Arc welding, to join two steel structures together, is a cumbersome and expensive process, subject to human error and ingress of defects into the weld itself. *Bogdan Vasilescu/Shutterstock.com*

Friction-stir welding could revolutionise vessel construction

New technology could weld different steel grades together effortlessly and improve accuracy, quality and automation

Craig Eason

ALTHOUGH the shipping industry remains obsessed with fuel-efficiency designs and with calling the latest vessel an eco-ship, little consideration has been made of how to improve the construction process.

The industrialisation of shipbuilding has introduced modular construction methods perfected in South Korea, then used worldwide, and automation in cutting and plate bending. But that was decades ago and little has happened since.

Arc welding was invented in the 1940s, when US and UK allies needed fast construction methods to build liberty ships in the Second World War. Little has changed since then.

Now, shipbuilders could be about to benefit from revolutionary new technologies and methods that will not only enable steel structures to be welded more accurately, quickly and safely, but will also allow different materials to be welded together, and will test and assess the quality of construction work more smartly and quickly.

These developments could have major implications for shipbuilding schedules, construction quality and development of new materials to create lightweight ships — a move some see as crucial in the drive for increased fuel efficiency.

These could be seen as steps that will revolutionise ship construction in a way that goes beyond the small developments that underpin new vessels' eco claims.

Arc welding, to join two steel structures together, is a cumbersome and expensive process, subject to human error and ingress of defects into the weld itself.

Classification societies, through their common interpretations of the rules created by the International Maritime Organization, place requirements on steel strength and welding.

Most standard vessels use two types of steel, of normal and higher strength. Welding requirements are exact, as welds are a known weak point in a vessel structures that can cause fractures and failures.

The new research could revolutionise the welding and inspection process, if not the rules.

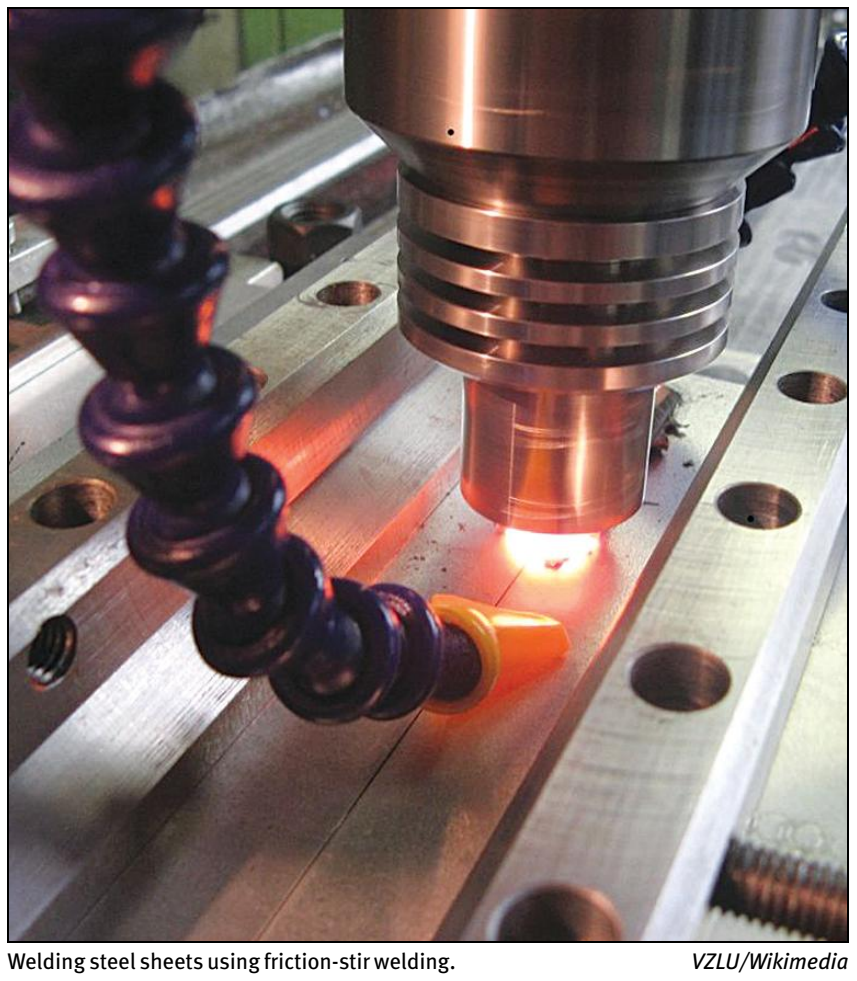
On the one hand, a new welding process is being investigated through a European Union co-funded project called Hilda, which includes the UK class society Lloyd's Register.

It could make it possible to weld different steel grades together effortlessly, at lower temperatures and without a flux or other component. Known as friction-stir welding, it is already being used in aluminium construction but has yet to be developed for steel construction.

A friction-rotating tool agitates the edges of two metals so they flow together like plastics.

It also promises to improve accuracy, quality and automation in the shipbuilding process, ships being built faster, more cheaply and to a higher quality, creating tonnage of a lower lightweight than would otherwise be achieved for a current vessel of the same deadweight.

Lower weight gives lower fuel consumption per tonne-mile.



Welding steel sheets using friction-stir welding. *VZLU/Wikimedia*

Friction-stir welding is also more energy-efficient and creates no fumes during the process, making it less detrimental to workers' health.

Initially, the Hilda project will look at how this process can be deployed in a shipyard, first with automatic welding of panel plates, then at the creation of a welding robot that can move up a hull, welding two blocks together a lot quicker than a human welder.

Software can predict the weld characteristics needed with the friction-stir welding apparatus, based on steel thickness and the properties required of the weld.

These developments could have major implications for shipbuilding schedules, construction quality and development of new materials to create lightweight ships

The partners in the project are one year into its three-year duration.

Another project funded by the European Commission, Mosaic, is focusing on resistance properties in high-strength or tough steel in shipbuilding, along with the introduction of composite materials.

Lloyd's Register welding and materials specialist Jan Przydatek says this will look at what can be done technically, recognising there may be a need to change structural and safety rules or for new types of composite materials.

Most composites are made with a type of hydrocarbon resin that is flammable and vessel structures need to be made of non-flammable materials that will not burn or emit toxic fumes.

A third project, X-scan, is looking to revolutionise inspection of newbuildings' welds, making this cheaper and quicker.

A team of engineers is creating a crawling robot that can move around a ship's surface, taking measurements to detect defects hidden in the welds.

The robot would used a technique known as phased-array ultra-sonic testing to examine inside a weld and a process known as alternating current field measurement to understand the size of external faults.

Both are existing technologies used in yards, but both have been manual tests with readings that take time to decipher.

The new method being developed will use a laser to guide a robot along a weld line and new software to interpret the readings.

The project is also looking to bring the project to commercial realisation as it will also speed up moves to abolish potentially harmful radiography, which some yards use to test weld quality. ■

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