SPB-8 Fatigue Analysis and Design of a Welded Auger Shaft

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Introduction

Fabricated auger shafts are a common means of crop conveyance in harvesting and storage operations. Their welded construction and on-off cycling frequency can make them vulnerable to fatigue failure, particularly when combined with the abnormal bending loads that may be induced by shaft out-of-straightness. An engineering study of one such component was undertaken for the twofold purpose of establishing a suitable depth of penetration requirement for the drive end attachment weld, and evaluating the overall fatigue serviceability of the structure, including its tolerance for shaft misalignment and the potential for harmonic excitation.

Technical Approach and Results

The finite element method was employed as an efficient means of evaluating the potentially interactive effects of several variables on stresses at the weld root and toe locations in question. The entire assembly was first modeled with realistic end constraints to establish accurate boundary conditions for subsequent fine-mesh analyses of the local geometries. A computational modal analysis was also performed to identify potentially dangerous running speeds for excitation of torsional and bending modes. Using hot-spot stress-life and fracture mechanics-based methods as appropriate, fatigue lives were predicted for a variety of cases.

Conclusions

The results of this work enabled reasonable limits to be placed on incomplete joint penetration, shaft out-of-straightness, shaft rotation speed, and crop density, in addition to providing a life expectancy range for within-tolerance assemblies and operating conditions.