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ADVANCED WELDED STRUCTURES FOR ADAPTIVE MOBILE POWER STATIONS: DESIGN AND ANALYSIS

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Abstract – Energy storage and its utilization, regardless of location, enable the provision of critical services and machinery operation in remote and isolated areas, such as rural regions, islands, or in war and crisis scenarios. By employing modern energy production and storage systems, it becomes possible to ensure a reliable energy supply in areas with inadequate or damaged electrical infrastructure. During the design of the mobile energy solution, a critical objective is to minimize the overall weight of the structure. For this purpose, the primary construction material is the lightweight yet durable heat-treated and artificially aged aluminum alloy profiles, which form the structural framework for both the station and the solar panel mounting and moving system. Structural integrity is as strong as the weld and base material connecting the profiles.

Constructing a renewable energy station from superior lightweight materials offers significant energy and sustainability benefits, such as reduced material usage, fuel efficiency, and carbon emissions. The research findings indicate that optimized welding parameters are important for the structural integrity of the aluminium alloy 6082T6 construction. The case study of a mobile power station demonstrates the practical applications of this approach, where carefully selected welding techniques and parameters ensure that joints achieve mechanical performance comparable to that of the base material. This ensures that both strength and durability requirements are met. The study concludes that tailored welding processes are crucial to minimizing the adverse effects of heat input on the material properties of heat-treated aluminum alloys. Lowering the heat energy input for structural manufacturing is energy saved from manufacturing. Considering these effects, manufacturers can leverage the alloys' mechanical advantages in lightweight constructions, thus expanding their applicability in industries focused on weight reduction and structural integrity. These findings provide valuable insights into advancing innovative engineering solutions in sectors such as transportation of renewable energy stations, aerospace, and marine. Overall, selecting a proper manufacturing technology, materials and methods results in energy efficiency and allow for innovative structural solutions for welded structures with a complex configuration.

Keywords – *Construction welding; constructional integrity; energy production; mobile renewable power station; solar power*



Fig. 1. Mobile renewable energy station front isometric



Fig. 2. Mobile renewable energy station rear isometric

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