Resurgam Project´s 2nd Press Release

RESURGAM

Robotic Survey, Repair & Agile Manufacture

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During the first months of work in the RESURGAM Project, the partners involved in WP 4 have developed an investigation to determine the scope of the application of FSW in shipbuilding, for this deliverable 4.1 was prepared "Report on Suitable Components for Modular Assembly", in which the potential use of the FSW method in Shipbuilding and marine structures was evaluated, focusing on the presentation of concrete examples of structures and steel sections where FSW technology could be applied as a more economical, safer and environmentally friendly alternative to traditional welding methods. Showing that Friction Stir Welding can help European shipyards to improve their production rate and competitiveness in the world market, as well as being a suitable technique for the introduction and promotion of automation and robotization in the production of the European shipbuilding and ship repair sector. Above all, taking into account the advances developed at the level of tools applicable to steel, overcoming the previous limitations for its application in other materials different to aluminum.

In addition to the detailed analysis of Friction Stir Welding, the report prepared to assess and evaluate the application of FSW to Shipbuilding and Ship Repair provides a comprehensive review of the different techniques traditionally applied, such as MIG/MAG welding, TIG/GTAW, MMA, Plasma arc method, SAW, Laser method... Therefore, an overview of the differences and advantages of some methods over others is provided. Among the main drawbacks of these traditional methods used in the shipbuilding industry, which can be solved with FSW, are the following:

- Structural distortion arising from the thermal energy input and the phase change from solid to liquid and back to solid;
- changes in metal properties due to the creation of a cast microstructure in what was previously typically wrought plate;
- changes in materials properties due to the addition of a filler material, or the boiling off or segregation of the original alloying elements;
- The potential for generating defects such as porosity, undercutting, lack of penetration and inclusions.

While the advantages of FSW are:

- The elimination of melting in the joining process;
- the generation of a forged rather than cast weld microstructure;
- the elimination of human variability and skill from the welding process.

Friction stir welding is a low energy consumption process as it only needs to heat and soften a small amount of metal rather than melt it. Energy costs are thus reduced. In addition, the low heat input also very significantly reduces distortion and so eliminates much of the cost of rework and straightening.

The materials on which the FSW method can be applied have been expanding, testing its effectiveness first with aluminum, then with titanium, copper or magnesium, and nowadays it is applied to welds of different types and thicknesses of steel.

By their nature, ships tend to be rather complex structures due to their purpose, technology implemented into it, high hull and superstructure integrity requirements and more recently even higher ecological standards. Hence the importance of projects such as RESURGAM, which works and researches to advance in the application of new production methods in the European scenario.

One of the questions addressed by the research was to determine which parts can be fabricated, welded with the FSW method. The different parts that can be made and adapted to shipbuilding and ship repair are described in detail, as well as the types of steels used and their thicknesses. The ships that were used as examples are of the most common typologies and that stand out the most in European shipbuilding. Their construction plans were provided and analyzed, identifying the parts and areas that could be built with FSW at this stage of development and also the improvements necessary for their potential use. We are talking about fishing vessels, research vessels, specialized work vessels (cable laying barge), patrol vessels or container ships. This last example is very representative of what can be achieved using friction welding and applying it to shipbuilding and ship repair, of its possibilities of use and benefits, as container ships use watertight transverse bulkheads inserted in key structural locations (such as cargo holds, the front wall of the superstructure and the aft wall of the superstructure). The case of the fishing vessel, practically built in 12mm steel, is in the range in which the RESURGAM project intends to develop tools.

Another of the opportunities identified in the study is the application of FSW on OPV vessels, since the welds produced by FSW in comparison to the standard welding are smoother, beadless and don't require grinding after fabrication. This could create an opportunity in creation of vessels for the European navies. As it is a stiffer and stronger weld, the stealth characteristic of the vessel's hull could easily be improved, which is a key aspect in this type of vessel. Beads of the welds might deflect radar waves back to the sender and increases radar cross section of the ship, thus increasing possibility of detection.

In addition, it has been demonstrated that the method could find a future application in the joining of aluminum to steel as an alternative to bimetallic joints. A good example would be the joining of aluminum superstructure elements and the steel hull. A possible application in offshore gas pipelines construction has also been identified, as the individual pipe sections would not require prior edge preparation (bevelling), and the weld would be of higher quality and strength.

Method is safer and cleaner when considering healthcare of the workers (reduction of welding gases, elimination of risk of burns due to the lack of need for welder), in addition, it produces stronger joints and eliminates the need for post-treatment, reduces weight, minimizes distortions and misalignments, as well as increases corrosion resistance. Fatigue tests of FSW welds show a durability close to that of the original material. In summary, it could be said that costs are reduced and the construction process is accelerated.

The examples presented and analyzed in the study are very specific and within the possibilities of most European shipyards, that is, their size is suitable for the production facilities and typical installations of small and medium-sized shipyards. Such as, for example, the identified opportunity for the installation of scrubbers, since this task would not require the grounding of the vessel, and is therefore feasible for small and medium-sized shipyards in the European Union despite the large size of the vessel.

It has been demonstrated that there are applications in which FSW can be used in modular construction in the Shipbuilding Industry. Although without being a limitation, we could highlight these components:

- Longitudinal bulkheads.
- Transverse bulkheads
- Walls
- Decks
- Shell plates

It could be concluded that being able to extend its use to curved plates would increase significantly the number of parts of the vessel that could be welded with FSW technology. The limitation lies in the

equipment that holds the head and drives the pluck, not the welding technology itself. Portable or fixed FSW kit could be a valuable asset in hull repairs and during hull construction process.

