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Experimental and Numerical Evaluation of a Shaft Failure Behaviour Using Three-Point Bending Test

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Abstract : A substantial amount of natural resources are nowadays consumed at a growing rate, as humans all over the world used materials obtained from the Earth. Machinery manufacturing industry is one of the major resource consumers on a global scale. Even though the incessant finding out of the new material, metals, and resources, it is urgent for the industry to develop methods to use the Earth's resources intelligently and more sustainable than before. Re-engineering of machine tools regarding design and failure analysis is an approach whereby out-of-date machines are upgraded and returned to useful life. To ensure the reliable future performance of the used machine components, it is essential to investigate the machine component failure through the material, design, and surface examinations. This paper presents an experimental approach aimed at inspecting the shaft of the rotary draw bending machine as a case to study. The testing methodology, which is based on the principle of the three-point bending test, allows assessing the shaft elastic behavior under loading. Furthermore, the shaft elastic characteristics include the maximum linear deflection, and maximum bending stress was determined by using an analytical approach and finite element (FE) analysis approach. In the end, the results were compared with the ones obtained by the experimental approach. In conclusion, it is seen that the measured bending deflection and bending stress were well close to the permissible design value. Therefore, the shaft can work in the second life cycle. However, based on previous surface tests conducted, the shaft needs surface treatments include re-carburizing and refining processes to ensure the reliable surface performance.

Keywords : deflection, FE analysis, shaft, stress, three-point bending
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