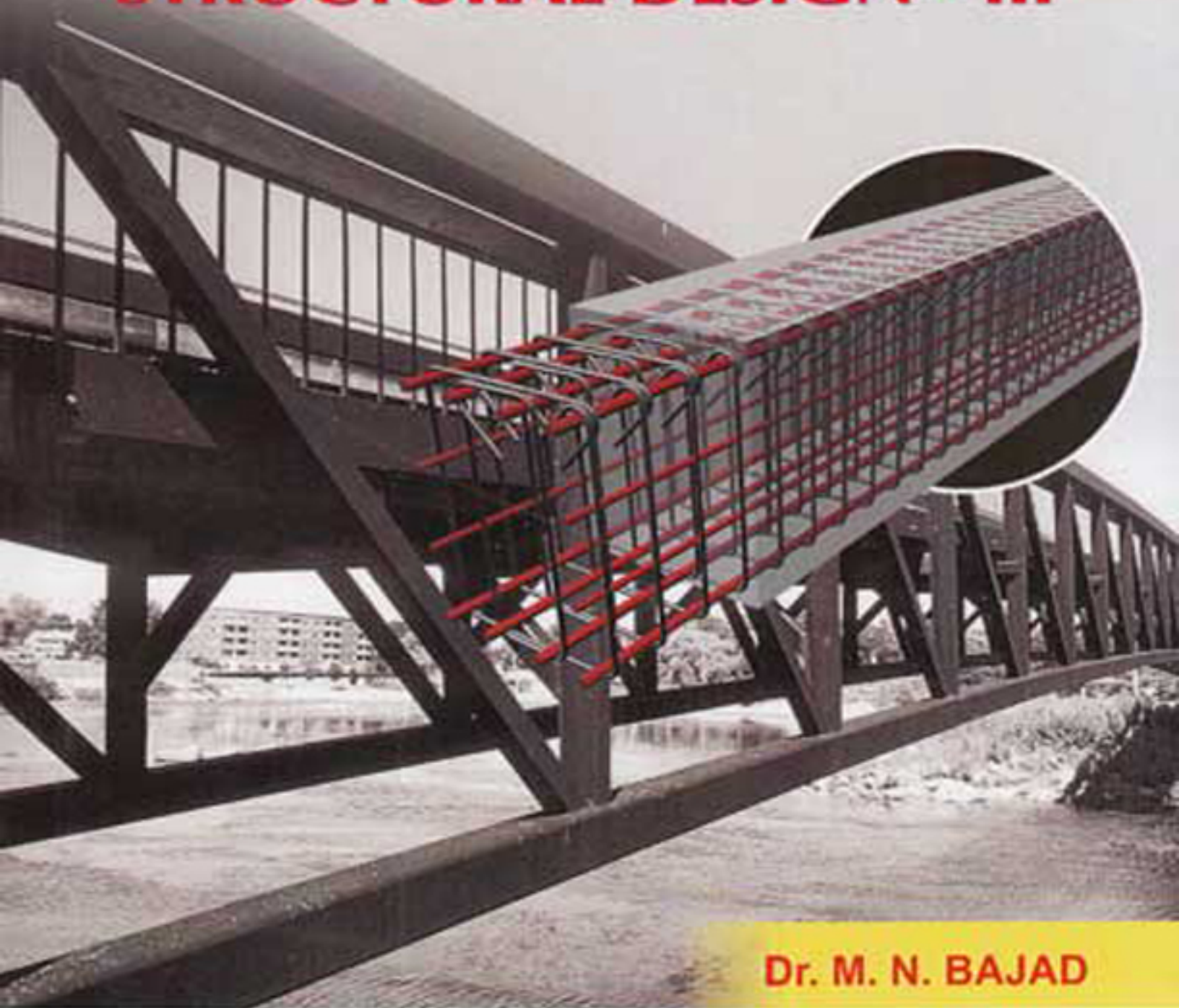




Final Year Degree Course In
CIVIL Engineering (SEM - I)


SPPU

STRUCTURAL DESIGN - III



Dr. M. N. BAJAD

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ADVANCEMENT OF KNOWLEDGE

A TEXT BOOK OF
STRUCTURAL DESIGN - III

For
SEMESTER – I

FINAL YEAR (BE) DEGREE COURSE IN CIVIL ENGINEERING

As Per New Revised Syllabus of
Savitribai Phule Pune University, Pune.
(2012 Pattern)

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PREFACE

This book titled "**Structural Design - III**" is strictly written according to the New Revised Syllabus of Savitribai Phule Pune University. This book will serve as a text book for the students of final year (B.E.) of degree Course in Civil Engineering.

The present text is presented in 15 chapters. The theory of each chapter is written in simplified language and number of solved problems which cover the practical aspect of theory are included at the end of each chapter. Since, the student usually has his greatest difficulty in applying the theory principles that he has learned to specific situations. To develop this ability among students, special attention has been given to the selection and treatment of illustrative examples. Every solved problem is presented in pictorial form which will help the students to imagine and grasp the practical problems from the field.

It is hoped by the author that solved examples will help the students to bridge the gap between mere cognizance of the general principles and ability to apply them to concrete problems. **I am included Sample Question Papers for In-Semester Assessment Exams. (30 Marks) and End Semester Theory Exams. (70 Marks) for practice of the both the Exams. I am also included University Question Papers (May 2008 to May 2015) at the end of each chapter for the benefit of students community.**

Shri Dineshbhai Furia, Mr. Jignesh Furia and Shri M. P. Munde of Nirali Prakashan have a lion's share in publishing this book. I express my sincere thanks to all the team of Nirali Prakashan. Namely Mrs. Depali Lachake (Co-ordinator), Mrs. Roshan Khan and Miss. Rani and Miss Rajashri. I am also sincerely thank to faculty colleagues and staff of SCOE Vadgaon. I am also thankful to renovation family for their support.

Although every care has been taken to check mistakes and misprints, yet it is difficult to claim perfection. Any error, omission and suggestions for the improvement of this volume, brought to my notice, will be thankfully acknowledged and incorporated in the next edition.

SYLLABUS

Unit 1 : Prestressed Concrete - Analysis

Introduction, Basic concepts, materials-various Pre-tensioning and post-tensioning systems, Concept of losses, Stress calculations, and concept of cable profile.

Unit 2 : Prestressed Concrete - Design

Design of post tensioned prestressed concrete simply supported rectangular and flanged sections for flexure and shear including end block.

Design of one way and two way post-tensioned slabs (Single panel only)

Unit 3 : Earthquake Force Calculation And Analysis And Design Of Frames

Review of methods of analysis for frames subjected to gravity and lateral loads. Earthquake loads by seismic coefficient method. Estimation of combined effect of lateral forces and vertical loading on multi storeyed frames. Design any intermediate continuous beam of the frames for combined effect of loadings

Unit 4 : Earth Retaining Structures

Introduction, Functions and types of retaining walls. Analysis and design of RCC cantilever, Type of retaining wall for various types of backfill conditions.

Unit 5 : Combined Footings

Introduction, Necessity and Types of combined footings, Design of slab type and Slab-beam type of combined footing.

Unit 6 : Liquid Retaining Structures

Introduction, Types, Function, Codal provisions, Methods of analysis and design of circular, square, and rectangular water tanks resting on ground.

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Chapter 1

FUNDAMENTAL PRINCIPLES OF PRESTRESSED CONCRETE

1.1 INTRODUCTION

The prestressing of concrete is a recent development, although the idea of prestressing is not a new one. Even in ancient days, this was practised, for example, in the case of a cart-wheel, upon which the iron tyre is shrunk-on, producing a radial precompression in it.

Several engineers and scientists in different countries have worked since the later part of the last century to develop suitable methods for pre-compressing the concrete. The first practical applications were, however, made in 1928 by an eminent French engineer, M. Eugene Freyssinet, who is regarded as the "Father of prestressing".

In the initial stages of the development of the prestressed concrete, the materials such as mild steel and concrete, as used in ordinary reinforced concrete work, were used to achieve the required degree of prestressing. But soon it was realised that these materials with the then available properties, were not suitable for prestressed concrete work. It was also found that the failures occurred due to loss of prestress on account of "creep" and "shrinkage" of concrete and the "plastic flow" of the steel itself under load.

M. Freyssinet found from his research work that high tensile steel was necessary instead of mild steel, so that after the losses of prestresses, which occurred there still remains sufficient stresses to produce the desired permanent precompression in the concrete. He also developed a concrete of high strength which is another basic requirement for attaining prestressed concrete.

Today, along with these materials and several systems of achieving precompression in the concrete, the prestressed concrete is one of the major structural materials available and has proved more economic than the ordinary reinforced concrete.

1.2 NEED OF PRESTRESSING

Tests on concrete have shown that it is weak in resisting tensile forces and that its tensile strength is about one-tenth of its compressive strength. Even this available tensile strength cannot be used for resisting any loads, as it is used up partly or wholly in resisting internal tensile stresses. These stresses are caused by heat evolved by the cement in setting or by atmospheric influences, difference in rate of drying and therefore shrinkage, etc.

The plain concrete structures may develop cracks in course of time, even if external loads are not applied. Therefore, mild steel bars are provided so that these can take up the tensile stresses and also keep the width of the cracks in the concrete within harmless limits. The reinforced concrete structures are, therefore, designed on the theory, which assumes that the tensile zone of the concrete is cracked and the tensile forces are resisted by the reinforcing bars only. (Refer Fig. 1.1).

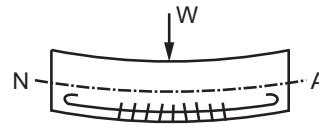


Fig. 1.1 : A simply supported R.C.C. beam, in which tensile zone is assumed to be cracked

By suitably distributing the mild steel bars, the width of these cracks can be kept small and also a good bond of concrete is achieved. It can be assumed that a crack width of 0.2 mm in case of structures in the open air and 0.3 mm in case of structures which are not exposed to the causes of serious corrosion, can be regarded as harmless. These cracks can be a cause of serious damage to the structures, especially in cases where cover to the bars is insufficient.

It was, therefore, already realised in the early days of reinforced concrete construction that these cracks were objectionable and that these should be prevented. This then given rise to an idea of placing the concrete under precompression, so that the cracks could be prevented from occurring. The prestressed concrete in its present form is the fulfillment to that idea.

1.3 BASIC PRINCIPLE OF PRESTRESSING

The basic principle of prestressing is to produce, by any suitable means, sufficient compressive stresses in all those parts of the concrete where tensile stresses would occur when the external loads (i.e. dead and live loads) are applied. These compressive stresses need to be produced in the concrete before the external loads are allowed to act, so that these have to be first neutralised by the tensile stresses developed due to external loading. Any tension can, in that case, actually occur in the concrete only when the tensile stresses exceed the already induced compressive stresses.

Consider an example, a concrete section of size 100 mm × 100 mm which is to be designed to carry an axial tensile force of 50 kN, therefore, tensile stress = $\frac{50 \times 10^3 \text{ N}}{100 \times 100 \text{ mm}^2}$
= 5 N/mm² will occur due to this axial tensile force.

Now, if by some any means, we introduce a compressive stress in concrete which is slightly greater than 5 N/mm² say 6 N/mm², finally the section is subjected to (6 – 5) = 1 N/mm² compressive prestress. In this way, concrete section is made able to carry tensile force.

Structural Design-III



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