Dynamic Condensation of Structural Systems

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Summary

Dynamic condensation has always received little attention from civil engineering community due to the recent huge diffusion of sophisticated Finite Element packages and powered computers.

Despite all of this, on hand simple models are attractive for the possibility to manage large systems with very few variables.

It follows that prediction of static and dynamic general behaviour under different type of loads speeds up for sensitive analysis. Worst loading cases could be selected and thus applied to a more general F.E. model to display detailed forces inside the structure.

This paper shows how to get a condensed dynamic model starting from a F.E. Model through a numerical approach. Three case histories are reported.

Keywords: Dynamic condensation; Mass and Stiffness matrices; Mass and Stiffness centroids; Raleigh quotient.

1. Introduction

This work shows a method about how to reduce a complex structural system, analysed by way of a Finite Element Model (FEM), to a very simple one which accounts only for few degrees of freedom so that it can be dynamically handled.
The method consists of two steps; the first seeks for a reduced mass and stiffness matrices based on few degrees of freedoms opportunely located in to the structure [1]; the second step finds out the stiffness and mass centroids located on rigid planes perpendicular to the main axis of the structure. Buildings comprising of rigid floor slabs can thus be reduced and analysed by way of this method with a numerical model which can be solved with a very simple electronic sheet.
The scope of this work is also to get an easy and quick method to account for the many constraints which the most up-dated building codes nowadays require about the regularity of structural systems. In fact the need to state whether the structure of a building is regular or not along with its height is an hard matter if dealt with a complex F.E. model; instead it can be easy checked if investigated with a simple model which accounts only for three degrees of freedom for each floor.

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