Fatigue life enhancement of welded joint using shot peening

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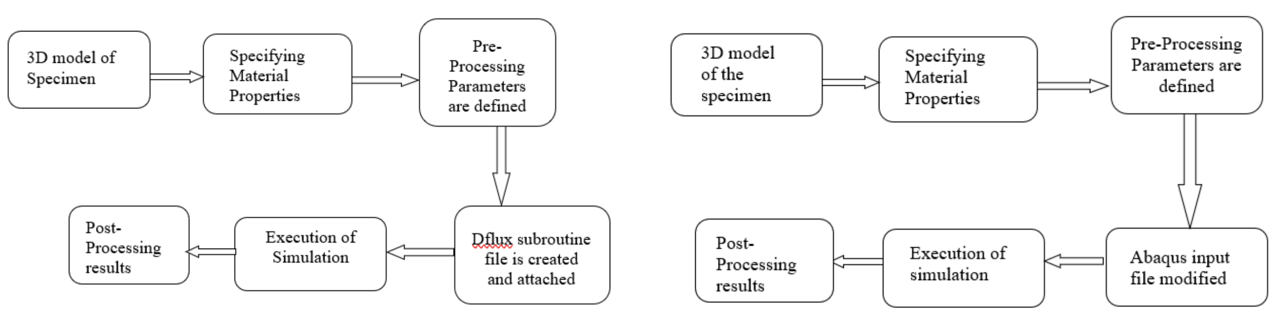
1 Introduction

Welding Process is a well-known process that has been used over the years on metallic infrastructure like bridges, rail, offshore and various other structures. As time progressed, improvements were made to the process but weld imperfections still exist, which deteriorate with respect to time due to dynamic loading as well as rough environmental conditions. Fatigue and corrosion have been two main sources of failure or damage to welded structures. The residual tensile stress on the welded specimen is caused due to incompatible thermal strains caused by heating and cooling cycles during the welding process. The heat-affected zone is usually the most affected region due to residual tensile stress and is generally considered an area where failure will usually occur. It is well established that some kind of defects will always be present in an as-welded specimen which cause detrimental effect on fatigue properties. Residual tensile stress further worsens the fatigue properties. Poor fatigue properties may lead to higher maintenance costs as well as lower life cycle of the welded element. To improve fatigue characteristics various methods such as shot blasting, heat treatment, shot peening, etc., techniques have been used. The primary objective of this work is to comparatively study the change in residual stress profiles of the specimen post welding and post shot peening operation using simulation techniques.

2 Methodology



(a) (b)

Figure 1: Three test cases: (a) Welding simulation flow char, (b) Shot peening simulation flow chart

3 Results

A multi-impact simulation on weld using SPH is executed by modifying abaqus input script to model solid particles. Two different shot velocities (90m/s and 60m/s) are used for the simulation to better understand the effects of Shot-Peening on residual stress profiles. Following are some of the main findings: A 15% improvement is seen in magnitude of maximum SCRS (Principal Absolute) induced with higher shot velocity of 90m/s compared to that at 60m/s. Also a wider spread of SCRS is seen for higher shot velocity but high magnitude SCRS is spread over a larger area along weld seam for lower shot velocity. A significant variation is seen in the shape of residual stress profiles in X, Y, Z directions along weld seam. In general, increase in magnitude of SCRS is seen for higher shot impact velocity, but SCRS distribution on weld seam differs in all 3 directions. SCRS induced at weld seam in Y direction is largest in magnitude and that induced in Z direction is lowest in magnitude.