The studies are devoted to strength and stability of I-beams with ribs. Such structures are often used in steel constructions, bridge industries, and many more. There are many papers describing simillar problem, but there is lack of optimization of distribution of ribs, their shape and thickness. This paper presents the numerical results of strength and stability of I-beams with diferent number, different distribution, different shape and different thickness of ribs. The I-beams are under three and four point bending. The results are obtained by FEM analisys for various parameters of I-beams. Deflections and critical forces are compared for different configurations and presented in tabels and figures. Finally the criterium function with weights for strength and stability was formulated. Minimization of this function was conducted for I-beams with different configurations of ribs.

The damage characteristics of cross-ply laminates subjected to abrasive water jet cutting for various process parameters

abst. 165
Repository

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Composite materials have been increasingly used in the manufacturing of sophisticated products requiring lightweight and higher strength to resist complex loadings in difficult environments. Due to their higher prices, their products are restricted to be used mostly in advanced engineering fields such as space, aircraft, boat and automotive sectors. The conventional machining techniques used in the manufacturing of metals can not be used efficiently for composites due to their heterogeneous nature, where the strong fibers are embedded into a softer matrix. The water jet cutting technique is one of the promising techniques used for machining composite materials due to lack of thermal damage, lower tool wear as a result of smaller cutting forces and high productivity. In this study, the water jet cutting of cross-ply CFRP laminates was investigated. In the performed experiments, different failure characteristics such as the intra-ply and interply damages were noticed. To understand the underlying physics, a three-dimensional FE model of the process was developed using ABAQUS finite element software. In the model, the water jet cutting process was simulated using the smooth particle hydrodynamics (SPH), Hashin damage model was used to simulate the behavior of the composite structure and cohesive zone elements were used to predict the delamination phenomena. The evolution of the damage in the composite plate was investigated for different process parameters such as the thickness, impact angle and speed of the water jet cutting as well as the thickness and stacking sequence of the laminate in depth. The experimental analysis and the numerical prediction are in good similitude

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LAMINATED COMPOSITE STRAIN GRADIENT NANOPLATES ANALYZED WITH MESHLESS METHODS

abst. 168
Repository

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Nanomaterials and nanostructures are emerging technologies in engineering and industry. Such structures generally made of different materials have a global behavior which depends on the material nano scale. Classical Laminated Theory (CLT) is not sufficient to capture some effects present in nano plates therefore a novel strain gradient theory which depends on a nano scale length parameter is preferred. Classical solutions of such problem consider simply supported boundary conditions as well as uniformly (UDL) and sinusoidally (SSL) distributed loads in static problems. To overcome limitations in analytical solutions numerical approaches could be considered such as classical finite element method and meshless methods. The authors are showing some dimensionless outcomes of the present problem when nanoplates are considered under bending loads. Stress recovery is also provided for proving the

validity of the present approach in terms of through-the-thickness stress profiles. It is demonstrated that meshless methods can be considered for accurate analysis of nanoplates when complex geometries are analyzed as well as random location of the point collocations.

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Strong- and Weak-Form Physics Informed Neural Networks for the Analysis of Composite Plates and Shells

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This work deals with the development of computational models relying upon the Physics Informed Neural Networks (PINNs) along with Extreme Learning Machine (ELM). The framework allows boundary value problems of linear elasticity to be solved using a strong- or weak-form approach. Goal of this paper is presenting and comparing these two approaches when applied to composite plates and shells. For this purpose, the PINNs/ELM framework is developed in conjunction with a Carrera's Unified Formulation, which is capable of handling several kinematic theories, ranging from Equivalent Single Layer (ESL) to LayerWise (LW) within the same framework. The strong-form approach is developed by collocating the solution in a grid of points belonging to the domain. No mesh nor numerical integration are needed. At the same, results show that the accuracy of predictions can be improved if the approach is rephrased in a weak-form. With this purpose, a weak-form strategy is developed, where integration is carried out via Montecarlo integration, whereas essential conditions are imposed with a penalty approach. Results are encouraging and show a drastic improvement on the quality of the predicted displacement and stress field. Comparison between the two methods is presented and discussed, and the results are validated against finite element computations.

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abst. 171
Room 1
Tuesday
July 20
12h15

Mechanics of layered shale as Cosserat continua with dilatancy effects

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Dilatancy is of importance for understanding the micromechanical behavior of layered materials and rocks such as shale. These effects are due to the elastic interfaces among rock formations and particles. Most of the times such interfaces have a rough surface which generate dilatancy and bring volume variation to the overall solid. However, such important effect is generally neglected in numerical analysis of layered shale. The aim of the present work is to study the effect of dilatancy on layered shale when rough elastic interfaces are considered. Different sizes of shale blocks are presented by changing their aspect ratio. The stiffness properties of the rough interface can be obtained by employing a contact density model. Different roughness is defined for the interfaces to assess the effect of dilatancy by changing the contact density function. A homogenization procedure based on an energetic equivalence criterion is used to generate the constitutive parameters. The problem is solved by using a homogenized micropolar continuum which is discretized by means of a finite element implementation. This study shows the validity of the micropolar theory when considering rough micro-structure as well as the importance of dilatancy effect in modelling such continua

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