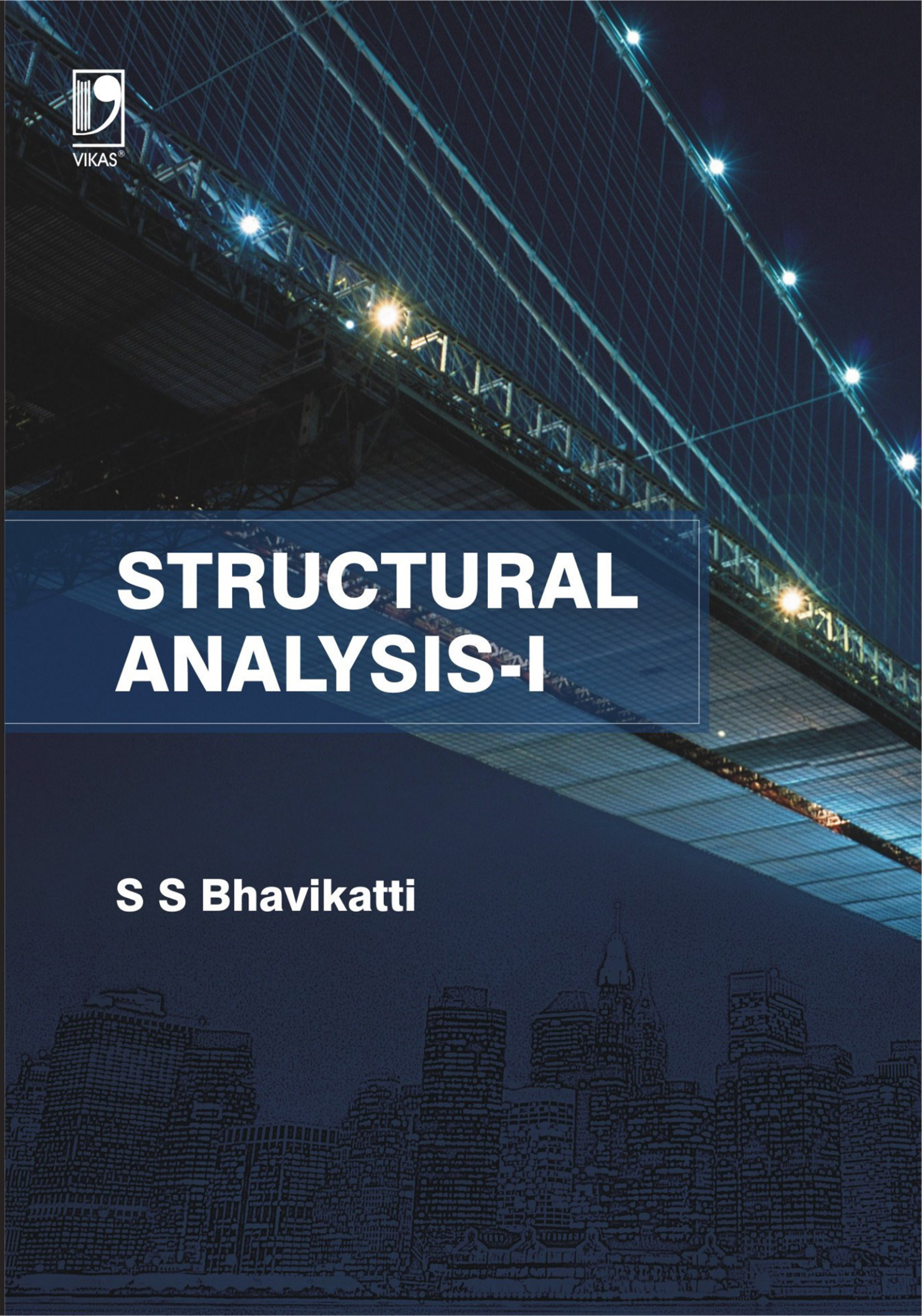

STRUCTURAL ANALYSIS-I

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Preface

This book, *Structural Analysis-I*, is a revised edition of the book *Structural Analysis Volume-I,* and it covers the basics of structural analysis measurements of deflection, various types of deflections, loads and influence lines, etc. This book is a prequel to my book *Structural Analysis-II*. Both the volumes together cover the complete course requirements usually taught in two semesters for under-graduate students in almost all universities.

In this book, SI units have been used throughout along with standard notations. One of the highlights of the book is the simple and systematic presentation of concepts.

A large number of examples and problems have been incorporated for the benefit of the students. The diagrams and calculations have been improved upon in this revised edition.

I would be grateful for any constructive suggestion and feed back.

Author

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Chapter 1

Introduction

Chapter Outline

1.1 INTRODUCTION

We come across various structures in our day to day life ranging from simple ones like the curtain rods and electric poles to complex ones like multistory buildings, shell roofs, bridges, dams, heavy machineries, automobiles, aeroplanes and ships. These structures are subjected to various loads like concentrated loads, uniformly distributed loads, uniformly varying loads, random loads, internal or external pressures and dynamic forces. The structure transfers its load to the supports and ultimately to the ground. Treating the entire structure as a single rigid body and finding the reactions from supports is the first step in analysing a structure which is covered under *Engineering Mechanics.*

While transferring the loads acting on the structure, the members of the structure are subjected to internal forces like axial forces, shearing forces, bending and torsional moments. *Structural Analysis* deals with analysing these internal forces in the members of the structures. The behaviour of the materials of the structures subjected to different types of internal forces is covered, under *Strength of Materials*. *Structural Design* deals with sizing various members of the structure to resist the internal forces to which they are subjected to in the course of their life cycle. However, the process of finding reactions, internal forces, behaviour of materials of structures to such forces and sizing of the members are so interconnected that it is difficult to separate them. Hence, a combination of topics in Engineering Mechanics, Strength of Materials, Structural Analysis and Structural Design are very common in various books and in syllabi of engineering courses. The analysis of pin-jointed determinate plane frames have been covered in the book 'Engineering Mechanics' and the determination of bending moment and shear forces in determinate beams in the book 'Strength of Materials'.

In this book determination of deflections in beams and frames by various methods is dealt. Finding shear forces and bending moment due to moving loads is explained. The analysis of determinate structure like 3-hinged arches, cables and suspension bridges is explained. An introduction to the analysis of indeterminate structures by consistant deformation method and three moment equations is presented.

1.2 IDEALISATIONS AND ASSUMPTIONS

The following idealisations and assumptions are made during analysis, under normal conditions:

1.2.1 Material Properties

Materials are assumed to be *homogeneous* and *isotropic*. Homogeneous material refers to the identical particles that exist throughout the material and isotropic refers to the physical properties of the materials which are identical in all the directions.

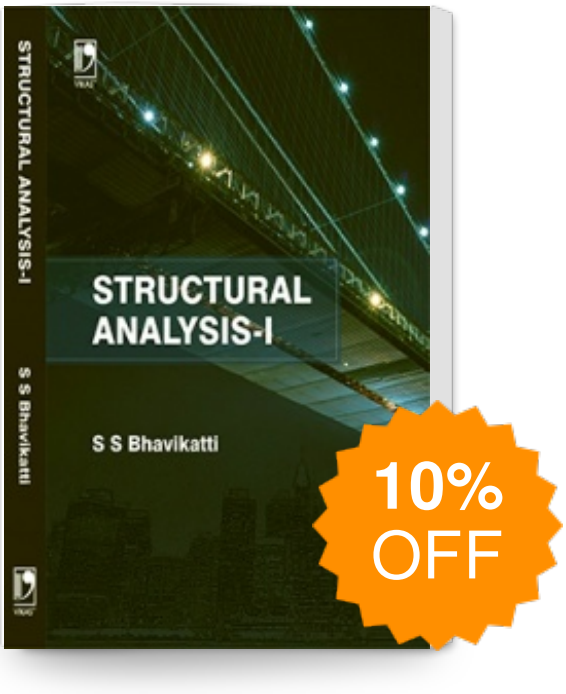
Another assumption is *stress–strain* relation is *linear*, which means in case of metals, the analysis is carried out within the limit of proportionality and in case of materials like concrete, the stress–strain relation is approximated to a linear relation.

1.2.2 Boundary Conditions

The boundary conditions for structures are assumed to fall under the following idealised cases only:

(*i*) *Free end* At the free end a structure can have linear or rotational displacement in any direction and hence, no reaction is developed, e.g., free end of a cantilever beam.

Structural Analysis-I



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