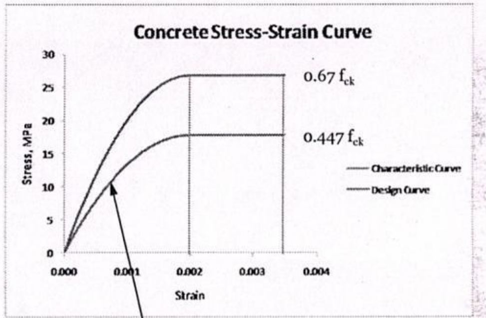
Review – Stress-Strain Diagrams for Fe415 Steel

Design Curve for Fe415

Stress Level	Elastic Strain	Inelastic Strain	Total Strain	Design Stress
0.800 $f_y/1.15$	0.00144	0.0000	0.00144	288.7
0.850 $f_y/1.15$	0.00153	0.0001	0.00163	306.7
0.900 $f_y/1.15$	0.00162	0.0003	0.00192	324.8
0.950 $f_y/1.15$	0.00171	0.0007	0.00241	342.8
0.975 $f_y/1.15$	0.00176	0.0010	0.00276	351.8
1.000 $f_y/1.15$	0.00180	0.0020	0.00380	360.9

Review – Stress-Strain Diagrams Concrete

Characteristic and Design Curves



$$f_c = 0.447 f_{CK}\left[2\left(\frac{\varepsilon}{0.002}\right) - \left(\frac{\varepsilon}{0.002}\right)^2\right] \quad 0 \le \varepsilon \le 0.002$$

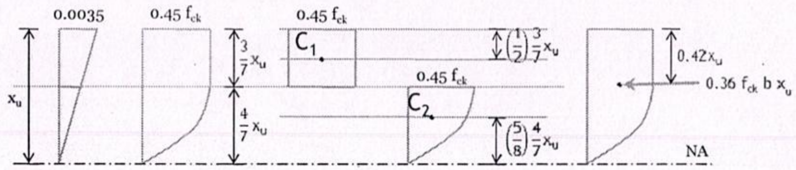
Review – Stress-Strain Diagrams for Fe500 Steel

Design Curve for Fe500

Stress Level	Elastic Strain	Inelastic Strain	Total Strain	Design Stress
$0.800\ f_y/1.15$	0.00174	0.0000	0.00174	347.8
$0.850\ f_y/1.15$	0.00185	0.0001	0.00195	369.6
$0.900\ f_y/1.15$	0.00196	0.0003	0.00226	391.3
$0.950\ f_y/1.15$	0.00207	0.0007	0.00277	413.0
$0.975\ f_y/1.15$	0.00212	0.0010	0.00312	423.9
$1.000\ f_y/1.15$	0.00217	0.0020	0.00417	434.8

Review – Concrete (Full) Stress Block Parameters

Concrete Stress Block Parameters



Force $C_1 = b^* 0.45\ f_{ck}^* \frac{3}{7} x_u = 0.193\ f_{ck} b\ x_u$ acting at $\frac{3}{14} x_u$ from top

Force $C_2 = b^* \frac{2}{3}\ (0.45\ f_{ck})^* \frac{4}{7} x_u = 0.17\ f_{ck} b\ x_u$ acting at $\frac{20}{56} x_u$ from NA

Total $C = (0.193 + 0.170) f_{ck}\ b\ x_u = 0.36\ f_{ck}\ b\ x_u$

$$\text{Location of C from Top} = \frac{0.193\ f_{ck}\ b\ x_u \left(\frac{3}{14} x_u\right) + 0.17\ f_{ck} b\ x_u \left(x_u - \frac{20}{56} x_u\right)}{0.36\ f_{ck}\ b\ x_u} = 0.42\ x_u$$

By This Time...

- ✓ Review of Limit State Method
- Design of Short Axially Loaded Columns
- Analysis of Short Columns with Uniaxial Bending
- Analysis of Short Columns with Biaxial Bending

Design of Axially Loaded Short Column

- For $\varepsilon = 0.002$, the design stresses are
  - For concrete : $0.447 f_{ck}$
  - For Fe250 : $0.870 f_y$
  - For Fe415 : $0.790 f_y$
  - For Fe500 : $0.746 f_y$
- Then Design strength is

  $P_u = 0.447 f_{ck} A_g + (f_{sc} - 0.447 f_{ck}) A_{sc}$

  $P_u = 0.447 f_{ck} A_c + f_{sc} A_{sc}$
- Code reduces the strength by about 10% and gives the Design strength as

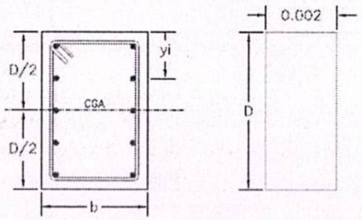
  $P_u = 0.4 f_{ck} A_c + 0.67 f_y A_{sc}$
- The required condition is $e \leq 0.05$ * lateral dimension

Design of Axially Loaded Short Column

- A compression member is considered as short if slenderness ratio is less than 12 (§25.1.1)
- Maximum strain in axial compression is taken as 0.002 (§39.1.a)
- Minimum Eccentricity for design shall be (§25.4)
  - $e_{min} = l/500 + b/30$
  - $e_{min} = 20$ mm
- If $e_{min} < 0.05$ times lateral dimension, the design equation is given by §39.3

The member shall be designed by considering the assumptions given in 39.1 and the minimum eccentricity. When the minimum eccentricity as per 25.4 does not exceed 0.05 times the lateral dimension, the members may be designed by the following equation:

$$P_u = 0.4 f_{ck}.A_c + 0.67 f_y.A_{sc}$$



1. Pure Axial Compression (e=0)

By This Time...

- ✓ Review of Limit State Method
- ✓ Design of Short Axially Loaded Columns
- Analysis of Short Columns with Uniaxial Bending
- Analysis of Short Columns with Biaxial Bending

Analysis of Short Column with Uniaxial Bending

Assumptions

- Plane sections normal to the axis remain plane after bending ⇒ strain varies linearly across the section
- The maximum strain in concrete (at highly compressed edge) is taken as

  $\varepsilon_{cu} = 0.0035$ if $x_u \le D$ (⇒ section has both tension & compression)

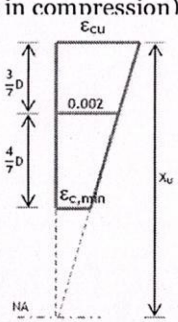
  $\varepsilon_{cu} = 0.0035 - 0.75\,\varepsilon_{c,min}$ if $x_u \ge D$ (⇒ total section is in compression)

The strain ε at any depth y from the most compressed edge is

$$\varepsilon = \varepsilon_{cu} - \frac{\varepsilon_{cu} - \varepsilon_{c,min}}{D}\,y$$

$$\varepsilon = \varepsilon_{cu} - \left[\frac{7}{3}\varepsilon_{cu} - \frac{4}{3}\,0.0035\right]\frac{y}{D}$$

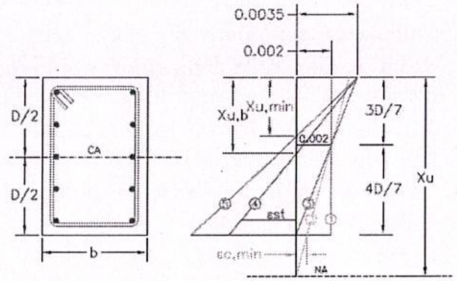
$$\varepsilon = 0.002 \;\; at\; y = \frac{3}{7}D$$



- Tensile strength of concrete is ignored
- Stress in steel is derives from its representative stress-strain curve

Analysis of Short Column with Uniaxial Bending

General Strain Profiles at Limit State



Case (1)

- Uniform compressive strain of $\varepsilon_{cu} = 0.002$ across the column section
- Eccentricity is zero ($e = 0$ and $M_u = 0$)
- Neutral axis is at infinity ($x_u = \infty$)

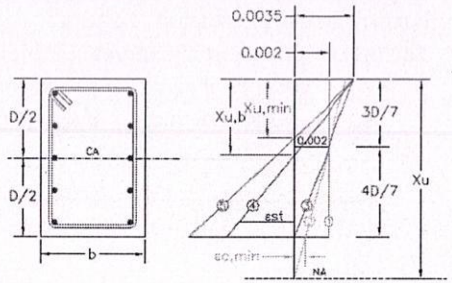
Analysis of Short Column with Uniaxial Bending

General Analysis Steps for a given Strain Profile

- Draw the stress diagram for concrete and find total compressive force C_u
- Calculate the moment M_{uc} of C_u about the centroidal axis
- From strain profile determine strain ε_i in all steel bars and read corresponding stress f_{si} for each of the bars
- Calculate the total force in steel bars as $\Sigma C_{si} = \Sigma(f_{si} - f_{ci})A_{si}$. f_{ci} is the stress in concrete at the level of steel bar i
- Calculate moment of forces in steel bars about centroidal axis as ΣM_{si}
- Ultimate axial load $P_u = C_u + \Sigma C_{si}$
- Ultimate moment is $M_u = M_{uc} + \Sigma M_{si}$

Analysis of Short Column with Uniaxial Bending

General Strain Profiles at Limit State

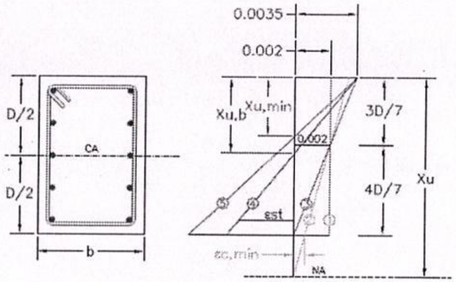


Case (2)

- General case of uniaxial compression ($M_u \neq 0$, $P_u \neq 0$)
- NA lies outside of section and $e_D < e < \infty$
- Strain varies linearly from ε_{cu} (<0.0035) to $\varepsilon_{c,min}$
- There is no tension in the column section

Analysis of Short Column with Uniaxial Bending

General Strain Profiles at Limit State

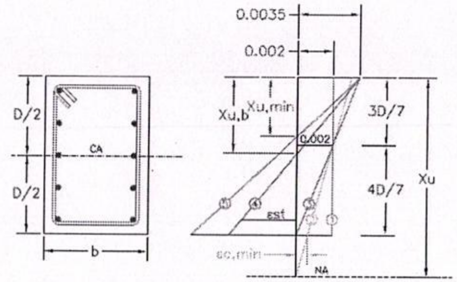


Case (3)

- NA coincides with the least compressed edge and $e = e_D$
- For $e > e_D$, entire section is under compression and NA lies outside of section
- For $e < e_D$, tension also exists, NA lies with the section and $\varepsilon_{cu} = 0.0035$

Analysis of Short Column with Uniaxial Bending

General Strain Profiles at Limit State

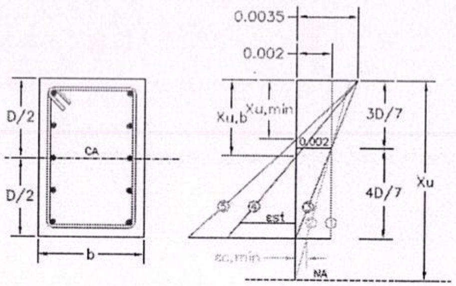


Case (5)

- Section is subjected to pure bending and axial load $P_u = 0$
- NA depth is minimum at $x_{u,min}$
- If $x_u < x_{u,min}$ then section is under axial tension and moment
- $x_{u,min}$ is found by trails

Analysis of Short Column with Uniaxial Bending

General Strain Profiles at Limit State

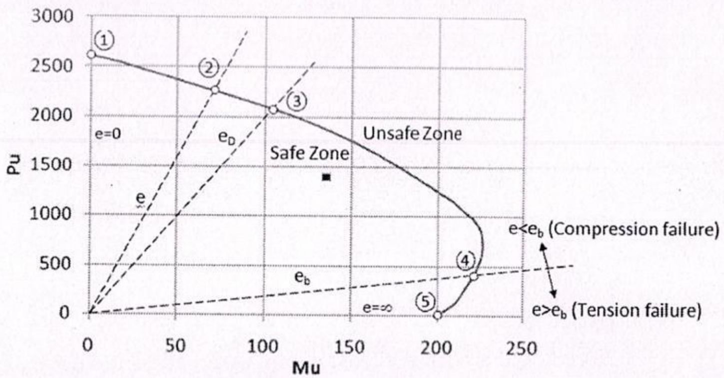


Case (4)

- Is called the balanced failure condition which is a tension failure
- NA depth is $x_{u,b} = d(\varepsilon_{cu}/(\varepsilon_{cu}+\varepsilon_{st}))$
- Maximum concrete strain $\varepsilon_{cu} = 0.0035$
- Maximum steel in steel $\varepsilon_{st} = \varepsilon_{yd}$

Analysis of Short Column with Uniaxial Bending

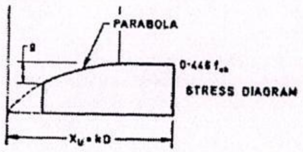
Interaction Curve



- Represents the design strength for a given column section
- If a design point (Mu, Pu) falls with in the design interaction, the section is safe; otherwise it is not

Analysis of Short Column with Uniaxial Bending

Stress Block Parameters for $x_u > D$



Let $x_u = kD$ and let g be the difference between the stress at the highly compressed edge and the stress at the least compressed edge. Considering the geometric properties of a parabola,

$$g = 0{\cdot}446 f_{ck} \left[\frac{\frac{4}{7}D}{kD - \frac{3}{7}D} \right]^2$$

$$= 0{\cdot}446 f_{ck} \left(\frac{4}{7k-3} \right)^2$$

Area of stress block

$$= 0{\cdot}446 f_{ck} D - \frac{g}{3}\left(\frac{4}{7}D\right)$$

$$= 0{\cdot}446 f_{ck} D - \frac{4}{21} gD$$

$$= 0{\cdot}446 f_{ck} D \left[1 - \frac{4}{21}\left(\frac{4}{7k-3}\right)^2\right]$$

The centroid of the stress block will be found by taking moments about the highly compressed edge.

Moment about the highly compressed edge

$$= 0{\cdot}446 f_{ck} D \left(\frac{D}{2}\right) - \frac{4}{21} gD \left[\frac{3}{7}D + \frac{3}{4}\left(\frac{4}{7}D\right)\right]$$

$$= 0{\cdot}446 f_{ck} \frac{D^2}{2} - \frac{8}{49} gD^2$$

The position of the centroid is obtained by dividing the moment by the area. For different values of k, the area of stress block and the position of its centroid are given in Table H.

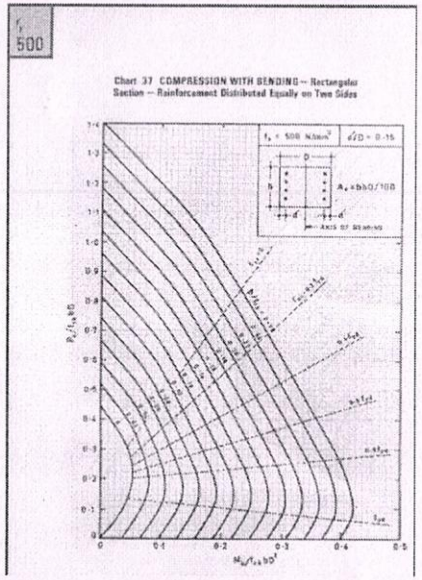
By This Time...

- ✓ Review of Limit State Method
- ✓ Design of Short Axially Loaded Columns
- ✓ Analysis of Short Columns with Uniaxial Bending
- Analysis of Short Columns with Biaxial Bending

Design of Short Column with Uniaxial Bending

Design of Section Using SP16

- Design charts are provided for rectangular and circular section
- Different configurations of steel placement for rectangular sections
- Charts for Fe250, Fe415 and Fe500
- Now-a-days computer programs are used for design



Design of Short Column with Biaxial Bending

Simplified Code Procedure for Design

39.6 Members Subjected to Combined Axial Load and Biaxial Bending

The resistance of a member subjected to axial force and biaxial bending shall be obtained on the basis of assumptions given in **39.1** and **39.2** with neutral axis so chosen as to satisfy the equilibrium of load and moments about two axes. Alternatively such members may be designed by the following equation:

$$\left[\frac{M_{ux}}{M_{ux1}}\right]^{\alpha_n} + \left[\frac{M_{uy}}{M_{uy1}}\right]^{\alpha_n} \leq 1.0$$

where

M_{ux}, M_{uy} = moments about x and y axes due to design loads,

M_{ux1}, M_{uy1} = maximum uniaxial moment capacity for an axial load of P_u, bending about x and y axes respectively, and

α_n is related to P_u/P_{uz}

where $P_{uz} = 0.45 f_{ck} \cdot A_c + 0.75 f_y \cdot A_{sc}$

For values of P_u/P_{uz} = 0.2 to 0.8, the values of α_n vary linearly from 1.0 to 2.0. For values less than 0.2, α_n is 1.0; for values greater than 0.8, α_n is 2.0.

By This Time...

- ✓ Review of Limit State Method
- ✓ Design of Short Axially Loaded Columns
- ✓ Analysis of Short Columns with Uniaxial Bending
- ✓ Analysis of Short Columns with Biaxial Bending

Workshop Concludes

Have A Nice Day

Discussion

Queries Please!!!

K.S.R.M College of Engineering

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KADAPA, ANDHRA PRADESH, INDIA-516003

DEPARTMENT OF CIVIL ENGINEERING

CERTIFICATE OF COURSE COMPLETION

This certificate is presented to

Venkata Sai J. (Reg. No. 199Y1A0116), Student of KSRM College of Engineering (Autonomous) for successful completion of certification course on "**Design of compression members Using Microsoft Excel**" offered by Department of Civil Engineering, KSRMCE-Kadapa.

Course Duration: 30 Hours;
From 22/03/2021 to 09/04/2021

Course Instructor:
Prof. A. Mohan,
Professor, CE, KSRMCE-Kadapa

G. V. Ragha

Coordinator

Head of the Department

V. S. S. Murthy

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CERTIFICATE OF COURSE COMPLETION

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Professor, CE, KSRMCE-Kadapa

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Department of Civil Engineering

Feedback of students on Certification Course on "Design of Compression members using Microsoft Excel"

Sl. No.	Reg. No.	Name of The Student	Do you understand use of Excel for Civil Engg.?	Are the lecture hours sufficient to cover the topics?	Rate the course instructor	Is this course useful for your Carrier?	Rate the entire course?
1	199Y1A0108	Anusha Dhamerla	Yes	Yes	Excellent	Yes	5
2	199Y1A0109	Chennakeshava Dirasantha	Yes	Yes	Excellent	Yes	5
3	199Y1A0116	Venkata Sai Janapati	Yes	Yes	Excellent	Yes	5
4	199Y1A0122	Nagarathna Kumbhagiri	Yes	Yes	Excellent	Yes	5
5	199Y1A0133	Venkata Siva Pagidi	Yes	Yes	Excellent	Yes	5
6	199Y1A0136	Arfathulla Khan Phatan	Yes	No	Excellent	Yes	5
7	199Y1A0141	Divya Ragi	Yes	Yes	Excellent	Yes	5
8	199Y1A0143	Hima Bindu Ravella	Yes	Yes	Excellent	Yes	5
9	199Y1A0144	Sadamini Sake	Yes	Yes	Excellent	Yes	3
10	199Y1A0146	Mahammad Salivemula	Yes	Yes	Good	Yes	5
11	199Y1A0147	Sudharshan Sandella	Yes	Yes	Excellent	Yes	5
12	199Y1A0159	Venkata Sai Pavan Sravanaboina	Yes	Yes	Excellent	Yes	5
13	199Y1A0163	Zareena Tasneem Syed	Yes	Yes	Excellent	Yes	5
14	199Y1A0164	Anil Kumar Reddy Thummala	Yes	Yes	Good	Yes	5

15	199Y1A0166	Venkata Sai Yeshaswini Uppu	Yes	Yes	Excellent	Yes	5
16	199Y1A0167	Chandrasekhar Vadde	Yes	Yes	Good	Yes	5
17	199Y1A0170	Prathyusha Yambadi	Yes	Yes	Excellent	Yes	5
18	209Y5A0101	Supraja Amarai	Yes	Yes	Excellent	Yes	5
19	209Y5A0102	Mahesh Amruthapuri	Yes	Yes	Excellent	Yes	5
20	209Y5A0103	Pavan Tej B Pavan Tej	Yes	Yes	Excellent	Yes	5
21	209Y5A0104	Surendra B	Yes	Yes	Excellent	Yes	5
22	209Y5A0105	Chinna Obulesu Bandela	Yes	Yes	Excellent	Yes	5
23	209Y5A0106	Sreehari Battena	Yes	Yes	Excellent	Yes	5
24	209Y5A0108	Pavan Kumar Reddy Bhumireddy	Yes	Yes	Excellent	Yes	5
25	209Y5A0109	Vishnu Vardhan Reddy Bollavaram	Yes	Yes	Excellent	Yes	5
26	209Y5A0110	Venkata Harsha Vardhini Boreddy	Yes	Yes	Good	Yes	4
27	209Y5A0111	Rupesh C	Yes	Yes	Good	Yes	5
28	209Y5A0112	Upendra Chakali	Yes	Yes	Excellent	Yes	5
29	209Y5A0113	Naga Venkata Tharun Kumar Chavidi	Yes	Yes	Excellent	Yes	5
30	209Y5A0114	Prudhviswar Reddy Chinnapareddy	Yes	Yes	Excellent	Yes	5

31	209Y5A0117	Jayadev Doppani	Yes	Yes	Excellent	Yes	5
32	209Y5A0118	Surekha Duggireddy	Yes	Yes	Good	Yes	5
33	209Y5A0119	Sandhya Erasala	Yes	Yes	Excellent	Yes	5
34	209Y5A0120	Harini G	Yes	Yes	Excellent	Yes	5
35	209Y5A0122	Santhosh Giddaluru	Yes	Yes	Excellent	Yes	5
36	209Y5A0123	Veera Chandana Giddaluru	Yes	Yes	Excellent	Yes	5
37	209Y5A0124	Geetha Nandini Gorige	Yes	Yes	Excellent	Yes	5
38	209Y5A0126	Venkata Sai Prasanna Jandlamaram	Yes	Yes	Excellent	Yes	5
39	209Y5A0127	Boya Kondaiah Jeripiti	Yes	Yes	Excellent	Yes	5
40	209Y5A0128	Kalinga Jukuru	Yes	Yes	Excellent	Yes	4
41	209Y5A0129	Guru Vinod Kaluva	Yes	Yes	Excellent	Yes	5
42	209Y5A0130	Kesava Rao Kanigiri	Yes	Yes	Good	Yes	5
43	209Y5A0131	Dharmateja Kathi	Yes	Yes	Excellent	Yes	5
44	209Y5A0132	Jyothi Sujatha Kodivalasa	Yes	Yes	Excellent	Yes	5
45	209Y5A0134	Ramakrishna Kondapuram	Yes	Yes	Excellent	Yes	5
46	209Y5A0135	Mallikarjuna Kummara	Yes	Yes	Excellent	Yes	5
47	209Y5A0136	Pushpalatha Kurra	Yes	Yes	Excellent	Yes	5
48	209Y5A0137	Dwarakanath Reddy Levaku	Yes	No	Excellent	Yes	5
49	209Y5A0139	Venkata Naveen Kumar Maduru	Yes	Yes	Excellent	Yes	5

50	209Y5A0141	Venkata Siva Mandem	Yes	Yes	Excellent	Yes	5
51	209Y5A0142	Sneha Mandugundu	Yes	Yes	Excellent	Yes	3
52	209Y5A0143	Ganesh Matamkari	Yes	Yes	Good	Yes	5
53	209Y5A0145	Venkata Jagadeeshwar Reddy Mudamala	Yes	Yes	Excellent	Yes	5
54	209Y5A0146	Kirankumar Reddy Mudiveti	Yes	Yes	Excellent	Yes	5
55	209Y5A0147	Jithendra Reddy Mule	Yes	Yes	Excellent	Yes	5
56	209Y5A0148	Hari Krishna Mutta	Yes	Yes	Good	Yes	5
57	209Y5A0149	Gopinath N	Yes	Yes	Excellent	Yes	5
58	209Y5A0150	Suneel Kumar Nandyala	Yes	Yes	Good	Yes	5
59	209Y5A0151	Muneendra Naripoyina	Yes	Yes	Excellent	Yes	5
60	209Y5A0152	Pavan Kalyan Reddy Nimmakayala	Yes	Yes	Excellent	Yes	5
61	209Y5A0153	Sowjanya Nimmakayala	Yes	Yes	Excellent	Yes	5
62	209Y5A0154	Ammeer Basha Pagadala	Yes	Yes	Excellent	Yes	5
63	209Y5A0156	Asma Paidepalli	Yes	Yes	Excellent	Yes	5
64	209Y5A0157	Ramakumar Palla	Yes	Yes	Excellent	Yes	5
65	209Y5A0158	Obula Reddy Pasam	Yes	Yes	Excellent	Yes	5
66	209Y5A0159	Ajay Kumar Pesala	Yes	Yes	Excellent	Yes	5
67	209Y5A0160	Madhusudhana Peyala	Yes	Yes	Excellent	Yes	5
68	209Y5A0161	Lakshmana Pillagowla	Yes	Yes	Good	Yes	4

69	209Y5A0162	Narendra Reddy Ponnapureddy	Yes	Yes	Good	Yes	5
70	209Y5A0163	Pavan Post	Yes	Yes	Excellent	Yes	5
71	209Y5A0164	Mohanbabu Pothuganti	Yes	Yes	Excellent	Yes	5
72	209Y5A0166	Obulesu Puli	Yes	Yes	Excellent	Yes	5
73	209Y5A0168	Mabujan Rayapati	Yes	Yes	Excellent	Yes	5
74	209Y5A0169	Deepak Sambu	Yes	Yes	Good	Yes	5
75	209Y5A0170	Jaya Simha Santolla	Yes	Yes	Excellent	Yes	5
76	209Y5A0171	Fareed Ahmed Shaik	Yes	Yes	Excellent	Yes	5
77	209Y5A0174	Sohail Shaik	Yes	Yes	Excellent	Yes	5
78	209Y5A0176	Parthasarathi Reddy Thammireddy	Yes	Yes	Excellent	Yes	5
79	209Y5A0180	Vinod Kumar Uppara	Yes	Yes	Excellent	Yes	5
80	209Y5A0181	Gayathri Vanthatipalli	Yes	Yes	Excellent	Yes	5
81	209Y5A0182	Venkataramana Vasi	Yes	Yes	Excellent	Yes	5
82	209Y5A0183	Sai Kumar Velligaram	Yes	Yes	Excellent	Yes	4
83	209Y5A0184	Jagan Mohan Reddy Vennapusa	Yes	Yes	Excellent	Yes	5
84	209Y5A0186	Madhava Reddy Vundela	Yes	Yes	Good	Yes	5
85	209Y5A0187	Hemadri Yatagiri	Yes	Yes	Excellent	Yes	5
86	209Y5A0188	Venugopal Yenumula	Yes	Yes	Excellent	Yes	5

87	209Y5A0189	Naga Mahendra Yerragorla	Yes	Yes	Excellent	Yes	5

Coordinator

HoD-Civil Engg.

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