CASE STUDIES OF SOFT ACTIVE MATERIALS FOR ENGINEERING APPLICATIONS

M. M. L. Pemachandra[1], A. P. Rathnayaka[2] and Y. R. D. R. Senanayaka[3]

[1]Department of Civil & Environmental Engineering, University of Ruhuna, Sri Lanka
[2]National Water Supply & Drainage Board, Sri Lanka
[3]State Engineering Corporation, Sri Lanka
lahiru.p@cee.ruh.ac.lk

Abstract: This research investigates the potential of soft active materials (SAMs) as transformative elements across diverse engineering domains. Focusing on four key applications—overhead bridges, sustainable dancing floors, hybrid systems, and camera lenses—the study explores the practical implementation of SAMs to address contemporary challenges. In this study, engineering applications are explained using existing theories of soft active materials and material science with analyzing newly developed finite element models. Piezoelectric elements were integrated into an overhead bridge model to assess their potential for structural health monitoring and energy generation. With use of PZT-4 material, 0.12 millivolts were induced, under applied forces and specific boundary conditions. Sustainable dancing floors were conceptualized to harness energy from human movement through piezoelectric material integration. With typical reasonable assumptions, the estimated energy generation was 126 KJs. In the realm of hybrid systems, regenerative braking systems incorporating dielectric elastomers were modeled to enhance energy efficiency. With the use of a brake shoe comprising 1000 layers of polyisoprene dielectric elastomer, under an average braking force, per braking cycle 48 millijoules of electrical energy could be generated. The study also explored the application of SAMs in camera lens technology, aiming to develop compact, high-performance lenses through tunable refractive index materials. These case studies collectively demonstrate the versatility and potential of SAMs in addressing complex engineering problems. In conclusion, this study finds that soft active materials such as piezoelectric elements, dielectric elastomers, etc., can be used as sustainable materials which can generate a significant impact on innovation and technological advancement which helps to improve sustainable practices creating a new path to sustainable green economy in the world as well as in Sri Lanka.

Keywords: energy harvesting, piezoelectrics, soft active materials