SELECTED TOPICS
In Aerospace Engineering

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IIUM Press
INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA

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Published by:
IIUM Press
International Islamic University Malaysia

First Edition, 2011

Perpustakaan Negara Malaysia Cataloguing-in-Publication Data

ISBN: 978-967-418-145-1

Member of Majlis Penerbitan Ilmiah Malaysia – MAPIM
(Malaysian Scholarly Publishing Council)

Printed by :
IIUM PRINTING SDN.BHD.
No. 1, Jalan Industri Batu Caves 1/3
Taman Perindustrian Batu Caves
Batu Caves Centre Point
68100 Batu Caves
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12.1. Introduction

Most of formulations to construct stiffness matrix in the finite element method are based on the so-called stiffness approach [15, 16]. However, for special type of element, such as a beam element with arbitrary variation of its stiffness, another approach based on a flexibility approach may give a more accurate result as reported by many articles [4, 5, 11, 12]. The drawback of using the flexibility method is usually on the need to transform the resulting flexibility matrix into the stiffness matrix to form a standard finite element equation. A direct approach to perform a matrix invert operation, even though it looks simple in the formulation, may reduce the accuracy of the solution in addition to increasing computational time. In this chapter, an efficient technique to transform the flexibility matrix into the stiffness matrix without inverting the matrix is proposed. The technique is developed based on the method of translation of axis for planar problem in [42] and further extended to non-planar problem in the present work. The present procedure is the basis to formulate the stiffness matrix developed in Chapters 22 and 23.

12.2. Static Equivalence Translation

Consider a force vector P_α and a moment vector M_α at point α as shown in Fig. 15.1. The actions at point α can be computed from their static equivalence P_β and M_β actions at other point β based on the following expressions: