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CASTING DEFECTS AND THE MECHANICAL DESIGN PHILOSOPHIES

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ABSTRACT

There are two philosophies in Mechanical Design, the safe life design and the fail safe design. The safe life design is based on concept that there must be no cracks or defects in the material. And fail safe design consider that there is a defect in material, but the component can be working safety, this is, the damage tolerance concept assumes the existence of initial flaws in the mechanical component and its philosophy is based on the acceptance that damage will propagate and an adequate system of inspection should be implemented in order to monitor the damage. This work aims to present a state of art in relation to the mechanical design of components that contain defects inherent to the casting process and present a methodology to be following in mechanical design of casting components.

Keywords: fail safe design, damage tolerance, casting defects, mechanical design philosophies, sand casting.

INTRODUCTION

Mechanical design is a complex process, requiring many skills. The parameters that influence the durability of mechanical components are service loads, material properties, geometry, and the manufacturing process. The interaction of these four parameters must be taken into account at the mechanical design stage, in order to define the component lifetime (Morgado, 2016).

Sand casting is an example of a manufacturing process that can produce mechanical components with practically no limit to the size, shape or complexity. Nevertheless defects like gas defects (blow holes, open blows, air inclusions, pin holes porosity) and shrinkage cannot be excluded nor their influence in mechanical design.

The problem of the fatigue strength estimation of materials or components containing natural defects, inclusions or inhomogeneities is of great importance from both a scientifically or industrial point of view. Undoubtedly, an important factor affecting failure of components and structures is the presence of flaws due to processing, manufacturing or mechanical damage during service. The presence of flaws in the materials leads to failures at much lower applied stresses. It is therefore of primary importance to consider such defect features as input parameters in fatigue limit assessment. The fatigue limit of cast materials is mainly controlled

by the presence of casting defects such as microshrinkages or dross defects (Murakami, 1994; Beretta, 1997; Murakami 2002; Morgado, 2003).

In the last six years, methodologies based on microtomography, image analysis and finite elements have been developed, to analyse problems of fracture in mechanical components and investigate the influence of the casting defects in the durability of that components (Vanderesse, 2011; Tijani, 2013; Morgado, 2014).

RESULTS AND CONCLUSIONS

The results showed by many researchers in the last decades demonstrate that the study of the influence of intrinsic manufacturing defects in the mechanical design continues to be required. The proposed methodology is based in study cases and more research is need to optimized and generalize in addressing fail safe philosophy.

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