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A BEM solution to transverse shear loading of composite beams. (English) Zbl 1127.74338

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Summary: A boundary element method is developed for the solution of the general transverse shear loading problem of composite beams of arbitrary constant cross-section. The composite beam consists of materials in contact, each of which can surround a finite number of inclusions. The materials have different elasticity and shear moduli with same Poisson's ratio and are firmly bonded together. The analysis of the beam is accomplished with respect to a coordinate system that has its origin at the centroid of the cross-section, while its axes are not necessarily the principal ones. The transverse shear loading is applied at the shear centre of the cross-section, avoiding in this way the induction of a twisting moment. Two boundary value problems that take into account the effect of Poisson's ratio are formulated with respect to stress functions and solved employing a pure BEM approach, that is only boundary discretization is used. The evaluation of the transverse shear stresses is accomplished by direct differentiation of these stress functions, while both the coordinates of the shear center and the shear deformation coefficients are obtained from these functions using only boundary integration. Numerical examples with great practical interest are worked out to illustrate the efficiency, the accuracy and the range of applications of the developed method. The accuracy of the proposed shear deformation coefficients compared with those obtained from a 3-D FEM solution of the 'exact' elastic beam theory is remarkable.

MSC:

74K10 Rods (beams, columns, shafts, arches, rings, etc.)
74S15 Boundary element methods applied to problems in solid mechanics
74E30 Composite and mixture properties

Keywords:

transverse shear stresses; shear center; shear deformation coefficients; composite; beam; effect of Poisson's ratio; boundary element method

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