Solution Analysis and Design

Welded Mast-to-base Connection

Through the application of Finite Element Analysis (FEA) it is evident that a welded mast-to-base connection provides significantly better structural integrity and longevity than a bolted connection.

Design Considerations:

The mast-to-base connection on an SRM is the most critical structural design element on the machine. This connection absorbs large moments of force reaction imposed by the weight of the mast, lift carriage, and load. This connection is also exposed to extreme cyclic conditions from equipment acceleration and mast sway that occurs each time the machine starts and stops.

A common means for connecting the mast to the base is to bolt the structures together. Typically this is done by welding attachment flanges to the bottom of the mast and the mating base surface, and then providing bolts around the circumference to secure the connection. With this type of arrangement the bolt loading is not shared evenly and the amount of load applied to each bolt (and the localized area) is dependent upon the stiffness of the connection surrounding the bolt. The stiffer the connection, the more load a particular point is subjected to.

Welded Connection

The distribution of load in mast-to-base bolted connections is not easily calculated or accurately modeled by Finite Element Analysis (FEA) programs due to the complexity of predicting variances of localized structural stiffness or their combined impact. Historically this issue eventually leads to structural failures – some occurring within a few years of service. The resulting failures range from bolt failures to structural fatigue cracks in the mast or base material. These issues result in continual maintenance to replace bolts and/or perform weld and structural repairs.

A preferred method for connecting the mast to base is to weld the structures. The mast is fabricated with structural tubes on each side of the mast connected by a common plate front and back. The mating base structure includes structural tubes on each side that mate with the mast tubes. This design provides a continuous stress path to minimize stress concentrations associated with load path redirection. Also, at the mast-to-base connection formed plates are applied front and back on the major tension/compression surfaces. These formed plates provide a smooth stress transition from the mast to the base that is not compromised by welds, bolts, or other discontinuities that would otherwise result in stress concentrations and provide potential failure concerns. The end result is lower long term maintenance costs and better equipment safety.