Analysis of frames by substructuring technique based on using algebraic and graph methods

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SUMMARY

In this paper, substructuring techniques for the analysis of frame structures by the force method are reviewed. An algorithm is presented for the formation of cycle basis of the graph model of a frame structure. A simple and efficient graph method is proposed for preserving the sparsity of the matrices involved for including the boundary conditions when algebraic and graph force methods are employed. Copyright © 2007 John Wiley & Sons, Ltd.

1. INTRODUCTION

Substructuring methods are developed for the analysis of large-scale problems [1–3]. It is a well-known fact that computing a good basis for the null space of the equilibrium matrix is the most fundamental step in the force method of structural analysis [4–7]. Upon construction of the sparse null basis matrix, the other computations are straightforward. It is also known that the graph theory is a powerful tool for the formation of such bases. This is achieved by selecting minimal and optimal cycle bases [8, 9], and generalized cycle bases of the graph model of structures [10]. A complete description of these methods can be found in [11, 12], where the sparsity, structuring and conditioning of structural matrices are developed.

Substructuring techniques for the analysis of frame structures by the force method are well documented by Przemieniecki [3]. In this paper, an algorithm is presented for the formation of cycle basis of the graph model of a frame structure. In addition, a simple and efficient graph

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