Gap Supporting and Pre-Lift Weighing Before Topside Disconnection.

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Technical challenges particular to the growing decommissioning and abandonment sector include the need to accurately weigh individual modules being removed from the structure being decommissioned, before disposal. The removal and recycling of topside and substructure equipment and facilities are two significant costs in the global platform decommissioning sector and so are key targets for time and cost reductions.

Traditionally, cutting through concrete platform legs or module bases has required a complex system of wedges, levers and crane supports to prevent the diamond cutting wire from becoming trapped once a significant portion of the item has been cut through. Time wasted in trying to free stuck or broken diamond wires can impact negatively on operational productivity and some structural analysis effort may be spent on avoiding this, during the engineering phase of the project.

There is a correlation between the weight of offshore platform topsides and the overall economics of a decommissioning project. Previously, determining the overall weight and centre of gravity of modules weighing multi-K tonnes prior to a heavy lift, skidding or trailering operation has involved methods including making calculations from original 2D/3D CAD construction drawings or deploying a series of large capacity load cells underneath the object being weighed.

Why do we need a new solution ?

Until recently, structures were generally not designed for removal, and consequently each installation demands a unique method for decommissioning. Two of the key drivers of any decommissioning project are safety and cost. Now, innovative technology can be used to both minimise man hours in the engineering phase and cost-effectiveness during the execution of the project.

PowerPad™

Building on the success of the unique and field-proven ThinJack® technology, research and development has resulted in the first hydraulically inflatable, millimetric-thin steel envelope for supporting and maintaining the height of the gap during a cutting operation. The PowerPad system with its custom-designed software reads and displays in real time individual PowerPad inflation pressures in bar, the individual load readings and the total load.

The steel envelopes are positioned in the cut gap then connected via a manifold with individual control needle valves to a hydraulic pump and the system is pressurised with water. Pressure is pumped into the envelopes which expand and, using the established formula “Force = Pressure x Area”, maintains the gap opening. These can be adjusted in real time to compensate for any adverse forces resulting from downward pressure by the concrete mass onto the gap created by the cutting wire.

This patented application can also, with specialist software, be used for accurate weighing of any large structure under which it is placed.

Field Test Operations of Holding Open the Wire Cut Gap

With the recent focus on decommissioning and removal of concrete-based offshore structures, PowerPad was field tested onshore in July 2014 and held open an 11mm high gap for a diamond wire as it cut through a concrete block. This was held in a compressive test frame under 500 tonnes of load to simulate a scaled down structure offshore. The objective was to test a way of supporting the cutting gap after the cut had reached a critical 65% cut stage, where previously the concrete mass had cracked and then collapsed, thereby jamming and breaking the cutting wire.

A series of four pads, each of which at 3mm thickness un-inflated were thinner than the wire cutting gap, were inserted into the gap created by the diamond wire once it had passed sufficiently through the concrete block [Fig 3]. These were then inflated and the pressurised water inside locked in. By working in this passive mode, the pads retained their shape and withstood the force from the concrete block. They held open the wire gap right through to the end of the cutting process, supporting the concrete mass and the 500 tonnes of pressure from above. Critically, the block was successfully supported by the inflated pads as the cutting wire passed the milestone 65% stage of cutting through the block where, historically and without support, it would have shown cracking or collapsed.

Fig 1: PowerPads

Fig 2: PowerPads within cut gap

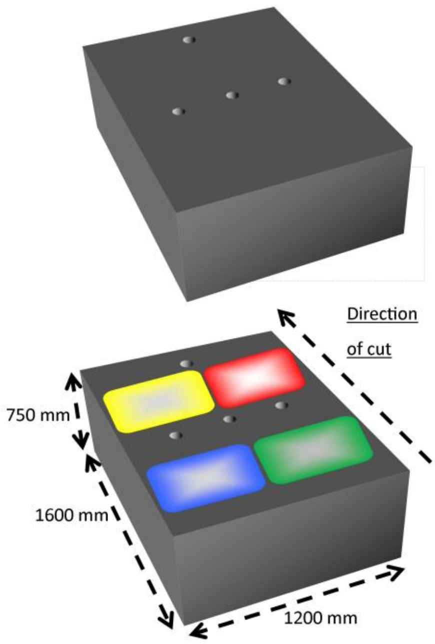

Fig 3: PowerPads within an expanded schematic of the concrete block

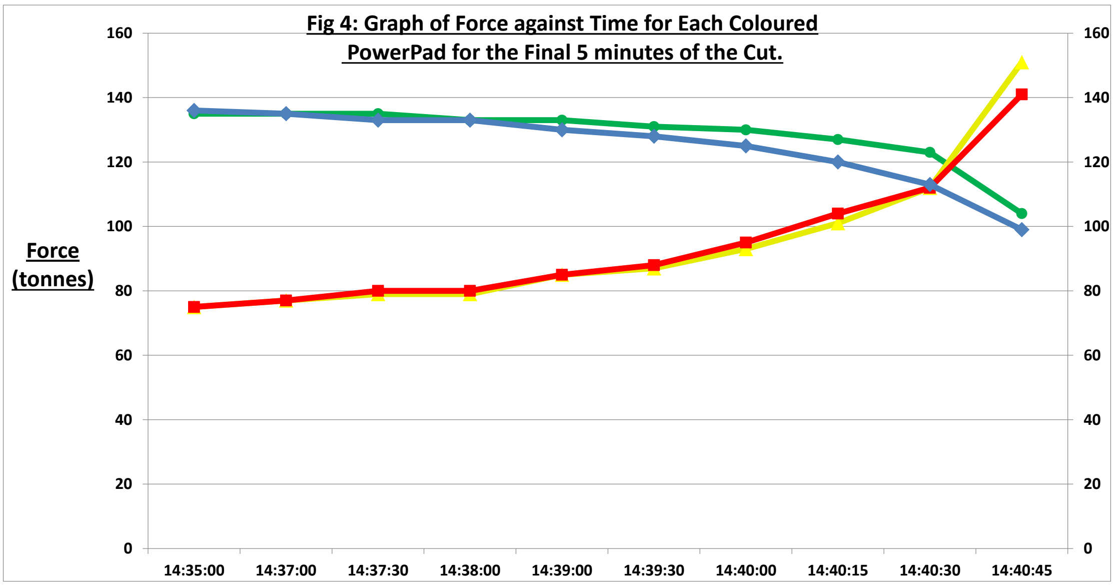

Fig 4: Graph of Force against Time for Each Coloured PowerPad for the Final 5 minutes of the Cut.

After one hour of cutting, the first two hydraulic pads were inserted and inflated to 40 bar to initiate support of the block and hold open the increasing wire cut gap. At this "activation pressure" the stroke of the pad increased to fill the 11mm gap from the diamond wire cut. The hydraulic fluid volume injected (and locked into the pad) at the start of this "active mode" was approximately 1.4 litres per pad.

During the next three hours of cutting, the pressure within the inflatable pads had increased to 90 bar, this pressure being adjusted by the system operator when reviewing the real time data received from the pressure sensors attached to the system. Operations were then suspended (at the 80% cut distance mark) to allow the operators access to the test piece to insert a second pair of inflatable pads. As a safety precaution during this suspension, which lasted about 45 minutes, the hydraulic pressure of the first two pads was released. Once the two additional pads were in place, they were all inflated to 40 bar, 500 Te compression re-applied, and cutting proceeded successfully at a constant speed right through the block. The test piece suffered no cracking at all.

Field Experience with New Technology leads through R&D to New Application

The development of the new weighing application has followed naturally from the application of using these inflatable pads to hold open the gap during cutting through the concrete grout which adheres a topside module to the platform jacket or gravity base structure. The inflatable pad technology was initially implemented as a weighing system during the removal of Module Support Frame [MSF] structures in a northern North Sea field cessation project.

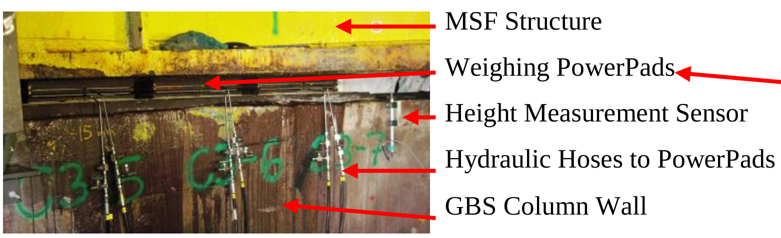

Fig 5: PowerPads and Sensors

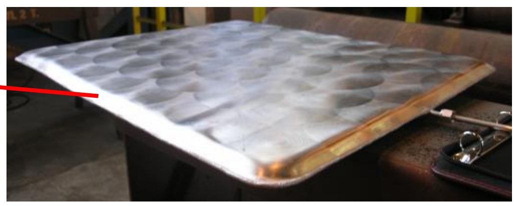

Fig 6: PowerPad

The principle of operation for the inflatable pads, "Force = Pressure x Area", is similar to that for holding open the gap during wire cutting of concrete assets. The PowerPad weighing system, with its sensors and custom-designed software, accesses and displays the individual pad load readings to the system operator in the weighing control room in real time. The operator can then calculate the total load and the centre of gravity of the module to be weighed. The system facilitates the safe lifting and transportation of large and heavy structures by enabling the lifting operators to determine the deadweight and, therefore, increase the variety and types of lift vessels and cranes required, as well as establishing the best position of the lifting points to keep the structure stable during the lift. Following a successful first field operation, the system is now being enhanced with newer load sensors and weighing algorithms.

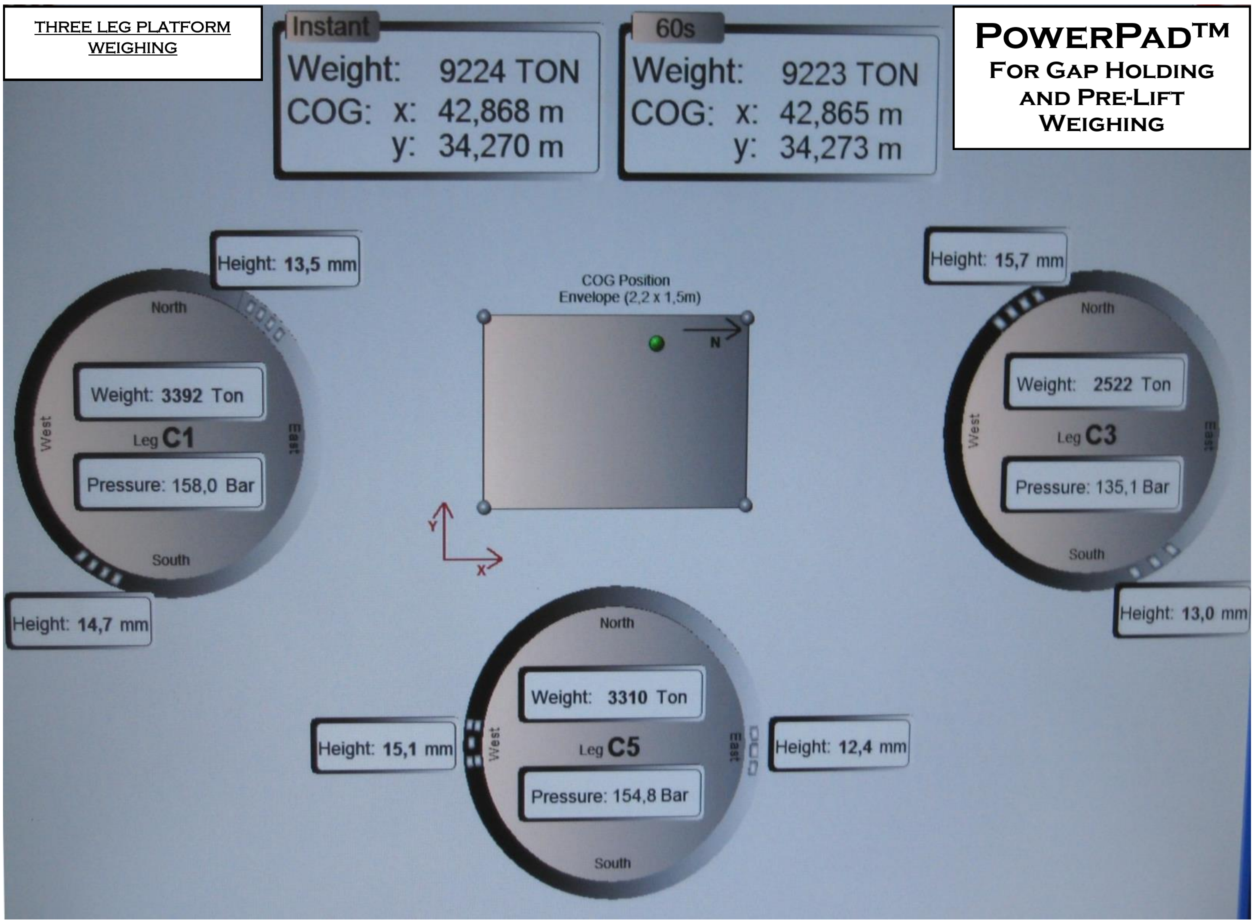

Fig 7. Platform mass and centre of gravity, at the top of the screen display, before lift of a 3 legged platform. The calculated mass, and PowerPad pressure, is within the circles. The heights, within rectangles outside the circles, show the stroke of the inflated PowerPads.

Conclusion

The availability of a millimetric thin inflatable pad to prevent objects being cut from collapsing in on the cut gap and trapping and breaking the diamond wire thereby causing delays, meets a need to deliver productivity in engineering safe asset reduction techniques in the decommissioning sector. The inflatable pads permit faster and safer operations cutting through concrete assets. The same inflatable pads, with the addition of sensors and software, can also be used in the same decommissioning project, either simultaneously or consecutively to determine the weight, load requirements and centre of gravity of heavy items being removed.

When cutting through concrete, PowerPad is more effective than a solid and passive shim. Being initially thinner than the gap, they are pushed into the gap and inflated to fill it and the pressure is then locked off. Using PowerPads will equalise the force from above and keep the gap unchanged, minimising the likelihood of tension on the cutting wire.

Conversely, a solid passive shim can be made to slide into the gap, but it will not equalise the force from above completely as it can not “pack” the gap completely. If it did it would be impossible to slide in the solid passive shim. By not supporting the force from above the weight pushes down resulting in a higher tension on the cutting wire and there will be a higher risk of “crazing” in the concrete.

When the cut is complete, the upper part of the asset will be “floating” on the PowerPads, as in the onshore test described. The mass of the upper part of the asset can be calculated, as can the centre of gravity if needed. Furthermore, if PowerPads are bearing the expected total weight of the upper part of the asset, then this is an indication that the cut is completely through. With the capability to calculate the centre of gravity before the lift of the upper, cut off part of the asset, this permits widening the range of vessels which may be used for topside disconnection and thereby can contribute towards decreasing costs, with a range of structure sizes.

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