Structural integrity evaluation of a train pull arm

J.T.P. Castro*[,1], R.D. Vieira[1], M.A. Meggiolaro[1], J.L.F. Freire[1]
[1]*Mechanical Engineering Department, Pontifical Catholic University of Rio de Janeiro, Brazil*
jtcastro@mec.puc-rio.br

The arm of an equipment used to position huge iron ore trains during their unloading was cracking in service. Despite that, the operator would like to increase its capacity from 80 to 102 wagons. The objective of this work was to identify the cause of the cracking and to redesign the arm to increase its capacity, maintaining its overall dimensions. A load cell was designed and built to monitor the pulling forces. The positioning equipment was instrumented with strain gages to measure the real operating loads involved in pulling the 80 and 102 wagons. The actual strain histories were analyzed using a general purpose fatigue design program specially developed to quantify the damage induced by variable amplitude loading according to several crack initiation and propagation methodologies, including the SN, the εN, welding codes and the da/dN. The program also considers load sequence effects such as overload induced residual stresses and crack growth retardation and acceleration. Using these tools, the original design flaw was easily identified and corrected. As a result, the pulling capacity of the positioning equipment could be increased in an economical and safe way. Both the experimental procedures and the fatigue design code are discussed in this work, and the importance of their interaction is emphasized.

Keywords: Train pull arm, Fatigue design, Strain gage measurements, Crack growth predictions