Evaluation of the structural integrity of aging mine shafts

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Abstract

Mineshafts are amongst the most important components of the infrastructure in an underground mine, as they are used for transporting men and materials to and from the ore body, as well as hoisting the ore to the surface. Shaft steelwork, comprising horizontal buntons and vertical guides, is susceptible to corrosion and mechanical damage. This paper considers two shafts as case studies, namely a sub-vertical shaft running between 1800 and 2900 m below the surface, and a vertical shaft running to a depth of 2500 m below the surface in a deep gold mine. The steelwork in both shafts had extensive corrosion problems, which raised concern about the integrity of the shaft steelwork structure. An analysis of the shaft steelwork was carried out to define the lateral loads developed in the steelwork as a result of the dynamic interaction between the conveyances and the conveyance guiding system. The dynamic interaction between conveyances and the shaft steelwork is an interesting phenomenon, because it depends on the stiffness of the steelwork. As the steel corrodes, its stiffness reduces, and hence the lateral applied load also decreases. This analysis took cognizance of the effects of corrosion by successively reducing the thickness of the steel members, and calculating the resulting stresses. The extent of corrosion also made the possibility of supports failing a real concern, so certain supports were omitted in the analysis, to investigate the likely result of a support failure. The limiting criteria in this analysis were the local buckling stress of the thin residual material, and the guide deflections. Based on this analysis, acceptance criteria for the extent of corrosion were developed.