



Non-linear viscoelastic beams with
two-directional material
inhomogeneity: a longitudinal
fracture analysis

V. Rizov

This paper is focussed on analysis of longitudinal fracture in non-linear viscoelastic beam structures with two-directional continuous material inhomogeneity (the material properties change continuously in both width and thickness directions). The viscoelastic model that is used for treating the mechanical behaviour of the beam represents a combination of four linear and two non-linear springs and dashpots. The model is under strains which change with time. The material properties involved in the constitutive law are distributed continuously in the cross-section. The strain energy release rate (SERR) is derived. For this purpose, the curvatures are determined by using the equilibrium equations. The method of the J -integral confirms the correctness of the SERR solution. The results are shown in various graphs.

Fig. 1. Non-linear viscoelastic mechanical model.

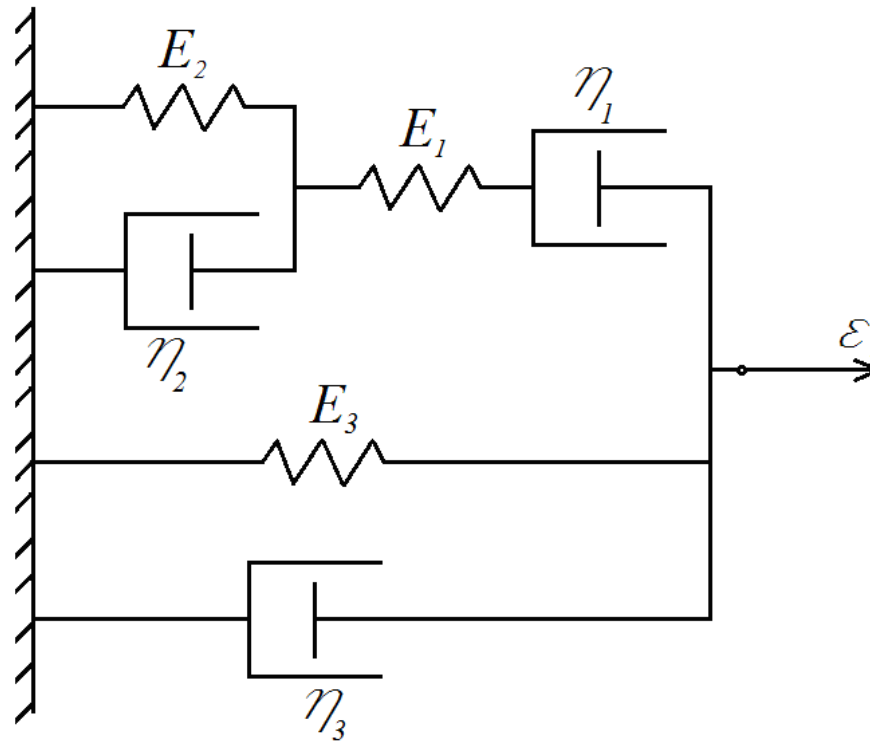


Fig. 2. Non-linear viscoelastic beam with a longitudinal crack.

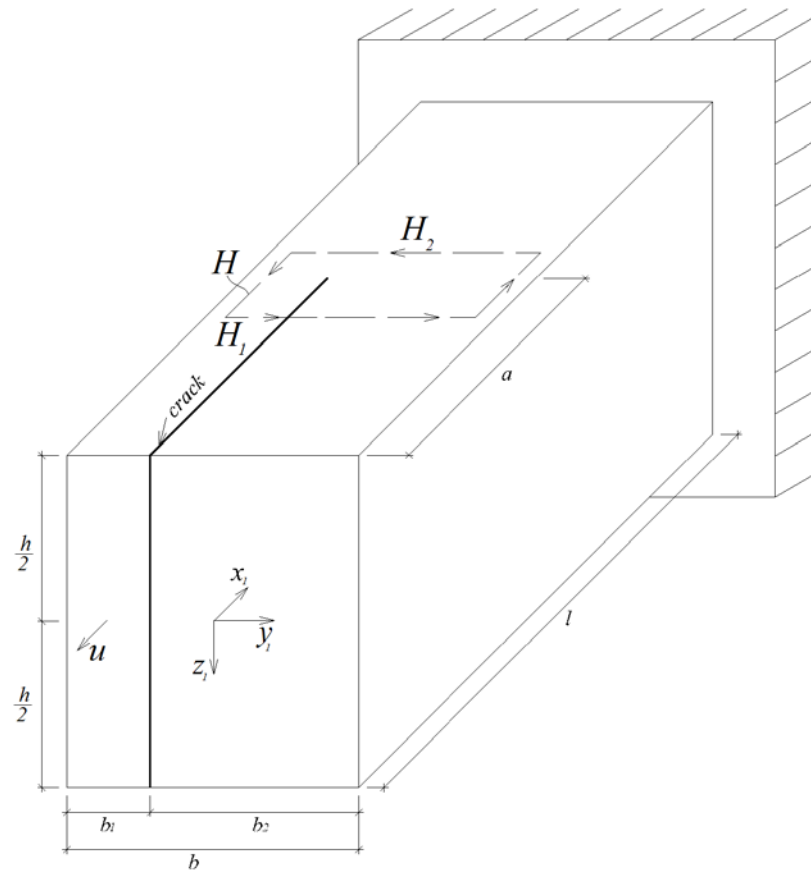


Fig. 3. The strain energy release rate presented as a function of time (curve 1 – at $m_1=0.5$, curve 2 – at $m_1=1.0$ and curve 3 – at $m_1=2.0$).

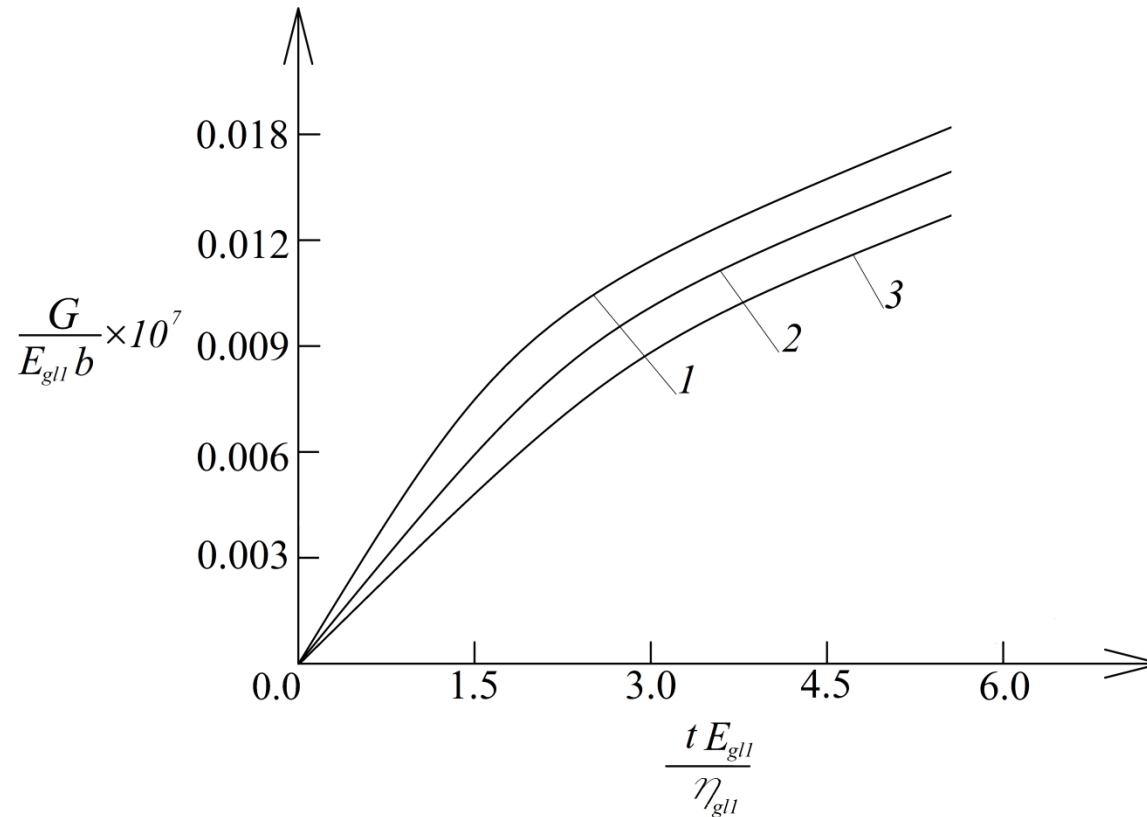


Fig. 4. The strain energy release rate presented as a function of $u\theta$ (curve 1 – at $m_1=0.5$, curve 2 – at $m_1=1.0$ and curve 3 – at $m_1=2.0$).

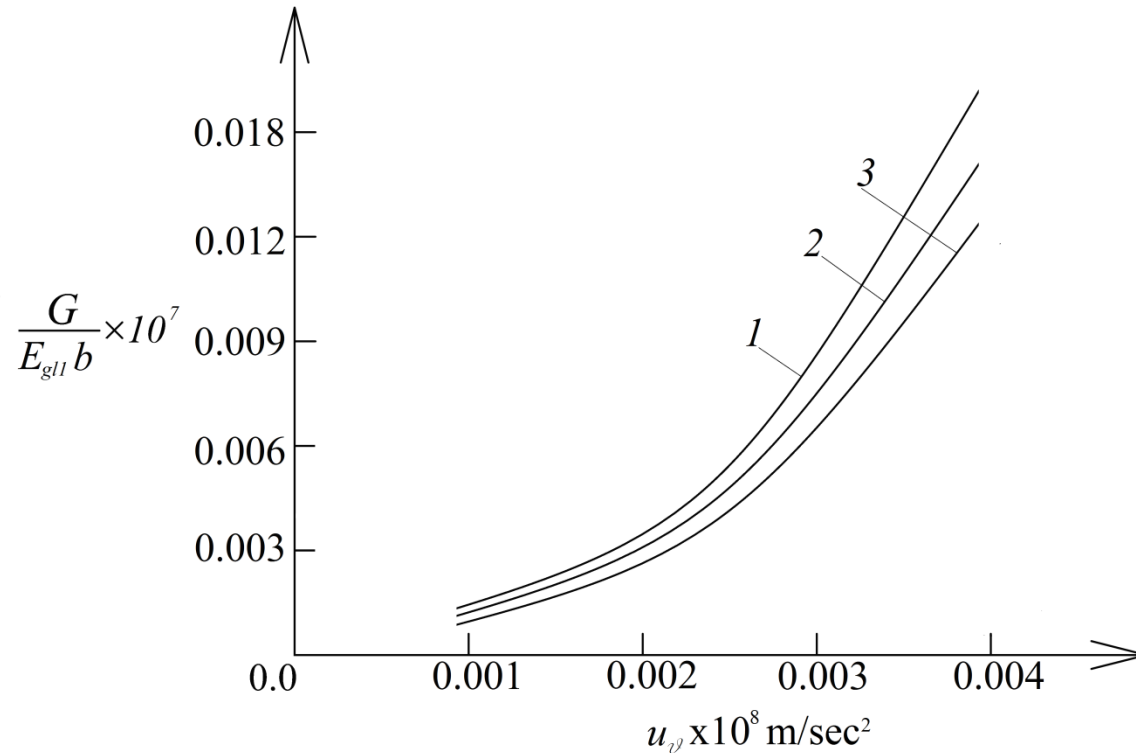


Fig. 5. The strain energy release rate presented as a function of m_5 (curve 1 - at $m_6=0.5$, curve 2 - at $m_6=1.0$ and curve 3 - at $m_6=2.0$).

