“Indee” & “Pardoo”
First of PSA’s Z-Tech’s delivered

In late March 2004, Cheoy Lee Shipbuilders Ltd. of Hong Kong delivered the first of the new Z-Tech class tugs, “Indee”, to Teekay Shipping Ltd. of Fremantle, Australia.

Although the first two tugs were ordered by PSA Marine (Pte.) Ltd. of Singapore for their own operations, the tugs were sold to Teekay about two months before completion in order to satisfy an urgent requirement for new tugs at the BHP Billiton bulk terminal operations in Port Hedland, in Northwest Australia. This late change in ownership and flag state necessitated a number of changes to the layout and detail of the vessel, delaying delivery. Amongst the alterations were the construction of a silent room in the engine room and making sure bunk length was 2.10 m., amongst others.

The Z-Tech design was developed by Robert Allan Ltd. of Vancouver, BC, Canada, in response to the challenges posed by PSA Marine for a new and versatile class of tugboat for major port operations worldwide. The new design is aimed at capturing the best operational advantages of ASD ‘pusher’ configurations and Z-drive ‘tractor’ configurations.

The resulting Z-Tech concept to the casual observer looks like a tractor type tug and could in fact be typified as such. However, when taking a better look what appears to be the bow in fact is the stern. This is the result of a re-think of the functionalities of the various elements that make up a tug:

- A very important working area of the tug is the area around the winches. A safe and well laid-out working area in this case dictates space around the towing gear. Furthermore it is advantageous in azimuthing tugs to have the wire as far aft or forward as possible. To guide the wires / ropes use is made of so-called staples. Here also, working space is needed around the staple. Traditionally, this space can best be found aft where a wide hull is available. In the bow the available space is much less for obvious reasons.

Towing over the stern for stern drive and conventional tugs means the towing winch must be forward near the pivoting point of the tug. This in turn dictates the position of the superstructure which in turn dictates how much space is left in the bow area. Most

Photo: courtesy PSA Marine
stem drive tugs are fitted with winches fore and aft allowing for a variety of uses of the tug, although winches are expensive pieces of equipment. An increasing number of tugs employed only in shiphandling makes use of the push/pull method of towing. Consequently they are fitted with a single winch while for emergency purposes a tow hook is usually installed on the aft deck in the traditional position. In stem drive tugs the push/pull method means the winch is on the fore deck.

The Z-Tech therefore has the superstructure shifted somewhat aft and the towing deck re-positioned forward, creating a wide bow area. The forward deck (over the skeg) has a low, flat sheer, creating a spacious, relatively flat and safe towing deck, without any obstructive anchor chains, etc. By omitting the second towing winch the aft deck – over the Z-drives – could be reduced in size to provide just sufficient space to install or withdraw the Z-drive units. A small anchor winch is fitted on this deck.

For distance towing operations, the Z-Tech effectively sails astern in the tractor mode, so the shape of this part of the hull is more rounded in plan than would typically be seen in a stem-drive design.

There is no appreciable loss of ballard pull or speed in this direction of operation. The increased flare and freeboard at the aft end is simply to ensure a drier operation when towing in this direction. The winch therefore usually will be a double-drum winch, with one drum carrying a synthetic hawser, and the other fitted with a steel towing wire.

To avoid damage when working under large overhanging flared hulls the wheelhouse was placed at the aft end of the accommodation. A single control station serves both harbour ship-handling duties, facing forward over the working deck, and transit voyages, (facing astern).

Apart from the operational advantages described above, a number of features incorporated in the Z-Tech are aimed at reducing costs or improving performance. The shaft line is designed to minimize the number of bearings and associated pedestal structures, and to eliminate the use of universal joints. This simplifies the overall alignment, eliminates the service life issue and maintenance costs related to U-joints and eliminates the potential for future bearing induced bending stresses and vibration in the shafting. The system also saves the initial cost of the bearings and pedestals, and the often considerable cost of effectively aligning shafting with multiple bearings.

The system as designed incorporates the following elements, from engine output aft:
- Elastic coupling for torsional vibration control.
- Flywheel housing-mounted bearing to provide the support for the forward end of the line shaft and to isolate the shafting loads from the crankshaft.
- Flexible plate coupling to accommodate the expected movement of the main engine on the vibration isolators.
- Hollow steel intermediate shaft to reduce the shaft weight and thus increase the allowable span between bearings.
- Self-aligning bulkhead bearing/seal. The bulkhead provides excellent radial support with little additional structure compared to pedestal bearings, and eliminates the need for a separate seal, again saving initial cost and ongoing maintenance costs.
- "Elastic Shaft"—this shaft consists of a pair of the flexible plate couplings (the same as used at the engine end) separated by a short ‘floating’ shaft. This arrangement, in combination with the misalignment coupling at the engine end of the hollow shaft, allows the engine and Z-drive to move relative to each other without creating any vibration and without overstressing the bearings in the engine or in the Z-drive.
Note: in this g/a plan the silent switchboard room in the engine room was still omitted.
Noise and vibration control on smaller, high-powered tugs is of increasing importance. Recognizing this fact at the outset of the Z-Tech project, the following features were incorporated into the design:-
- Main engine resilient mounting (coupled with the shaft coupling system described above).
- Auxiliary engine resilient mounting.
- High attenuation silencer systems.
- Resiliently mounted exhaust systems.

Maximising visibility is achieved by the use of ‘bonded’ windows. Although not a first among Robert Allan Ltd. tug designs, the use of adhesive bonding of glass to steel is still a fairly unique application of this technology, widespread in the fast ferry industry, but as yet little used elsewhere in the marine world.

By eliminating the complete window frames, the amount of “wood” between windows can be absolutely minimized, and obviously then the arcs of vision are maximized.

Escort skeg
The escort skeg performs a number of critical functions in the Z-Tech design. It enables the tug to work in the Z-drive tractor mode, much as a more conventional Z-tractor tug would do. When the Z-Tech works as a stern drive tug (sometimes called ‘pushers’ in today’s terminology), the skeg provides much enhanced astern directional stability, without impeding regular ahead performance in any way. In keeping with the original design development, the skeg also enables the Z-Tech design to offer a much enhanced indirect towing capability.

The prototype tugs were constructed by Cheoy Lee Shipyards Ltd. at Hong Kong.
First to be completed was Indee. An extensive series of owner’s acceptance and performance verification trials were conducted in the waters off China and Hong Kong from 22 to 29 March, 2004. Delivery to BHP followed on 31 March. The vessel performed exceptionally well, and exceeded all expectations.

Sister Pardoo ran trials on 8 and 12 May, 2004 and was delivered to BHP on 14 May 2004. The tugs are classed LR +100A1 +LMC.

The hull is heavily fendered with tubular fendering at the bow and stern. Fendering at the bow is a triple layer consisting of two tubular fenders and a block type fender at deck level deepening towards the stern. Fendering continues along the sides.
Engine uptakes

Fire monitor

The washroom was constructed as a fibreglass module

Caterpillar dedicated fire pump engine

Hydraulic pump for main towing winch

Crew accommodation

photo: courtesy PSA Marine

photo: courtesy PSA Marine

photo: courtesy PSA Marine

photo: Lekko / Al Lindner

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photo: courtesy PSA Marine
Dimensions are: 27.4 m (oa) / 24.8 m (wl) x 11.5 m (oa) x 5.0 m. Maximum draught is 5.0 metres. Tonnage: 325 gt, 97 nt. Bowdavid pull ahead is 63 tonnes (70.1 tonnes max); astern 58.7 tonnes (60.2 tonnes max). Speed is 12.65 knots ahead, 12.8 knots astern. Sound levels in the crew accommodation and control spaces varies from 65 to 71 dBA.

Below main deck and rather unusual in todays designs is additional accommodation in two 3-berth cabins. To port aft of the cabins is a toilet / shower facility, while to starboard the galley store is situated. The engine room houses the main engines. In Indee and Pardoo the main engines are two Caterpillar 3516-B-HD. These provide an output of 1.865 kW each at 1600 rpm.

The Z-Tech features a spacious engine room

Superstructure PARDOO

The boat deck houses the battery room which is situated below the wheelhouse. The two liferats are stowed to port and starboard. At the forward end of the boat deck is an on-deck winch control console. The two Unitor foam / water fire monitors are fitted at the forward end of the boat deck.

The wheelhouse itself has all controls arranged in a U-type control desk. At the aft end to starboard is the chart table. Communication equipment is installed for GMDSS Area 2.

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