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Boundary Element Formulation for the Inelastic Dynamic Analysis of Beams

Andreas E. Kampitsis[1] and Evangelos J. Sapountzakis[2]

[1]National Technical University of Athens, Zografou Campus, GR–157 80 Athens, Greece,
cvakamb@gmail.com
[2]National Technical University of Athens, Zografou Campus, GR–157 80 Athens, Greece,
cvsapoun@central.ntua.gr http://users.ntua.gr/cvsapoun

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In this investigation a Boundary Element Method (BEM) is developed for the inelastic dynamic analysis of Euler-Bernoulli beams of simply or multiply connected constant cross section having at least one axis of symmetry. The beam is subjected to arbitrarily distributed or concentrated dynamic loading along its length, while its edges are subjected to the most general boundary conditions.

A displacement based formulation is developed and inelastic redistribution is modeled through a distributed plasticity model exploiting material constitutive laws and numerical integration over the cross sections. An incremental - iterative solution strategy is adopted to restore global equilibrium along with an efficient iterative process to integrate the inelastic rate equations [1]. The arising boundary value problem is solved employing the boundary element method [2]. The essential features and novel aspects of the present formulation compared with previous ones are summarized as follows.

i. The beam is subjected to the most general nonlinear boundary conditions including elastic support or restrain, while its cross section is an arbitrarily monosymmetric one.
ii. The formulation is a displacement based one taking into account inelastic redistribution along the beam axis by exploiting material constitutive laws and numerical integration over the cross sections (distributed plasticity approach).
iii. A hysteretic model is employed.
iv. An incremental - iterative solution strategy is adopted to restore global equilibrium of the beam. Integration of the inelastic rate equations is performed for each monitoring station with an efficient iterative process and stress resultants are obtained employing incremental strains.
v. A BEM approach is employed for the dynamic inelastic analysis of beams.

Numerical results are worked out to illustrate the method, demonstrate its efficiency and wherever possible its accuracy.

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