Line Element-less Method (LEM)
for beams in torsion and Plates in bending

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Abstract

Capturing the structural behaviour through solving the formulations of the physical problem, is the constant interest of engineer and scientist researches working on civil construction field. Generally the equations governing the problem, for instance the elasticity problem, are partial differential equations (PDEs) and since exact solutions are available just for a restricted range of application, engineers and scientists have been started to improve numerical procedures. The main idea of numerical simulation is to transform a complex practical problem into a simple discrete form of mathematical formulation representing the problem of concern. The method used for numerical analysis of structures during the last 30 years is mainly the Finite Element Method (FEM) [1]. Then the Boundary Element Method (BEM) [2] was an alternative tool for numerical analysis, but in late Meshless or Meshfree (MFree) method has been developed with a great success [3]. Basically FEM needs a discretization over the entire domain through finite element mesh. Modification of the discretized model to improve the accuracy of the solution may be cumbersome. Although FEM evaluates the field function accurately, it is not proper to determine its derivatives. BEM overcomes these latter drawbacks since the discretization is only over the boundary of the body, thus to remodel will be very easy. Moreover the BEM allows evaluation of the solution and its derivatives at any point of the domain.

The definition of Meshfree method (GR. Liu 2002,[3]) is: Meshfree method is a method used to establish system algebraic equations for the whole problem domain without the use of a predefined mesh for the domain discretization.

In this paper, since the challenge is to avoid the mesh, it will be introduced the Line Element-less Method (LEM), for torsion solution applied in a beam of isotropic material and arbitrary cross section. LEM may be considered a truly no-mesh method because it does not need any discretization. All integrals are simple line integral even those used for evaluating the properties of cross-section as area, moment of inertia [4] Numerical results, which show the elegance and efficiency of the method will be reported contrasted with results of exact solution if available or approximate found in literature. Further the extension of this method to capture the structural response of plates under uniformly distributed edge moments [5] and transverse load, will be presented.

Also for this latter case, several numerical examples will assess the accuracy of the proposed approach comparing the obtained results with other classical methods.

Keywords: **Line Element-less Method**

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