

# Home Work 02 – Structural Analysis by Matrix Method

## Engineering Mechanics IV

Lecture : Pramudiyanto, M.Eng.

Instruction :

Otherwise stated, do all this assignment on MS Excel (or any spreadsheet software available). The due date of this assignment is on Dec 10<sup>th</sup> 2012. Send it through my drop box at <http://dropitto.me/pramudiyanto> (pass:pramudiyanto)

1. Compute the displacements, reactions, and element forces for the trusses shown below. Cross-sectional area (in  $\text{mm}^2$ ) are shown in each bar. Knowing that modulus of elasticity,  $E = 200,000 \text{ MPa}$ .

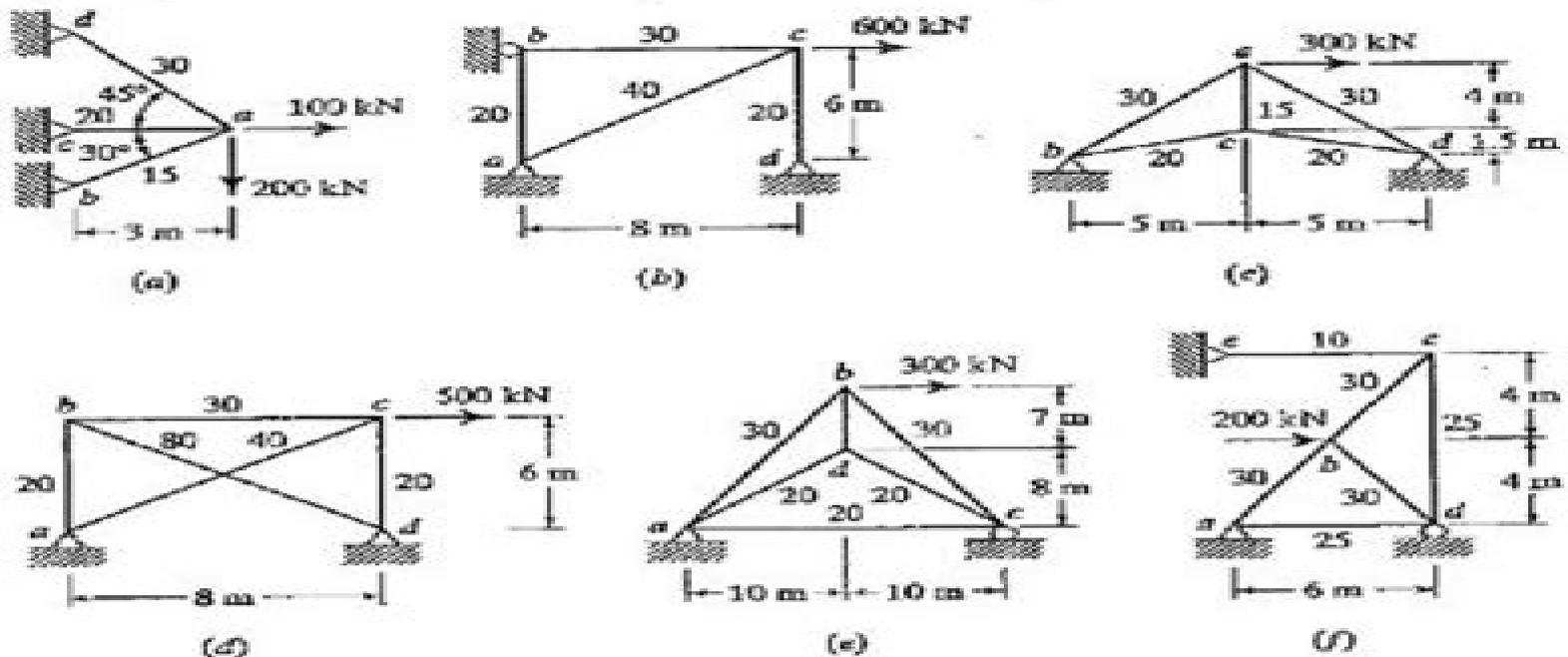
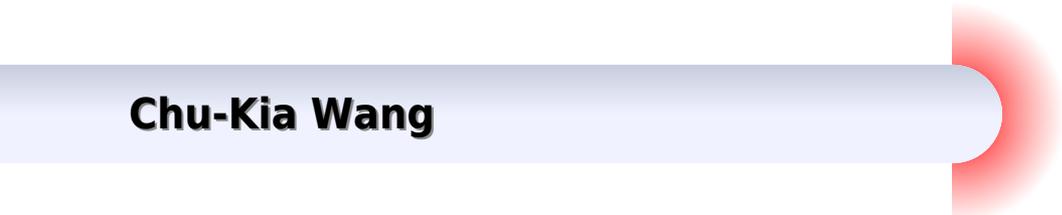


Figure 1. Assignment no 1

2. The areas of bars  $ab$  and  $ac$  in  $\text{mm}^2 \times 10^3$  are as indicated.  $A$  varies from 0 to  $40 \times 10^3 \text{ mm}^2$ . (a) plot the variation in the force in each bar versus  $A$ . (b) If the allowable stress is 140 MPa, for approximately what value of  $A$  does the system have the highest ratio of load-carrying capacity to weight? Assume the same material is used for all three bars.

# Structural Analysis Matrix Method

**Chu-Kia Wang**



## **Structural Analysis Matrix Method:**

**Matrix Methods of Structural Analysis** M. B. Kanchi, 1993  
Manolis Papadrakakis, Evangelos Sapountzakis, 2017-11-13 Divided into 12 chapters Matrix Methods for Advanced Structural Analysis begins with an introduction to the analysis of structures fundamental concepts and basic steps of structural analysis primary structural members and their modeling brief historical overview of methods of static analysis programming principles and suggestions for the rational use of computer programs This is followed by the principal steps of the Direct Stiffness Method including plane trusses plane framed structures space trusses and space framed structures The case of plane or space framed structure including possible rigid elements at their beam ends rigid joints is discussed in detail Other topics discussed in this reference include the procedure for analyzing beams with internal releases partial connection of beam elements and elastic hinges as well as the alternative handling of internal releases by modifying the element stiffness matrix Furthermore the Method of Substructures is demonstrated for the solution of large scale models in terms of the associated number of degrees of freedom The principal steps of the Direct Stiffness Method are presented for plane and space trusses as well as plane and space framed structures The handling of beams with internal releases and elastic hinges The method of substructures for large scale structures A computer code basic steps and source files based on MATLAB software for the analysis of beam like structures

**Matrix Methods of Structural Analysis** R. K. Livesley, 2014-05-16  
Matrix Methods of Structural Analysis presents how concepts and notations of matrix algebra can be applied to arriving at general systematic approach to structure analysis The book describes the use of matrix notation in structural analysis as being theoretically both compact and precise but also quite general The text also presents from the practical point of view matrix notation as providing a systematic approach to the analysis of structures related to computer programming Matrix algebraic methods are useful in repeated calculations where manual work becomes tedious The Gauss Seidel method and linear programming are two methods to use in solving simultaneous equations The book then describes the notation for loads and displacements on sign conventions stiffness and flexibility matrices and equilibrium and compatibility conditions The text discusses the formulation of the equilibrium method using connection matrices and an alternative method The book evaluates the compatibility method as programmed in a computer and it discusses the analysis of a pin jointed truss and of a rigid jointed truss The book presents some problems when using computers for analyzing structures such as decision strategy accuracy and checks conducted on handling large matrices The text also analyzes structures that behave in a non linear manner The book is suitable for structural engineers physicist civil engineers and students of architectural design

*Modern Structural Analysis* Anthony E. Armenàkas, 1991 This companion to the previously published book *BO Classical Structural Analysis* BX also by the same author focuses on advanced structural analysis using matrix methods for the element method of design calculations With this method the structural properties of each structural member or element taken

together of an entire structure are used to calculate load behaviour and construction needs of a whole building or other structure. The matrix method is particularly suited to computer methods that must employ thousands of reiterate calculations. The book contains dozens of worked out problems and design exercises as well as an actual computer program at the end of the book for matrix method calculations. **Problems in Structural Analysis by Matrix Methods** P. Bhatt, 1981

MATRIX METHODS OF STRUCTURAL ANALYSIS NATARAJAN, C., REVATHI, P., 2014-01-20 Designed as a textbook for the undergraduate students of civil engineering and postgraduate students of structural engineering this comprehensive book presents the fundamental aspects of matrix analysis of structures. The basic features of Matrix Structural Analysis along with its intricacies in application to actual problems backed up by numerical examples form the main objective of writing this book. The text begins with the chapters on basics of matrices and structural systems. After providing the foundation for matrix structural representation the text moves onto dimensional and behavioral aspects of structural systems to classify into pin jointed systems then onto beams and finally three dimensional rigid jointed systems. The text concludes with a chapter on special techniques in using matrices for structural analysis. Besides MATLAB codes are given at the end to illustrate interfacing with standard computing tool. A large number of numerical examples are given in each chapter which will reinforce the understanding of the subject matter. **Theory of Matrix Structural Analysis** J. S. Przemieniecki, 1985-01-01 This classic text begins with an overview of matrix methods and their application to the structural design of modern aircraft and aerospace vehicles. Subsequent chapters cover basic equations of elasticity energy theorems structural idealization a comparison of force and displacement methods analysis of substructures structural synthesis nonlinear structural analysis and other topics. 1968 edition *An Introduction to Matrix Methods of Structural Analysis* Muhammad Akram Tahir, Worsak Kanok-Nukulchai, 2024-12-20 This textbook provides a comprehensive introduction to matrix methods of structural analysis framed within a discrete modeling approach that is well suited for digital computation. Two principal procedures namely the Matrix Force Method and the Matrix Displacement Method are thoroughly illustrated for one dimensional structural systems. Among them the Matrix Displacement Method is more widely adopted owing to its straightforward extension to two and three dimensional structures. The book demonstrates how displacements taken as the primary variables enable the formation of local element stiffness matrices in the Direct Stiffness Method. In this latter approach individual element contributions are assembled into a system level representation permitting the modeling of virtually any complex structure. This direct stiffness methodology underpins the development of today's general purpose finite element programs offering both breadth and depth to structural analysis. Features Establishes discrete structural modeling as the basis of finite element methods which are now the industry standard for structural analysis. Provides a step by step explanation of the Force Method the Displacement Method and the Direct Stiffness Method for 1D members such as beams trusses plane frames grillages and space frames ensuring a clear and accessible learning experience. Highlights Berkeley's approach to representing joints by employing rigid

nodes within a nodal network of interconnected 1D 2D or 3D deformable members Offers an illustrative extension through the MAIL Matrix Analysis Interpretive Language which enriches analysis examples exercises and problems Targeted at senior undergraduate and graduate students in structural engineering this book serves as an essential prerequisite for the Finite Element Analysis of Structures *Matrix Structural Analysis* Jamal J. Azar, 2013-10-22 Matrix Structural Analysis focuses on the theory and practical application of matrix structural analysis Organized into seven chapters this book first describes the matrix algebra and the fundamental structural concepts and principles which are directly related to the development of the matrix methods Subsequent chapters present the theory and application of the direct stiffness matrix method and matrix force method to structural analysis The element stiffness matrices of lifting surface type structures and the general theory of analysis by structural partitioning are also presented This book will be useful for students and practicing engineer as a quick reference material in this field of interest *MATRIX METHODS OF STRUCTURAL ANALYSIS* GODBOLE, P.N., SONPAROTE, R.S., DHOTE, S.U., 2014-07-20 The book describes in great detail the Matrix Methods of Structural Analysis used extensively for the analysis of skeletal or framed structures The book gives complete coverage to the subject starting from the basics It is organized in four parts Part 1 contains basic knowledge required to understand the subject i e Matrix operations Methods for solving equations and concepts of flexibility matrix and stiffness matrix methods Part 2 deals with the applications of stiffness and flexibility matrix methods using system approach By taking simple examples the steps involved in both the methods are discussed and it is concluded why stiffness matrix method is more suitable for analysis of skeletal structures Part 3 covers the Stiffness matrix displacement method with member approach direct Stiffness method which is extensively used in the analysis of framed structures It gives the details of the method the steps involved in the method and its application to plane truss space truss beams plane and space frames and grids Part 4 includes a unified computer program written in FORTRAN C for the analysis of framed structure The development of computer program explanation of various subroutines input output formats with examples is given in this section An accompanying CD with the book contains source code explanation of INPUT OUTPUT and test examples Though the concepts have been presented in quite general form so that the book serves as a learning aid for students with different educational backgrounds as well as the practicing engineers the primary objective is to present the subject matter in a simple manner so that the book can serve as a basic learning tool for undergraduate and postgraduate students of civil engineering **Matrix Structural Analysis** Ronald L. Sack, 1994-11-08 Packed with plenty of clear illustrations this introductory work shows how to use the matrix methods of structural analysis to predict the static response of structures Sack emphasizes the stiffness method while providing balanced coverage of the fundamentals of the flexibility method as well He introduces the various topics in a logical series and develops equations from basic concepts The result readers will gain a firm grasp of theory as well as practical applications Practical in approach the well presented material in this volume is

devoted to giving a solid understanding of matrix analysis methods combined with the background to write computer programs and use production level programs to build actual structures

*Matrix and Finite Element Analyses of Structures* Madhujit Mukhopadhyay, Abdul Hamid Sheikh, 2022-11-25 This textbook has been primarily written for undergraduate and postgraduate engineering students studying the mechanics of solids and structural systems The content focuses on matrix finite elements structural analysis and computer implementation in a unified and integrated manner Using classical methods of structural analysis it discusses matrix and the finite element methods in an easy to understand manner It consists of a large number of diagrams and illustrations for easy understanding of the concepts All the computer codes are presented in FORTRAN AND C This textbook is highly useful for the undergraduate and postgraduate engineering students It also acquaints the practicing engineers about the computer based techniques used in structural analysis

**INTRODUCTION TO MATRIX METHODS OF STRUCTURAL ANALYSIS** HAROLD C AUTOR MARTIN, 1966

**Matrix Method Of Structural Analysis - Element Approach** S.S. Bhavikatti, Mamata B Mogali, 2023-05-27 The structural analysis deals with the determination of the response of the structure subjected to loads The rapid development of computers and the need for complex and lightweight structures led to the development of the matrix method of structural analysis The readers of this book should be familiar with consistent deformation and slope deflection methods of structural analysis The systematic development of these methods to suit computer applications gave rise to Matrix Method of Structural Analysis The development of consistent deformation method led to Flexibility Matrix Method while the development of slope deflection method led to Stiffness Matrix Method The book deals with the subject in four chapters starting from the Introduction Flexibility Matrix Method Element Approach Stiffness Matrix Method Element Approach and Computer Programming Preliminaries One Appendix Matrix Algebra Review is also given at the end of the book This book will be a useful reading for students of civil engineering

**Matrix Structural Analysis** William McGuire, Richard H. Gallagher, 1979-05-10 Examines computerized structural analysis methods for buildings bridges and other structures with special emphasis on current practices Covers the stiffness analysis of frames the flexibility method virtual work principles special analysis procedures and more Defines the terminology coordinate systems and fundamental concepts of structural behavior laying the foundation for the study of more advanced treatments such as the finite element method

*Matrix Analysis Framed Structures* William Weaver, James M. Gere, 2012-12-06 Matrix analysis of structures is a vital subject to every structural analyst whether working in aero astro civil or mechanical engineering It provides a comprehensive approach to the analysis of a wide variety of structural types and therefore offers a major advantage over traditional methods which often differ for each type of structure The matrix approach also provides an efficient means of describing various steps in the analysis and is easily programmed for digital computers Use of matrices is natural when performing calculations with a digital computer because matrices permit large groups of numbers to be manipulated in a simple and effective manner This book now in its third edition was written

for both college students and engineers in industry It serves as a textbook for courses at either the senior or first year graduate level and it also provides a permanent reference for practicing engineers The book explains both the theory and the practical implementation of matrix methods of structural analysis Emphasis is placed on developing a physical understanding of the theory and the ability to use computer programs for performing structural calculations

**Matrix Method Of Structural Analysis - Structures & Element Approach** S.S. Bhavikatti,Mamata B Mogali,2023-05-29 This book covers all important topics in 7 chapters Chapter 1 Introduction that explain the statics Indeterminacy and Kinematic Indeterminacy chapter 2 Consistent Deformation and Slope Deflection Methods Chapter 3 Flexibility Matrix Method Structures Approach Chapter 4 Stiffness Matrix Method Structures Approach Chapter 5 Flexibility Matrix Method Element Approach Chapter 6 Stiffness Matrix Method Element Approach And Chapter 7 Computer Programming Preliminaries This Book will be a useful reading for student of civil engineering The readers of this book are familiar with consistent deformation and slope deflection methods of structural analysis The systematic development of these methods to suit computers application gave rise to Matrix method of Structural Analysis The development of consistent deformation method led to flexibility Matrix Method while the development of slope deflection method led to Stiffness Matrix Method

Matrix Methods of Structural Analysis Chu-Kia Wang,1966

Structural Analysis Jack C. McCormac,2006-10-13 Presenting an introduction to elementary structural analysis methods and principles this book will help readers develop a thorough understanding of both the behavior of structural systems under load and the tools needed to analyze those systems Throughout the chapters they ll explore both statically determinate and statically indeterminate structures And they ll find hands on examples and problems that illustrate key concepts and give them opportunity to apply what they ve learned

**Matrix Methods of Structural Analysis** S. S. Bhavikatti,2011-08 Preliminary chapters are supposed to give suitable transition from structural analysis classical methods studied by students in their compulsory courses Then structure approach to matrix method is dealt so that the students get clear picture of matrix approach Finally stiffness matrix method element approach is explained and illustrated so that before developing computer program student will understand what to instruct computer Finally a chapter an computer programming preliminaries which will help to develop the computer program and cautious the way of program develop by the others is included

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