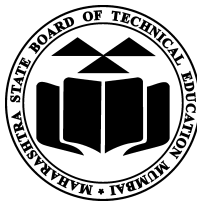


A Laboratory Manual for

Design of Structures

Third year Diploma in
Civil Engineering Group (CE, CR, CS)



Maharashtra State
Board of Technical Education, Mumbai

CURRICULUM DEVELOPMENT CELL, MSBTE, MUMBAI.

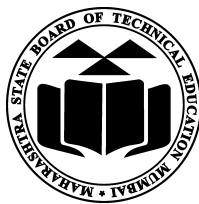
LABORATORY MANUAL DEVELOPMENT PROJECT

Item	Team for design	Team for restructuring
Educational Consultant/ Regional Project Coordinator	Dr. R.S. Mahashabde Technical Teachers' Training Institute, Extension Centre, Pune	Shri. D.M.Makone Ex. Secretary, M.S.B.T.E., Mumbai
Project Institution	Govt. Polytechnic, Yavatmal	Govt. Polytechnic, Khamgaon
Project Period	April 2002 - March 2003	July 2004 - Feb. 2005
Chief Project Coordinator	Principal, Shri C. S. Thorat	Principal, Shri F. A. Khan
Project Coordinator	Shri. R. P. Mogre Head of Applied Mech. Dept., Govt. Poly., Yavatmal	Shri. R. N. Vaidya HOD (Civil Engg.), Govt. Polytechnic, Khamgaon.
Course Coordinator	Shri. N. V. Raut, Lecturer (Applied Mechanics), Govt. Poly., Yavatmal.	---
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Subject Editor	---	---

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MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION

Certificate

This is to certify that, Mr. / Ms. _____
roll no. _____ of Third Year Diploma in _____ has
completed the term work satisfactorily in **Design of Structures (1504)** for the
academic year 200 _____ to 200 _____ as prescribed in the curriculum.

Place : _____

Enrolment No.: _____

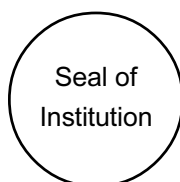
Date : _____

Exam. Seat No.: _____

Subject Teacher

Head of the Department

Principal



LEARNING OVERVIEW

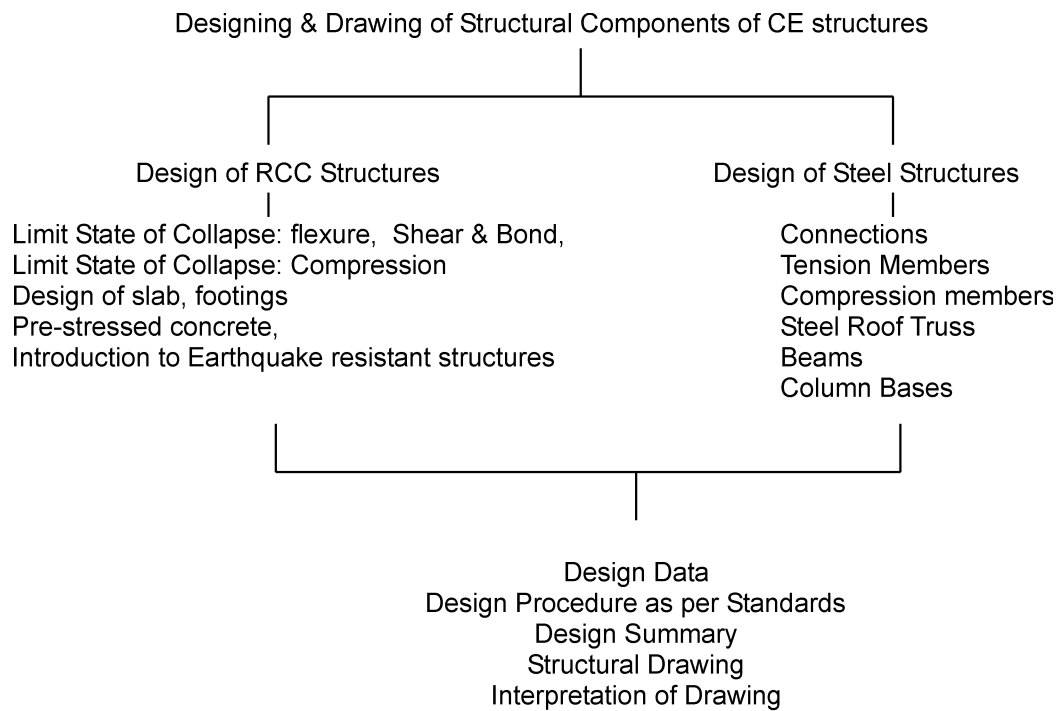
Importance Of The Subject

Design of structures is a core technology subject intended to teach the students core facts, principles and procedures of designing simple civil engineering structures constructed in R.C.C. and Steel.

It is associated with creativity, judgments and challenges. A sound and economical design is not just theory, but an art, which has to be cultivated through systematic study, observation and practice. For this reason this subject is important. It consists of Design of Reinforced Concrete Structures and Design of Steel Structures.

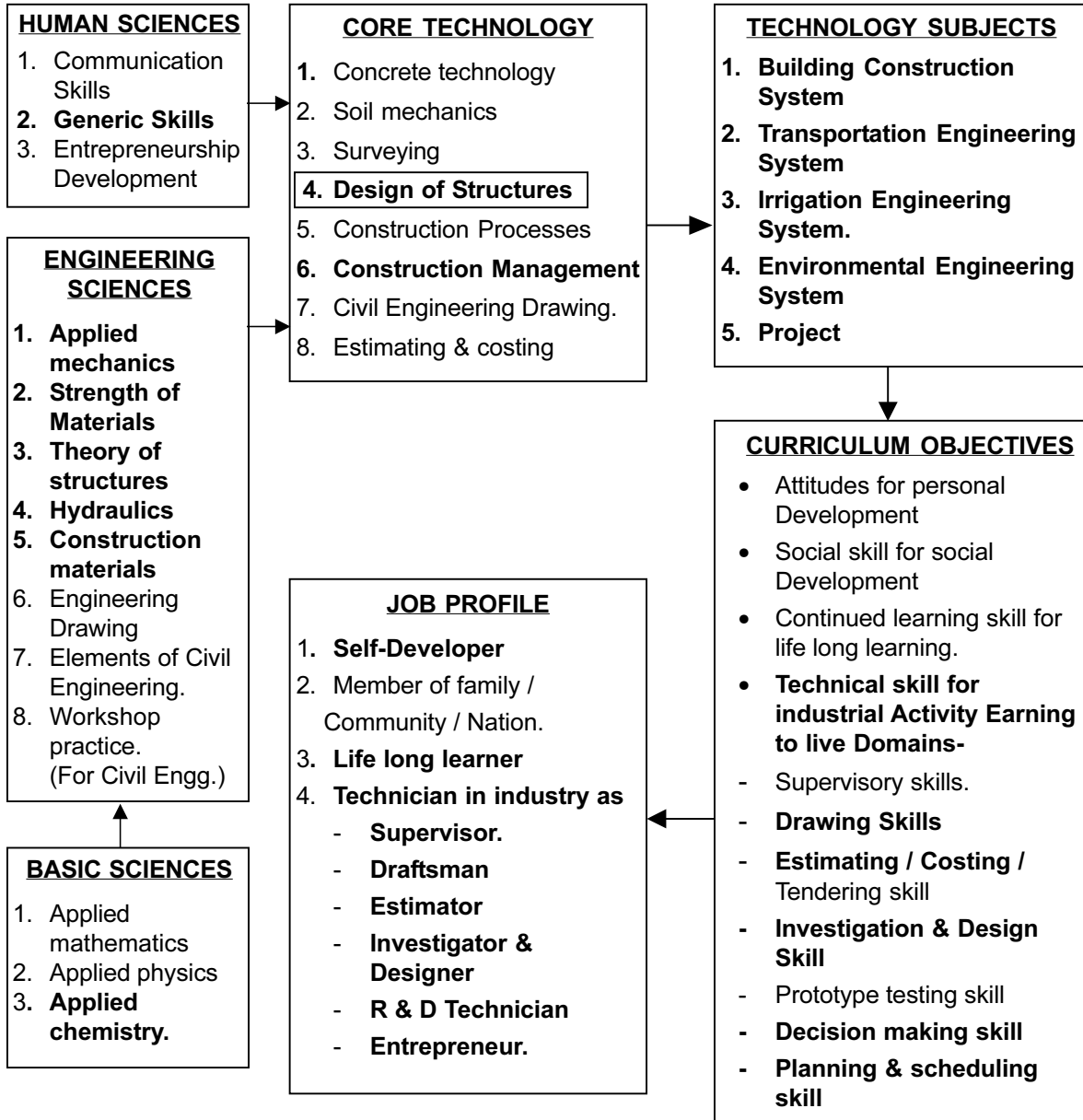
A Civil Engineer has to use structural drawings for execution of Civil Engineering Structures. In this subject emphasis have been given to study the scientific methods of design as per Bureau of Indian Standards and understanding structural drawings.

Major Topics and Their Inter Relationship:



Note: All relevant drawings along with detailed designs of remaining similar category of members like beam, slab, column & footing are to be drawn as per curriculum requirement & are to be submitted in the separate drawing folder along with this manual.

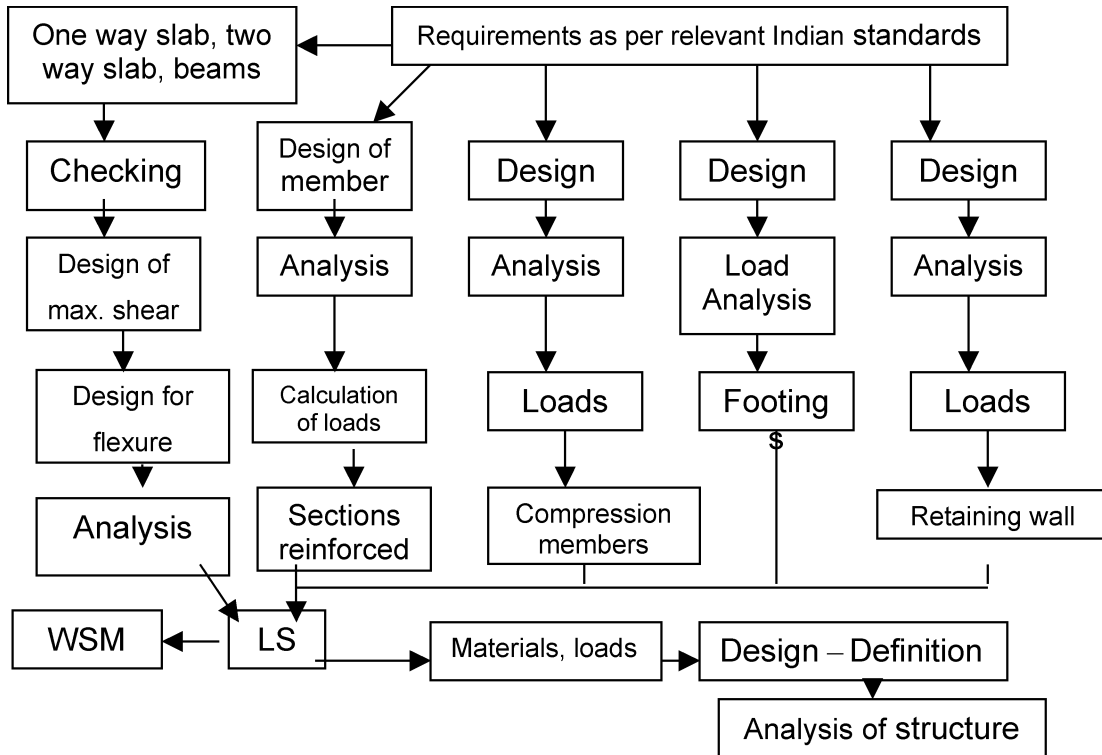
LINK / BLOCK DIAGRAM SHOWING INTER RELATIONSHIP OF SUBJECT AREAS, CURRICULUM OBJECTIVES & JOB PROFILE.



GRAPHICAL STRUCTURE OF SUBJECT AREA

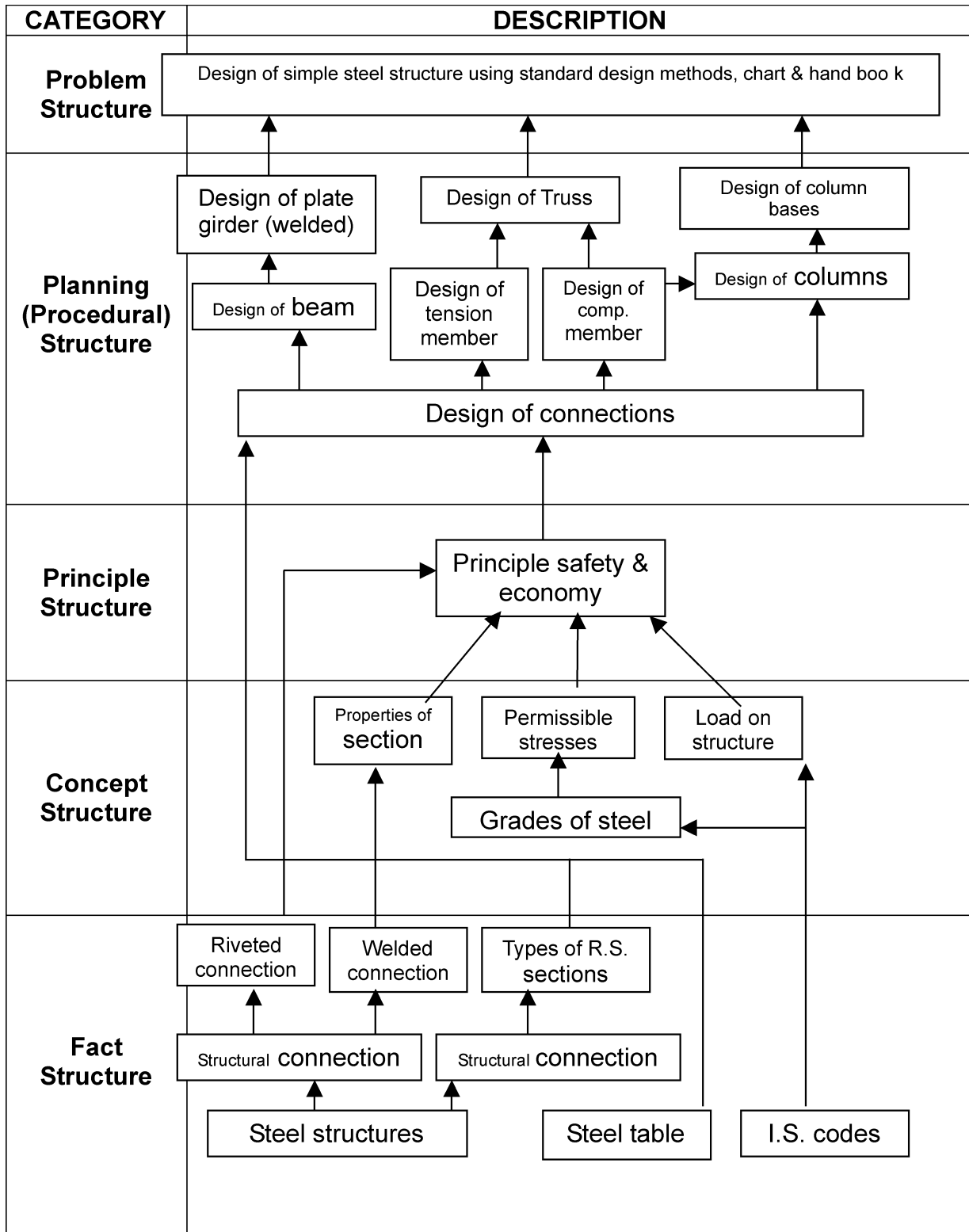
Third year- Civil Engineering

DESIGN OF STRUCTURES (1504)



GRAPHICAL STRUCTURE OF SUBJECT AREA

B) Design of steel structure



DEVELOPMENT OF SKILLS

In design of structures students will learn specific knowledge such as concepts, principles & procedures of designs; drawing, reading and interpreting the structural drawings of various Civil Engineering Structures. In addition, students are also expected to make efforts to develop desired intellectual and motor skills.

A broad perspective of acquisition of skills and content specific knowledge is given below:

- a) Intellectual skills:
- 1) Identifying various structural components of CE structures (I_1)
 - 2) Designing various RCC & Steel structure components (I_2)
 - 3) Reading and interpreting structural drawings (I_3)
 - 4) Field observation of CE structures from structural point of view (I_4)
- b) Motor Skills:
- 1) Drawing free hand sketches of various structural components (M_1)
 - 2) Drawing structural drawings of designed components (M_2)
 - 3) Preparation of sketches showing details from field observations (M_3)

Following table gives a grid of experiments and related intellectual and motor skills. Students are expected to focus on acquiring specific skills mentioned there in:

GRID TABLE

Following table gives grid of the exercises and related intellectual and motor skills.

- Teacher shall ensure for development of generic skills during the practicals.
- Students are expected to focus on acquiring specific skills mentioned therein.

SN	Exercise No. & Title	Intellectual skills				Motor skills		
		I_1	I_2	I_3	I_4	M_1	M_2	M_3
	Design of RCC structures							
1	Structural design & drawing of single storied building	✓	✓	✓			✓	
2	Structural design & drawing of cantilever retaining wall	✓	✓	✓			✓	
3	Preparation of neat labeled free hand sketches	✓						
4	Visit to construction site - observing & sketching reinforcement details	✓			✓			✓
5	Interpretation of given reinforcement schedule			✓				
	Design of Steel Structures							
1	Structural design & drawing of steel roof truss	✓	✓	✓			✓	
2	Design & drawing of supporting structure of an industrial floor	✓	✓	✓			✓	
3	Preparation of neat labeled free hand sketches	✓						
4	Visit to construction site - observing & sketching structural steel details	✓			✓			✓
5	Interpretation of given steel drawing schedule for riveted & welded connection			✓				

NOTE : ✓ - Identified Skills

STRATEGY FOR IMPLEMENTATION

It is suggested that 40 to 50% experiments shall be completed in first term and remaining experiments in the second term.

GUIDELINES FOR TEACHERS

Teachers shall discuss the following points with students before start of practicals of the subject.

- 1) **Learning Overview:** To Develop better understanding of importance of the subject. To Know related skills to be developed such as intellectual skills and Motor Skills.
- 2) **Link / Block Diagram :** Context of the subject in the form of link diagram showing interrelationship of various subject areas, curriculum objectives and job profile.
- 3) **Graphical structure:** In this topics and sub topics are organized in systematic way so that ultimate purpose of learning the subject is achieved. This is arranged in the form of fact, concept, principle, procedure, application and problem.
- 4) **Know your Laboratory work :** To understand the layout of laboratory, specifications of Equipment /Instruments/ Materials, procedure, working in groups, planning time etc. Also to know total amount of work to be done in the laboratory.
- 5) Teacher shall ensure that required equipment are in working condition before start of experiment, also keep operating instruction manual available.
- 6) Explain prior concepts to the students before starting of each experiment.
- 7) Involve students activity at the time of conduct of each experiment.
- 8) While taking reading/observation each student (from batch of 20 students) shall be given a chance to perform/observe the experiment.
- 9) List of questions is given at the end of each experiment. Teacher shall instruct the students to attempt all questions given at the end each experiment / exercise. Teacher shall ensure that each student writes the answers to the allotted questions in the laboratory manual after performance is over.
- 10) If the experimental setup has variations in the specifications of the equipment, the teachers are advised to make the necessary changes, wherever needed
- 11) Teacher shall assess the performance of students continuously as per norms prescribed by MSBTE.
- 12) Teacher should ensure that the respective skills and competencies are developed in the students after the completion of the practical exercise.
- 13) Teacher is expected to share the skills and competencies to be developed in the students.
- 14) Teacher may provide additional knowledge and skills to the students even though not covered in the manual but are expected from the students by the industries.
- 15) Teachers shall ensure that industrial visits recommended in the manual are covered.
- 16) Teacher may suggest the students to refer additional related literature of the technical papers / reference books / Seminar Proceedings, etc.
- 17) During assessment teacher is expected to ask questions to the students to tap their achievements regarding related knowledge and skills so that students can prepare while submitting record of the practicals. Focus should be given on development of enlisted skills rather than theoretical/codified knowledge.
- 18) Teacher should enlist the skills to be developed in the students that are expected by the industry.
- 19) Teacher should organised Group discussions / brain storming sessions/ Seminars to facilitate the exchange of knowledge amongst the students.
- 20) Teacher should ensure that revised CIAAN-2004 norms are followed simultaneously and progressively.
- 21) Teacher should give more focus on hands on skills and should actually share the same.
- 22) Teacher shall also refer to the Circular No. MSBTE/D-50/Lab Manual / 2005 / 3183 dated 5th May, 2005 for additional guidelines.

Note: All relevant drawings along with detailed designs of remaining similar category of members like beam, slab, column & footing are to be drawn as per curriculum requirement & are to be submitted in the separate drawing folder along with this manual.

INSTRUCTIONS FOR STUDENTS

Students shall read the points given below for understanding the theoretical concepts & practical applications.

- 1) Listen carefully to the lecture given by teacher about importance of subject, curriculum philosophy, graphical structure, skills to be developed, information about equipment, instruments, procedure, method of continuous assessment, tentative plan of work in laboratory and total amount of work to be done in a year.
- 2) Students shall undergo study visit of the laboratory for types of equipment, instruments, material to be used, before performing experiments.
- 3) Read the write up of each experiment to be performed, a day in advance.
- 4) Organize the work in the group and make a record of all observations.
- 5) Understand the purpose of experiment and its practical implications.
- 6) Write the answers of the questions allotted by the teacher during practical hours if possible or afterwards, but immediately.
- 7) Student should not hesitate to ask any difficulty faced during conduct of practical / exercise.
- 8) The student shall study all the questions given in the laboratory manual and practice to write the answers to these questions
- 9) Student shall visit the recommended industries and should study the knowhow of the shop floor practices and the operations of machines.
- 10) Student shall develop maintenance skills as expected by the industries.
- 11) Student should develop the habit of pocket discussion / group discussion related to the experiments / exercises so that exchanges of knowledge / skills could take place.
- 12) Student shall attempt to develop related hands-on-skills and gain confidence.
- 13) Student shall focus on development of skills rather than theoretical or codified knowledge.
- 14) Student shall visit the nearby workshops, workstation, industries, laboratories, technical exhibitions, trade fair etc. even not included in the Lab Manual. In short, students should have exposure to the area of work right in the student hood.
- 15) Student shall insist for the completion of recommended Laboratory Work, industrial visits, answers to the given questions, etc.
- 16) Student shall develop the habit of evolving more ideas, innovations, skills etc. than included in the scope of the manual.
- 17) Student shall refer technical magazines, proceedings of the Seminars, refer websites related to the scope of the subjects and update their knowledge and skills.
- 18) Student should develop the habit of not to depend totally on teachers but to develop self learning techniques.
- 19) Student should develop the habit to react with the teacher without hesitation with respect to the academics involved.
- 20) Student should develop habit to submit the practicals exercise continuously and progressively on the scheduled dates and should get the assessment done.
- 21) Student should be well prepared while submitting the write up of the exercise. This will develop the continuity of the studies and he will not be over loaded at the end of the term.

Note: All relevant drawings along with detailed designs of remaining similar category of members like beam, slab, column & footing are to be drawn as per curriculum requirement & are to be submitted in the separate drawing folder along with this manual.

List of Exercises & Record of Progressive Assessment

Sr. No.	Name of the Exercises	Page No.	Date of Performance	Date of submission	Assessment Max. Marks 15	Sign. of teacher & Remarks
A	Introduction to Design of Structures.	1				
DESIGN OF REINFORCED CONCRETE STRUCTURES						
1	Structural Design & Drawing of Single Storeyed Building	5				
2	Structural Design & Drawing of Cantilever Retaining Wall	44				
3	(a) Preparation of neat labelled free hand sketches for reinforcement details and stresses in beam.	52				
	(b) Preparation of neat labeled free hand sketches for prestressing and post tensioning arrangement	55				
	(c) Preparation of neat labelled free hand sketches for beam and column junctions.	58				
4	Stress Block Parameters in LSM for Singly Reinforced Section	61				
5	Systems of Prestressing	64				
DESIGN OF STEEL STRUCTURES						
1	Structural Design & Drawing of Steel Roof Truss	66				
2	Structural Design & Drawing of an Industrial Floor	83				
3	Preparation of free hand sketches of the following:	95				
	(a) Standard steel sections with their properties	95				
	(b) Lacing and battening for column	98				
	(c) Built-up sections for columns & beams	101				
	(d) Welded plate girder	103				
	(e) Gusseted base	105				
4	Visit to construction site	108				
5	Interpretation of steel drawing schedule for riveted and welded connection	111				
					Total Marks Average Marks out of 15..... *	

* To be transferred to proforma of CIAAN- 2004 (Proforma I-1)