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The phenomenological energy model of orthotropic nonlinear elastic material on the example of rolled sheet of cylindrical tank

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The orthotropic materials are one of the most important construction elements. In many cases the orthotropic is the relic of technological process like plate rolling. Because the mechanical properties of such type of material depend on the chosen sheet rolling direction, the ability to predict the strength situation is very important, when the material will be destroyed. Very useful can be the strain energy based methods which were used among others in papers and sheet rolling direction of sheet metal and mechanical properties changes can be important when loaded part of device is under dynamic impacts. Fatigue processes initiation depends also on local material properties differences and micro notches. The authors of the presentation applied the strain energy density function for the analytical description of the behaviour of orthotropic material forced in plane state of stress. The described investigation results are presented on a practical example of the back surface of the thin-walled cylindrical tank under the influence of internal pressure. The material stability assumptions formulated on the basis of the strain energy density function, will be very useful and important in the prediction of failure of material due to a plastic flow and particularity in the assessment of strength of the responsible cylindrical shell. As mentioned, dynamic impacts and fatigue phenomena depend on local material properties and notches shapes. Strain energy based method proposed by authors can be developed and helpful for researchers and engineers interested in the design of the responsible constructions. The proposed energy method is universal and can be modified for the investigated model of construction and applied materials also unconventional materials such as composites or polymers.

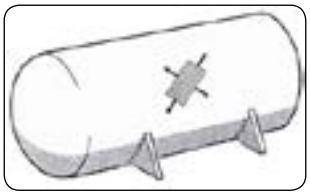

Figure 1: Orthotropic tank

Recent Publications:

1. Wegner T (2000) Surface of limit state in nonlinear material and its relation with plasticity condition. The Archive of Mechanical Engineering 47(3):205-223.
2. Wegner T and Kurpisz D (2013) Phenomenological modelling of mechanical properties of metal foam. Journal of Theoretical and Applied Mechanics 51(1):203-214.
3. Obst M, Kurpisz D and Paczos P (2016) The experimental and analytical investigations of torsion phenomenon of thin-walled cold formed channel beams subjected to four-point bending. Thin-Walled Structures 106:179-186.
4. Obst M, Kurpisz D and Mencel K (2015) Energy based mechanical characteristics of polymers POM-C, PET, PA6, PVC, PVDF. Machine Dynamics Research 39(4):93–106.
5. Obst M, Rodak M and Paczos P (2016) Limit load of cold formed thin- walled nonstandard channel beams. Journal of Theoretical and Applied Mechanics 54(4):1369-1377.

Biography

Maciej Obst is a Scientific Worker at the Poznan University of Technology. His scientific interests include experimental and analytical research of mechanical properties of materials, dynamics, constructions and complex structures where strength of materials, mechanics and energy dependences are used for analysis and research. His scientific activity also includes automotive technology, transportation problems, applied mechanical engineering directed to material properties, stress and strain dependences, energy distribution. Research experience and academic activity are energy based method material properties modeling, material properties experimental research, construction experimental research such as car seat belts, lashing straps, suspension air springs, brakes and friction research, scientific experimental stands design and other interesting devices.

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