SPLICING

Development of Advanced Fibre Splicing Techniques

Technical Notes 06, April 2016

Cross section detail through splice

Splicing on conventional ropes is centuries old, however, long established splice designs are not necessarily suitable for high performance synthetic fibre materials and their high technology, high cost applications. TTI is a world leader in the design and proof testing of innovative splices.

TTI has the capability to custom design and manufacture splicing rigs as shown below, that have the facility to equalise tension and to wind layers at the controlled angles required for precision splicing.

EXAMPLE PROJECT

Remote Operating Vehicles are used for a range of marine operations including oceanographic research, offshore oil installation inspections and naval search activities. Most are connected to the mother ship by an umbilical cable that provides power, control and communications. As ROV system mobility is affected by the cable size, umbilicals are high technology, optimally small in section and high cost.

The US Navy operates an ROV, "CURV 3", for search and rescue missions in water depths to 6,100 metres. Its umbilical length is 6,700 metres, of 38 millimetres overall diameter incorporating 7 layers of Kevlar 49 covering composite optical fibre and copper conductor cores. Design breaking load is 60 tonnes.

Cable replacement costs are around $1M with special order delivery in excess of one year. Damage in operation is always a possibility and the US Navy required a technique to enable complete repair, at sea or in port.

Comprehensive tests on the completed trial splices confirmed the required range of performance characteristics were achieved.

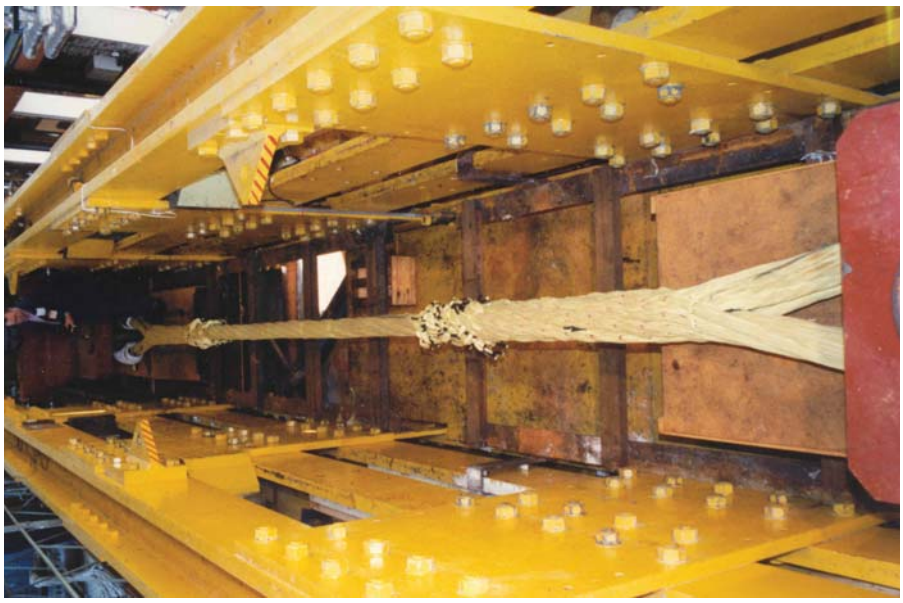
TTI was the only bidder offering to create a solution.

The concept splice design that was develped by TTI is an adhesive modified long splice and is shown in the cross section above. It is believed to be the first ever splice that meets US Navy criteria.

The project objectives

- A repeatable technique to be described in a manual enabling skilled operatives to achieve the same results aboard ship of opportunity (space restrictions limit handleable splice length to 2.7 metres).
- Cable diameter over the spliced joint length not to exceed 20% greater than the nominal original
- Retention of at least 80% of the unspliced tensile strength of the standard termination
- Working load extension of remade cable not to exceed that of original cable length by more than 0.5%
- Repaired cable to retain sufficient flexibility to allow operation over a traction winch and on to a 1.2 metre diameter take-up drum
- Splice compactness to avoid loading of the conductors and optical fibres

Splicing rig showing lay up under constant tension



TTI have designed and made splices in Kevlar ropes up to 1000 tonne nominal break load and polyester ropes up to 1500 tonnes break load. The Kevlar strand splice was developed using special techniques to ensure strands were tensioned and tucks made at constant pitch.

As a result the test strop failed midspan, well away from the splices demonstrating the highest possible tensile efficiency (strop broke midspan photo). This splice was used in the 1000 tonne rope for which again, a very high tensile efficiency was obtained with an actual 1260 tonnes break load achieved.

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