

Mechanical insights on energy dissipating devices behaviour

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**Title:** Mechanical insights on energy dissipating devices behaviour

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## Abstract

Whenever a structure or a system are subjected to dynamic loads, energy dissipation happens. If the energy incoming to the system is significant, it would be non-feasible to only rely on the system damping to dissipate energy and, for this reason, plastic properties of materials are exploited. However, some phenomena imply an incoming energy so high that dissipation needs to be assigned to specific components, appropriately designed for this purpose. With reference to rockfall protecting flexible barriers, these components are located along the ropes that connect the structure with the foundation system (anchors). Investigating their mechanical behaviour is fundamental to develop more performant and efficient brakes and to monitor the systems in which these components are already applied.

In this work, two energy dissipating devices commonly used in the field of rockfall protection have been analyzed: the dissipation mechanism in these braking devices is based on friction and plastic deformation. The first brake is constituted by a hollow slender square pipe in compression with an internal transversal restrain provided by the connecting rope. The second is a steel ribbon bended around a fixed roller. The mechanical behaviour of the devices was investigated thanks to the limited literature on the topic [1-3] to provide an analytical solution of the dissipating mechanism. Static tests were conducted on small scale devices in order to calibrate the model. The analytical model can be used to quantify the properties of aged devices by adjusting the mechanical and geometrical properties of the brakes.

## References

- [1] Wang M., Shi S.-Q., Cui L.-M., Yang Y.-K., "Mechanical performance analysis on U-brake energy dissipator used in passive protection nets", *Engineering Mechanics*, 33, 114-120 (2016) (in Chinese)
- [2] Wierzbicki T., Abramowicz W., "On the crushing mechanics of thin-walled structures", *Journal of Applied Mechanics*, 50, 727-34 (1983)
- [3] Abramowicz W., Jones N., "Dynamic progressive buckling of circular and square tubes", *International Journal of Impact Engineering*, 2, 179-208 (1986)