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Resistance of Concrete Slender Columns

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Abstract

The paper presents a calculation of slender concrete column resistance with a non-linear analysis which takes into account a contribution of second order theory, non-linear distribution of concrete stresses in cross-section and cracking. The Transfer Matrix Method was used as a step by step method for calculation of nodal forces and deformation vectors and modified rigidities of reinforced concrete segments. Also Newton method for searching equivalence of normal forces and bending moments on each step of calculation and central cross-section of column segment is explained in details. Theoretical results are compared with another non-linear software and realized experiment.

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Keywords: Non-linear analysis, slender concrete columns, Transfer Matrix Method, Newton method

1. Introduction

Design of slender concrete columns requires the analysis of second order effects for taking into account a total bending moment. Approximate methods for calculating this second order moment are not always on the safe side of the design. In the paper we present the genuine software for analyzing slender concrete columns by the general non-linear method which is based on step by step procedure of Transfer Matrix Method combined with sectional analysis.

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These calculations were compared with another non-linear software DIANA and an experimental tested concrete column to verify and calibrate the new method of non-linear analysis.

Nomenclature

C	nodal matrix
B	segmental matrix
P,PR	temporary result gathering matrices
O1	unknown parameters matrix at nodal point 1
O2	boundary conditions matrix at the end point - defines the set of algebraic equations
R	result parameters matrix
D	state vector of force and deformation parameters
u,v,φ	deformation parameters
N,V,M	axial force, shear force and bending moment, respectively
$\varepsilon_0,\varepsilon_h$	edge strains of cross-sections
e_0	eccentricity of normal force acting on the column in the first and the last nodal point
EA_{ij}	axial rigidity
EI_{ij}	bending rigidity

2. Procedure of Transfer Matrix Method and sectional analysis

Algorithm of transfer matrix method is defined in two principal steps. During the first step the unknown initial parameters defined by the matrix of initial parameters are transferred by using the matrix multiplication of segmental and nodal matrices into the end nodal point of the applied simulation.

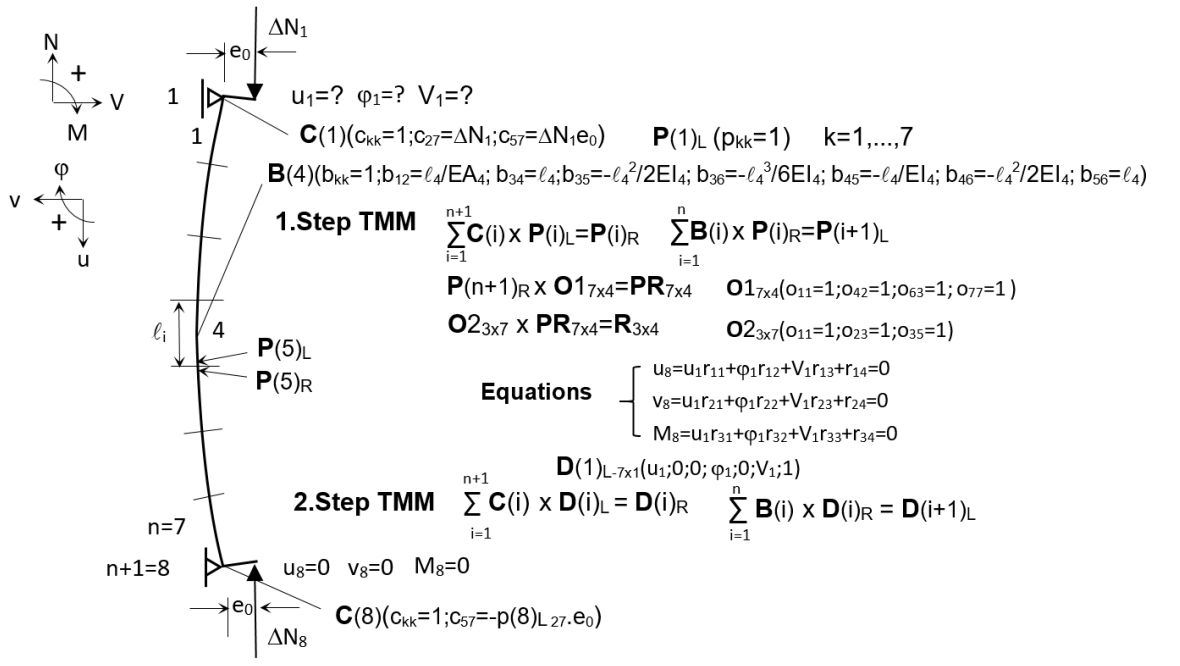

Fig. 1. Algorithm of transfer matrix method.