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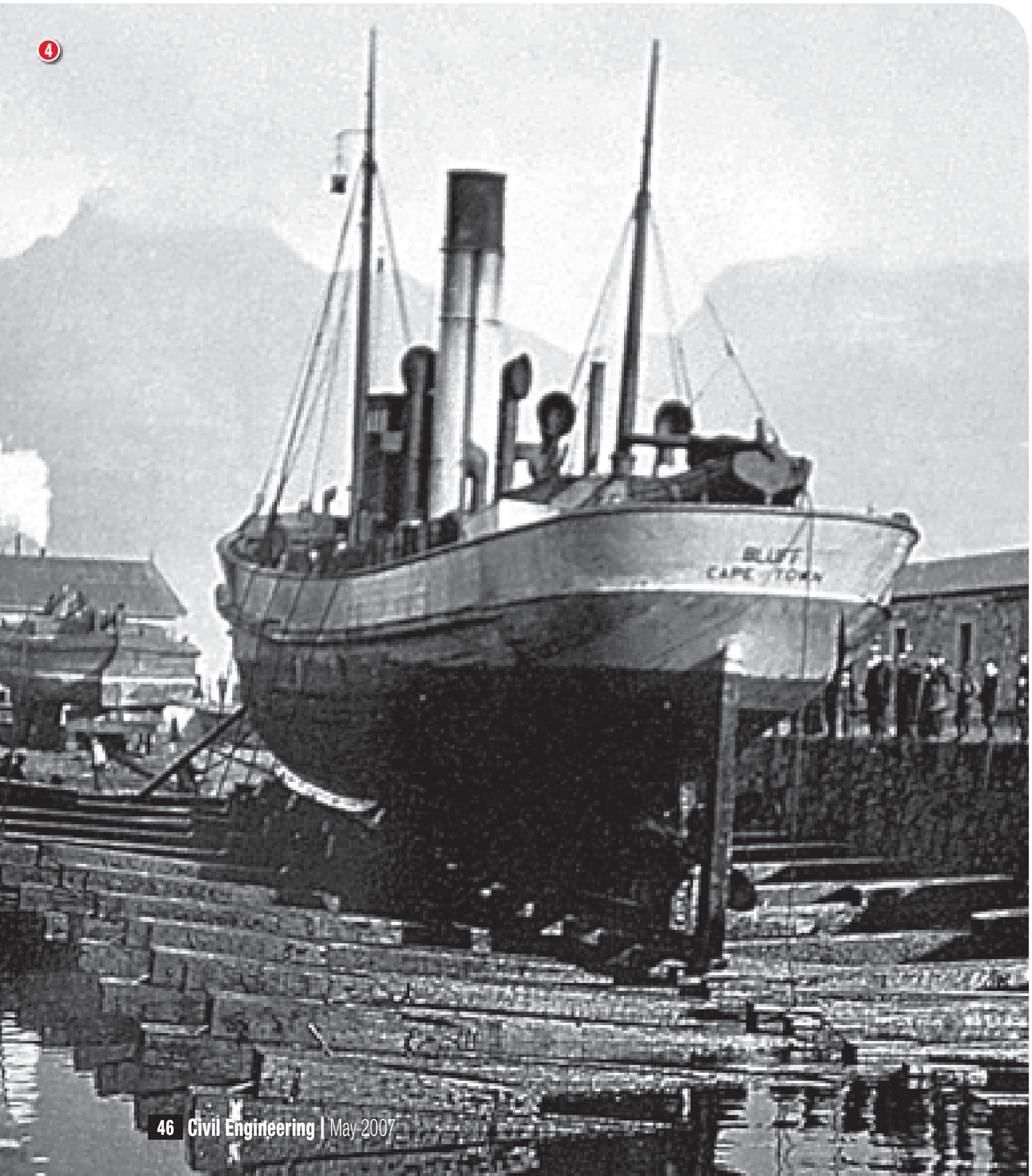
South African dry-docking



facilities

▶ **Figure 1** How not to dry dock (Wreck of Antipolis, 1976)
Figure 2 Greek ship sled (Chania, Crete, 1986)
Figure 3 Moving the Dias Caravel into the Dias Museum, Mossel Bay, 1988
Figure 4 Patent slip, Table Bay – early 20th century
Figure 5 Crandall railway dry dock, 1960

ORIGINS OF DRY DOCKS

Ships are built on land and the initial launching of a new building is a one-way affair – downhill. It is usually done on greased timber. The technology today is very sophisticated, despite the apparently archaic method. Tradition has it that in the old days Russian bear fat was used and the bear had to be shot at the right time of the year! Nowadays the timber of both the standing and the sliding ways is coated with specially formulated waxes and a layer of calcium based grease is laid up between. Once the vessels begin to move, the friction is generally in the order of 1%.

But vessels must return to dry land at regular intervals for inspection, maintenance and repair of the underwater body of the hull, of the stern gear and any other underwater kit. Getting them back on dry land is a much more difficult affair. It's an uphill thing. They must be dry docked.

In the beginning, when vessels were small, they were just hauled up and down the beach and from this the slipway developed. It probably first came into use in the Mediterranean and for thousands of years – at least as far back as the Late Bronze Age – the slipway consisted of a sled of heavy timber runners over timber sleepers laid on the beach. Some of these are still in use in Greece (figure 2).

This is the system I used to move the 100 t replica of the Dias caravel into the museum in Mossel Bay (figure 3).

In 1819 Thomas Morton of Edinburgh patented the modern system of a cradle on wheels on rails together with the idea of using sliding bilge blocks that are pulled in after the vessel has taken the keelblocks fore and aft to keep it upright. A typical 'patent slip' is shown in figure 4.

Starting in the 1850s, the Crandall family in New England developed their own particular type of slipway known commonly as a 'marine railway' or, more specifically, a 'railway dry dock' – terminology that is technically more correct but cumbersome compared to 'slipway'. The key features were the use of live rollers instead of wheels and axels, cradles built up at the stern to give a level line of blocks despite the declivity of the ways and a concomitant decking to the cradle to give assess to the vessel, docking frames mounted on the cradles to assist in docking the vessels and chain hauling instead of steel wire rope winches. A typical 'railway dry dock' is shown in figure 5.

The Dutch contribution would appear to be the floating dock. When the big square-rigged East Indiamen were developed their draft was too great to pass the shoals of Pampus that blocked the way to Amsterdam through the Zuiderzee at anything less than spring tide. Not only did the men want to get home after a long voyage, the merchants on the quay wanted their cargo. So they developed a system of camels that could be strapped under the bilges and so lighten the vessel that it could pass the shoals at any tide. It was but a simple step from these camels to the idea of the floating dock. A sketch of the use of camels is shown in figure 7.

One sometimes comes across the apocryphal account of the cutting down of a hulk called the 'Camel' in the Baltic in the time of Peter the Great and fitting a gate in the stern to make the first floating dock. The story was first reported by a Mr Vignoles in the discussion to Edwin Clark's paper on the first shiplift and is untrue. Subsequently, Clark's nephew, Lionel, at the end of the 19th century, made a major contribution to the technology of floating docks.

Edwin Clark was Robert Stephenson's house boffin and his RE on the construc-

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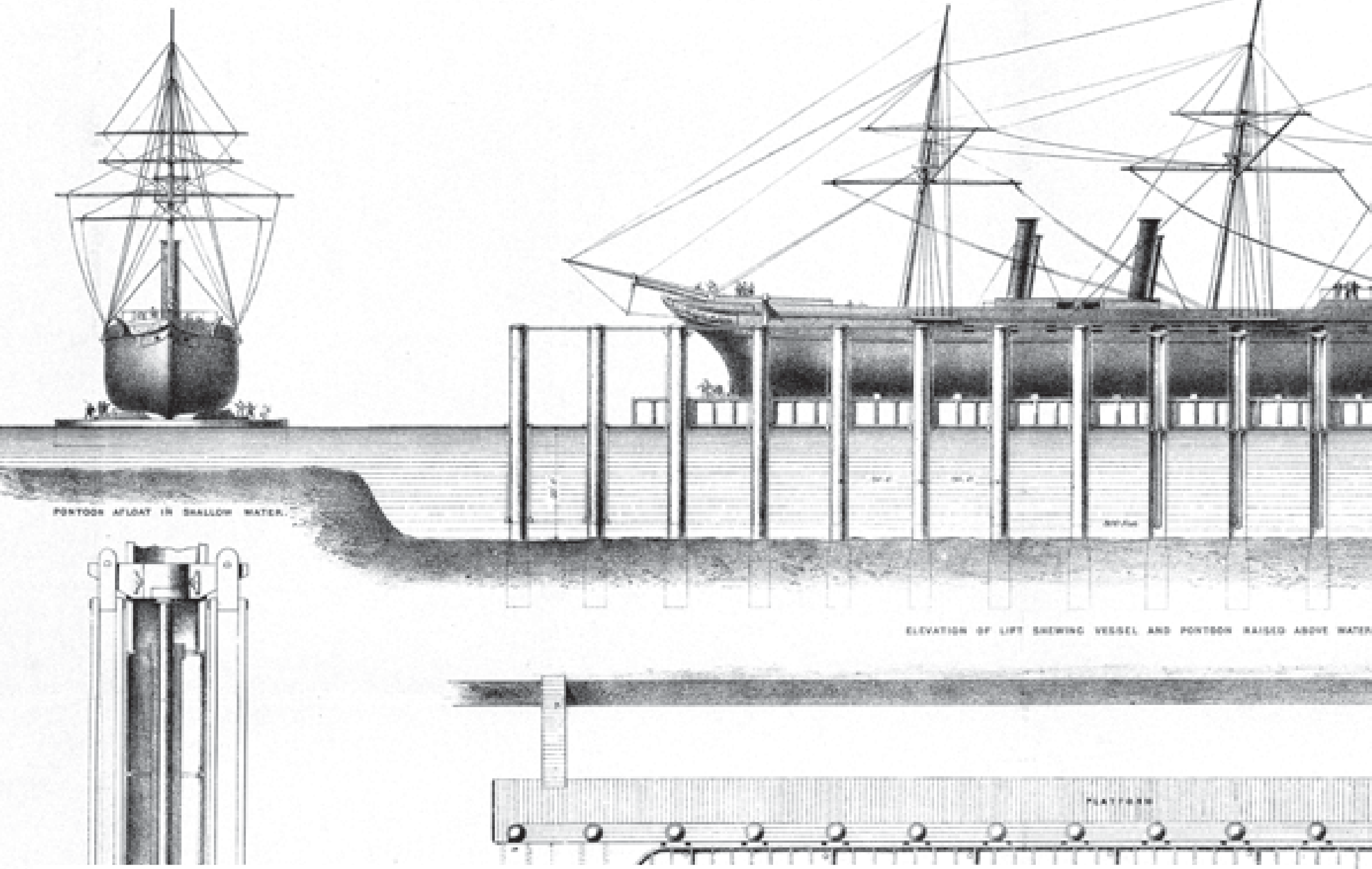
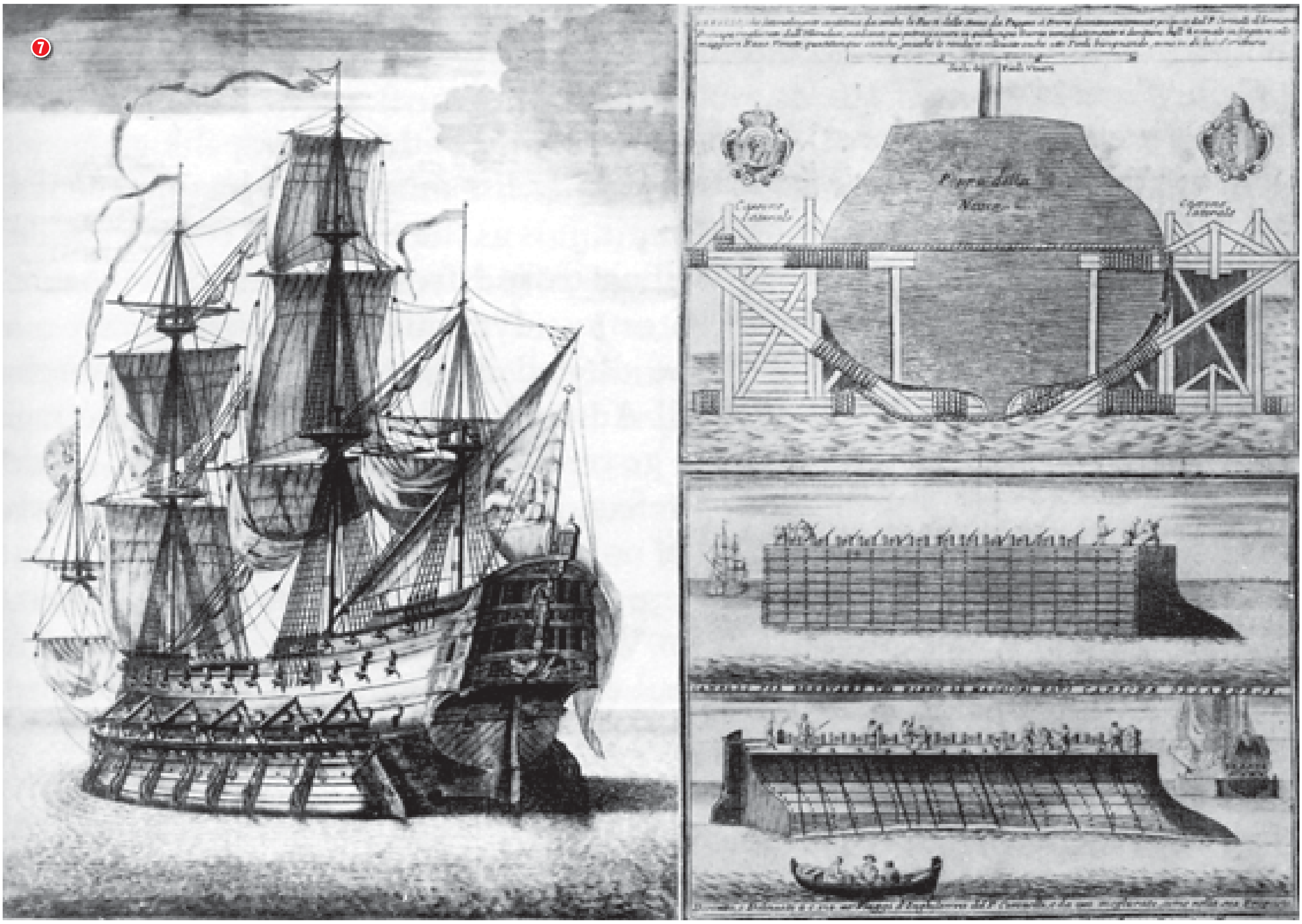
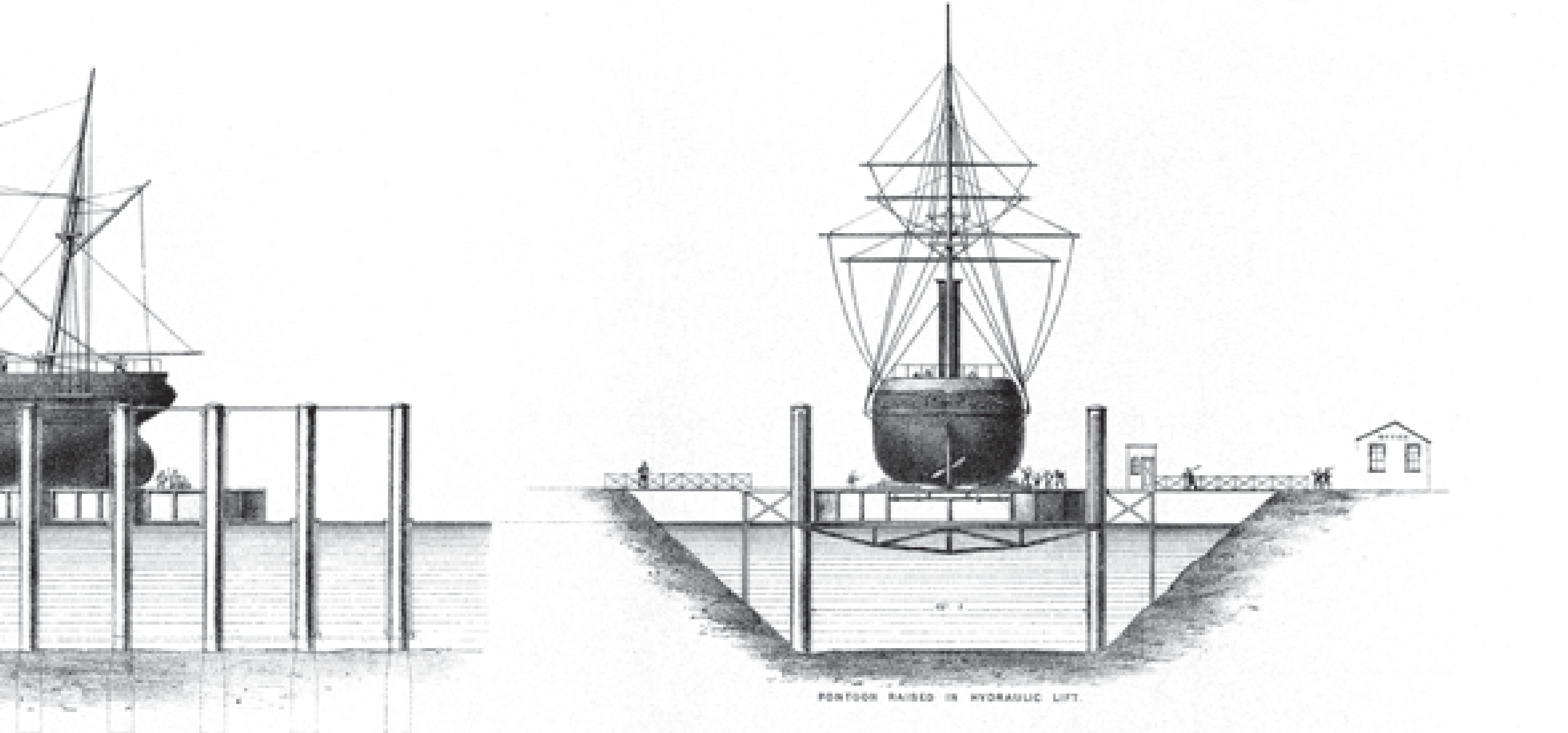
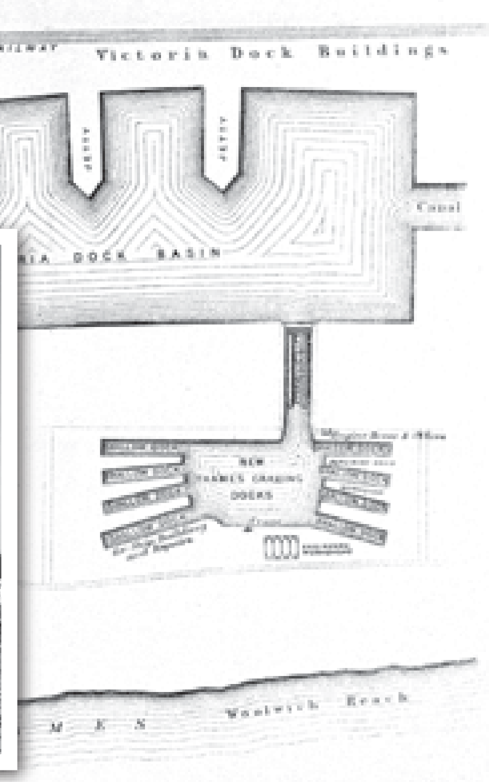

PONTOON AFLOAT IN SHALLOW WATER.
ELEVATION OF LIFT SHEWING VESSEL AND PONTOON RAISED ABOVE WATER
PLATFORM

7







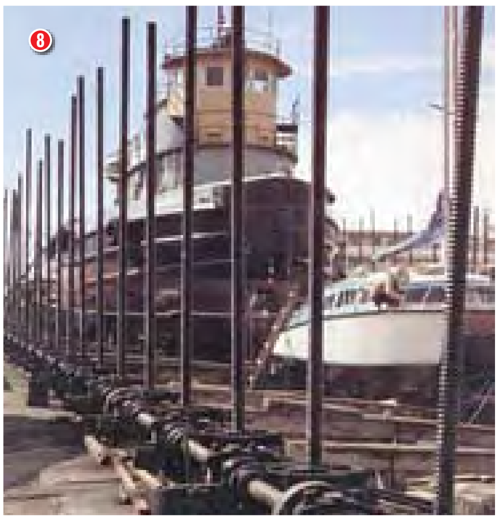


Figure 6 *Clark's hydraulic shiplift, 1857*
Figure 7 *Use of camels to lighten a ship*
Figure 8 *Blackwood's Barbados screw-jack shiplift*
Figure 9 *A 2 000 t shiplift and transfer yard, 1990*

tion of the Britannia Bridge over the Menai Straits. He adapted the method of using hydraulic jacks for lifting the bridge girders into place to build the first shiplift in London in 1857. It consisted of two parallel rows of hydraulic cylinders set into the dock floor with heavy steel beams spanning between opposing cylinders in the two rows. It had a capacity of about 5 000 t lift. The ship could be placed on pontoons resting on the beams. These pontoons could be flooded to sink then drained to float and moved off to repair berths so that a large number of vessels could be dry docked at the same time. It remains one of the most sophisticated shiplift systems ever built. Clark went on to adapt the concept to the first lift-lock at Anderton (figure 6).

In 1890 John Blackwood built a very different type of shiplift in Barbados. Lifting motive force was provided by screw jacks – a row of long vertical screw rods on both sides driven by worms riding on shafting down each side. Last I heard (1979) it was still in operation. This is shown in figure 8.

The modern shiplift was developed by Raymond Pearlson in the late 1950s using steel wire rope winches for lifting motive force. These in turn were driven by synchronous electric motors – hence the trade name 'Syncrolift'. Raymond's real contribution was not his invention but his salesmanship in selling the shiplift concept to the shipping world. A typical shiplift is shown in figure 9.

The English are blessed with a large number of deep estuaries with very high tide ranges, and this led naturally to the idea of a graving dock – stick a vessel up a creek and dam it off in the dry at low tide. In fact it would appear that slipways were not popular in England prior to Morton's invention. They preferred graving docks.

HISTORY OF SOUTH AFRICAN DRY DOCKS

The earliest dry docking facility in this part of the world was a graving dock built in Mauritius in about 1848. Dry docking in South Africa starts with Aaron de Pass. Although the name is hardly known in South Africa today, he and his son Francis effectively started the South African fishing industry, shipping industry, ship repair industry, guano trade, mining industry and sugar industry – all done on salt snoek. The full story is fascinating but needs to be told elsewhere.

In 1854 the firm of De Pass, Spence & Co drew up plans for a graving dock in Simonstown and in 1856 the Simonstown Dry Dock Co was formed by the residents to implement the project. In 1859 De Pass, Spence & Co signed a 30-year lease with the Cape Colonial government for a slipway site in Table Bay between the Amsterdam and Chavonne batteries and imported a Morton-type patent slipway in kit form. However, it was sold to the Simonstown Dry Dock Co and De Pass, Spence & Co were contracted to erect it on a site called Sober Island and later, when it was commissioned, to operate it. The Sober Island slipways are shown in figure 11. The No 1 slip built by De Pass is on the right. The No 2 Torpedo Boat Slip in the centre was rebuilt by the present author in 1976 for navy small craft. This rebuild was the first use of vertically curved ways in South Africa.

The Sober Island slipway with a capacity of 1 500 t was opened by the Governor, Sir George Grey, in 1860 at a cost of £20 000. In 1885 it was purchased by the Royal Navy and incorporated into their dockyard establishment. It was rebuilt by the South African Navy in 1957 and finally decommissioned in 1989.

The engineer who completed the original construction of the Sober Island slipway, Robert Mair, replaced the sliding bilge blocks with a system of hinged bilge arms he had patented himself. These arms have since become typical of the Cape slipways.

A year later, 1861, De Pass, Spence & Co imported another slipway kit and constructed their slipway in Table Bay. Soon afterwards, however, the government decided it needed the site for the new harbour works and swapped it for the rights to the guano islands. It was these guano rights that propelled the De Pass family into their other ventures.

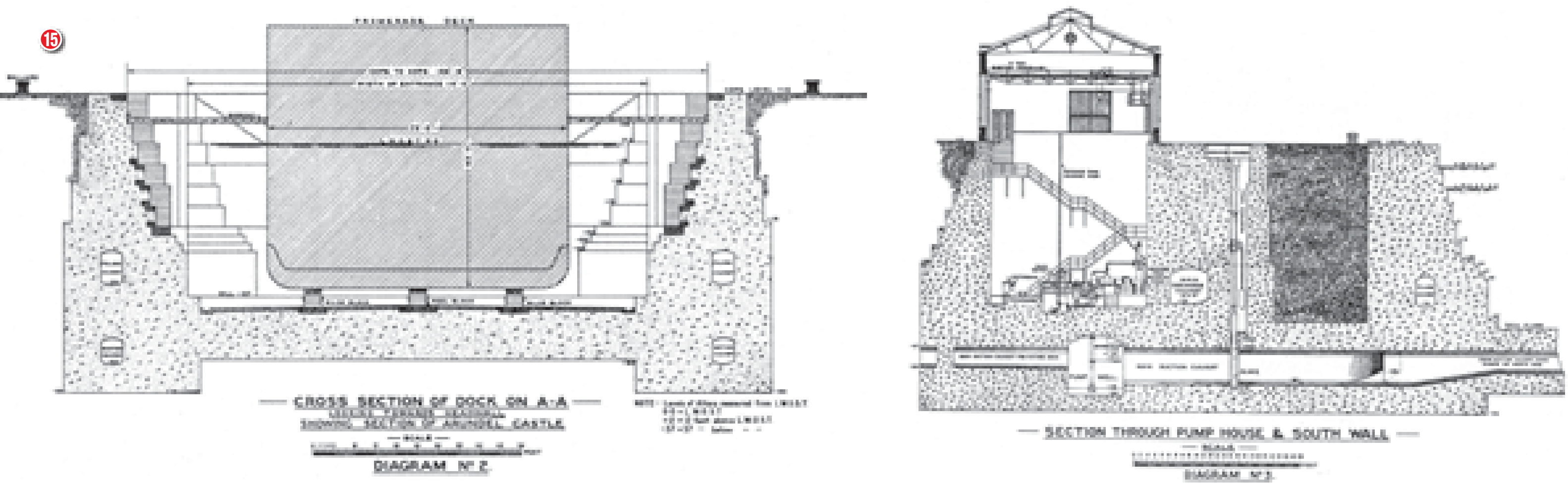
As part of the harbour construction project, a patent slipway was constructed at the head of the Alfred Basin. Interestingly, in 1867 the artist Thomas Bowler published an architect's perspective drawn from the engineers' site plan of the Alfred and Victoria basins – a copy hangs in the Rust en Vreugd Gallery in Buitenkant Street in Cape Town – showing the site of this patent slip as 'site for patent slip or shiplift'. Presumably the engineer, Sir John Coode, intended one of Edwin Clark's hydraulic shiplifts. Subsequently, in 1974, the old patent slip was replaced on the same site by a 'Syncrolift' shiplift. The De Pass slipway can be seen at the far left of the picture (figure 12).

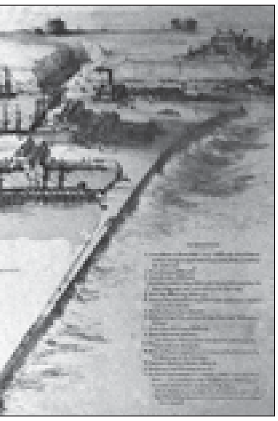
In 1897 Coode and Partners built an 800 t slipway in East London. It was extended in World War II and used for building landing craft. The cradle and winch have since disappeared but the civil works are still in excellent condition. The site now forms part of the premises of East London Shipyard. The method of construction is shown in figure 13. This is taken from Brysson Cunningham's textbook on dock engineering published at the beginning of the 20th century.

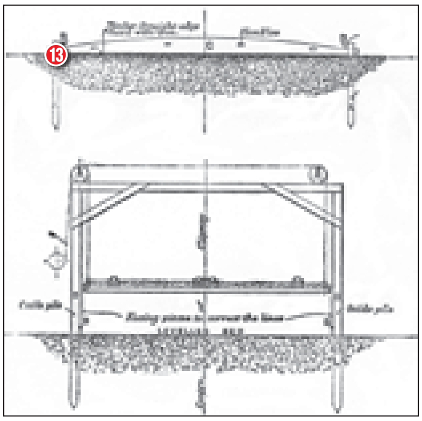
The first graving dock in South Africa was the Robinson dock built off the Alfred Basin in 1882. The following 60 years saw the construction of all the other graving docks in the country. No other graving docks have been built in South Africa since then. Table 1 lists these five docks.

The Selbourn Dock was built by the

▶ **Figure 10** *Aaron de Pass*
Figure 11 *The Sober Island slipways, 1895*
Figure 12 *Bowler's bird's eye view of Table Bay Harbour – now V&A Waterfront*
Figure 13 *Method of constructing East London slipway*
Figure 14 *Completion ceremony, Selbourn Dock, Simonstown, 1910*
Figure 15 *Cross-sections of Edward Dock and pump house*
Figure 16 *Eldock and NPA Dock, Durban*







British Admiralty as part of the naval dockyard in Simonstown and completed in 1910. Figure 14 shows the opening of the dock. The Edward in Durban was planned soon after but construction was delayed by World War II and only started in 1919, with completion in 1925. It was constructed departmentally by the SAR&H under the direction of the RE, W R Crabtree. No costs of construction are given in the official report. Figure 15 shows cross-sections of the dock and pump house to illustrate the enormous amounts of concrete used in older mass gravity construction.

The construction of the Sturrock and Elizabeth docks both received substantial contributions from the British Admiralty. The Sturrock is in fact one of an identical pair commissioned by the Admiralty immediately before World War II. The other is the Captain Cook Dock in Sydney. Legend has it that the Admiralty appointed different consulting engineers for the two docks and the Sturrock ended up slightly longer. When it was built it was the largest in the world.

In the 1970s three 'Syncrolift' shiplifts were built in South Africa (plus one in Walvis Bay, which was part of South Africa at the time). These are listed in table 2.

Over the years the NPA or its predecessors, Portnet or SAR&H, have maintained small floating docks in Cape Town and Durban. The only floating dock currently in their service is the No 3 Floating Dock in Durban.

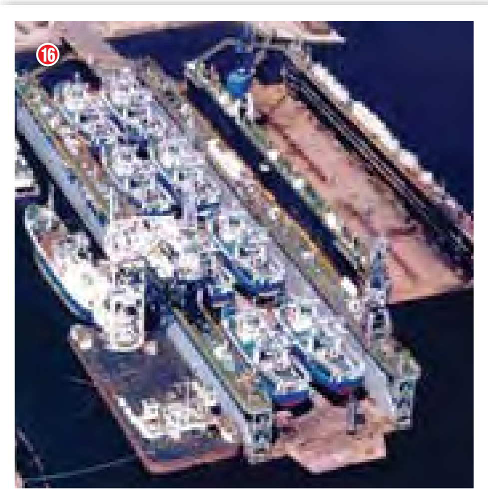


Table 1 South African graving docks

Dock	Started	Finished	Cost	L x B	Draft over cill
Robinson Table Bay	1876	1882	£156 000	162 x 20	7,6
Selbourn (Navy) Simonstown	1905	1910		230 x 29	11
Prince Edward Durban	1919	1925		350 x 33	12,5
Sturrock Table Bay	1942	1945	£3 600 000	370 x 45	14
Princess Elizabeth East London	1942	1947		200 x 27	10

Table 2 South African shiplifts

Lift	Owner	Capacity (t)	Winches	Repair bays
Simonstown	SA Navy	2 000	22 x 180 t	6
Table Bay	NPA	1 750	18 x 180 t	5
Durban	SA Navy	2 300	18 x 240 t	3

Table 3 South African floating docks

Dock	Owner	Capacity (t)	L x B	Draft	Construction
No 3 Durban	NPA	4 000	100 x 23	6	Rigid – all steel
Eldock Durban	Elgin Brown, Hamer	8 500	155 x 23,5	6,3	Rigid – steel wings, concrete pontoon

Table 4 Slipways in proclaimed fishing harbours

Harbour	Capacity (t)	Side Slips	Date	Comments
Lamberts Bay	120	2	1988	Variant 'Cape' type with docking frame and hydraulic arm. Designed for 200 t but now probably not safe at any load
St Helena Bay	120	4	1970	The largest of the unmodified 'Cape' type slipways
Saldanha Bay	1 200	2	1969	The original specs called for a 2 000 t cradle with only 1 200 t of cradle capacity installed
Hout Bay	90	1	1968	'Cape' type with docking frame and hydraulic arms
Hout Bay	50	1	1948	'Cape' type with docking frame
Kalk Bay	90	2	1968	Unmodified 'Cape' type
Kalk Bay	50	–	1919	Unmodified 'Cape' type
Gordons Bay	50	1	1939	'Cape' type with docking frame
Hermanus	90	2	1968	'Cape' type with docking frame
Gansbaai	90	1	1948	Variant 'Cape' type with docking frame and hydraulic arms

Although by far the greatest tonnage of capacity resides in the harbours of the National Port Authority (NPA), the greater number of facilities, the slipways, reside in the South African suite of fishing harbours. The oldest is the small slip at Kalk Bay. The original cradle was built to lower locomotives to the pont on the Orange River during General Louis Botha's German South West campaign. The hand winch used for uphauling the cradle had originally been used to raise the cast iron segments of the Slangkop lighthouse.

As a result of the pelagic fishing boom in the 1950s and 1960s, a number of fishing companies built their own slipways in Hoedjies Bay, Stompneus Bay, Laaiplek, Doring Bay, Hondeklip Bay and Port Nolloth. Once the state provided public slipways in the proclaimed fishing harbours all of these, except the Louw & Halvorsen slipway at Laaiplek, were allowed to deteriorate and were abandoned.

The development of these slipways coincided with the introduction of steel to replace timber for cradle construction and led to the development of a characteristic 'Cape'-type slipway.

These new slipways are listed in table 4.

During the 1970s and 1980s the author instituted a programme of upgrading the 'Cape' slipway and introduced the use of Crandall-type docking frames on these cradles and developed the use hydraulic rams operated by hydraulic pumps on the docking frame catwalks to actuate the Mair-type bilge arms. He also developed compact hydraulic cable jacks in 14, 20 and 40 t capacities for side slipping vessels on greased timber off the main cradle into side slip bays.

The Lamberts Bay slipway is the only slipway in the country to be coherently designed and the only one to be checked and certified by Lloyds Register. It also uses vertically curved ways. The derating is a result of inappropriate attempts at maintenance of what is a sophisticated system. This slipway in its original condition is shown in figure 17.

The Louw & Halvorsen slipway at Laaiplek with a capacity of 90 t belongs to a ship repair company and is still fully operational.

A scan along the coastlines of the world on Google Earth suggests that South Africa has significantly more dry-docking capacity than any other country in the southern hemisphere.

ISSUES IN DRY DOCKING

In theory, for a particular docking of a particular ship in a particular condition of lading on a particular dock, given full structural details of the ship and the dock and the load distributions within the ship, all the forces involved can be computed, particularly so with the advent of modern computers. In the case of difficult dockings, docking of a laden vessel in damaged condition for instance, this is sometimes done and the classification societies offer this as a service. In practice, however, for routine dockings this is logistically impractical and safe, rapid empirical methods that need only a minimum of input data – vessel length, beam, draft, trim and block coefficient – must be used. Guidance on these can be found in BS 6349: Part 3 and in Lloyds Register, Rules for Shiplifts and for Floating Docks.

Large, new-built cargo vessels generally have excellent docking plans showing all obstructions to the hull, frame positions, sections and flats of sides and bottoms and the keel loading in docking condition frame by frame. On fishing vessels one is lucky to get any docking plan at all, even if it is a photocopy of a photocopy of a sister ship!

On slipways and shiplifts, the keel-

▶ **Figure 17** *Lamberts Bay slipway*
Figure 18 *Corrugation corrosion*
Figure 19 *Butt corrosion*
Figure 20 *Periodic corrosion in shiplift ropes*

block spacing is usually fixed. In graving docks and floating docks the blocks must be reset for each new docking. Partly this is to match the load distribution, partly to avoid obstructions on the ships hull. This in turn demands sophisticated and disciplined block handling procedures and the recognition that this is a production, not a project activity. It involves rapid and efficient methods of handling the blocks and of surveying both position and level. In a large dry dock the set-up involving a few hundred blocks, each weighing in the order of a ton, often has to be reset weekly and the whole operation must be completed within a few hours while the dock is dewatered. Standard drawing office practice is to work from baselines and centrelines but for setting out the keelblocks extra dockyard standard conventions are needed to identify the reference lines. For instance, does the dockmaster's office instruct the docking teams to set the blocks to a reference point on the dock floor, the cill perhaps, and separately, the all-aft position of the vessel for positioning it or are the blocks referenced to the pre-specified all-aft position? A misunderstanding between the office and the dock floor could lead to serious consequences.

It is all very well to be able to set the blocks accurately and quickly, but the exercise is wasted if the vessel cannot be got into position just as accurately and quickly. Older docks used capstans, bollards and fairleads to warp the vessel into the dock and to locate it to the marks. Modern docks use leading mules. Although it is conceptually simple, considerable skill is needed both in designing and in using the warping equipment to achieve efficient usage. The system of marking used also needs to be careful thought out, perhaps even at the design stage of the whole dock. Again, this is a production, not a project activity and standard rigging and survey procedures are generally inappropriate.

The main issue in slipways centres on the ways and the wheels. Essentially slipway cradles are a rigid, unsprung system. The system design needs to focus on keeping as many wheels as possible on the rails bearing load. By and large the solution is to use very accurate track, large wheels and a two-way system. Tolerances to level for the rails should not exceed ±1,5 mm. To be practical, one should not expect underwater in-situ concrete for this sort of work to better than ±100 mm. The author has done comprehensive surveys of first class standards of conventional civil engineering of slipway rails and found that overall the accuracy to the rails was ± 75 mm with steps of 25 mm at rail joints in places. The only effective way to build slipway ways is to precast them accurately on shore, monolithically without any joints; to use incremental launching to move them down into position as casting proceeds; to jack the ways beams accurately to level then support them permanently on rough tremie concrete.

Steel slipway rails are subject to their own particular form of accelerated low water corrosion that is at is most severe just below spring low water. One form is corrugations of the rail head shown in figure 18. The cure is cathodic protection. The other form is differential aeration cell corrosion at butt joints creating a step in rails, as shown in figure 19. The cure here is to use full penetration butt welded joints.

The weak points of shiplifts are the steel wire ropes that suspend the platform. They too exhibit their own peculiar form of corrosion. It occurs at periodic spots along the rope, usually at 2–3 m centres, depending on the system design. It seems to start in the core of the rope with an initial extent of about 200 mm along the rope. It is very difficult to spot by inspection. Lloyds rules for inspection of shiplift ropes don't provide for this behaviour and can easily miss a defective rope. The only safe practice is an annual magnetic NDT inspection of the full length of all ropes on a lift. An extreme case of periodic corrosion is shown in figure 20.

There are two basic forms of shiplift, articulated and continuous. In the articulated form, the intermediate steel spanning between the main transverse beams is an independent unit placed on knuckle bearings on the bottom flange of the main transverse beams. In the continuous form the intermediate steelwork is welded through the main transverse beams, as shown in figure 21.

If a rope breaks on an articulated system, there is nothing to retrain the end of the main beam and it goes to the bottom. So too does at least the intermediate steel to one side of this beam creating a mess on the bottom that must be cleared away before lift can be salvaged and the vessel released. The sort of damage is shown in figure 22.

In the event of a rope break on a continuous system, the intermediate steelwork helps to support the end of the main transverse beam and recovery is much easier. The situation is shown in figure 23.

Surprisingly, in most incidents, only one rope breaks, the rest hold and the system does not 'unzip'. Unzipping is much more likely to happen if any attempt is made to move the platform before it has been salvaged – as happened in Darwin some years ago, with the effective loss of the ship and the platform.

Floating docks have a fundamental stability problem. When the keelblocks just break water, there is no waterplane area to either the ship or the pontoon. Only the wing walls provide stability during this critical stage. Normally this is not a problem but it can become so when pushing the limit on the maximum size of vessel. Under these circumstances or through incorrect management of ballast water, floating docks have capsized.

CURRENT SITUATION

I did attempt to canvass opinion on this matter from the South African ship repair industry, but the responses I got were all unprintable …

Although the total turnover of ship repair work on the slipways in the fishing harbours is relatively small, it is a very important component. Fishing is a major industry that depends on keeping its vessels at sea, and fishing boats are hard-worked vessels that need a lot of on-going maintenance. There is a knock-on effect if the fishing harbour facilities are inadequate. The vessels move up to the NPA facilities, which become blocked with 'rats and mice'.

This was the situation a few years ago before the Department of Public Works (DPW) stepped in when the fishing harbours were in a state of collapse and most of the slipways unworkable. Despite the potential for technical criticism, DPW did step up when they were needed; they put a lot of money into these harbours and got the job done. The main problem was the vehicle they chose: a repair and maintenance programme (RAMP). Essentially it was limited to restoring the existing facilities with little scope for changing the capital stock of the harbours. It was unable to upgrade the existing slipways to handle more of the larger fishing vessels; for instance upgrading the Saldanha Bay slipway to 2 000 t and installing a 700 t Crandall-type slipway with full transfer yard in Hout Bay.

In the background, however, is the apparent current paralysis of Marine and Coastal Management (MCM) with respect to their duty of managing these harbours and operating the slipways. There seems to be an underlying sense that their function is biology, not engineering, and a concomitant desire to shed their obligations. Currently they are grasping at the potential of 'privatising' and commercialising the harbours. The whole issue is beyond the scope of this article, but it could impact negatively on ship repair activities.

Dry docking and ship repair in the NPA ports centres on Durban and Cape Town, but the characteristics of the industry in the two ports are very different. Durban, as South Africa's major national port, not only has much higher traffic levels than Cape Town, it is a terminal port. Many vessels discharge their entire cargo before reloading. It is convenient for them to schedule their routine dry docking during their turn-around in Durban.

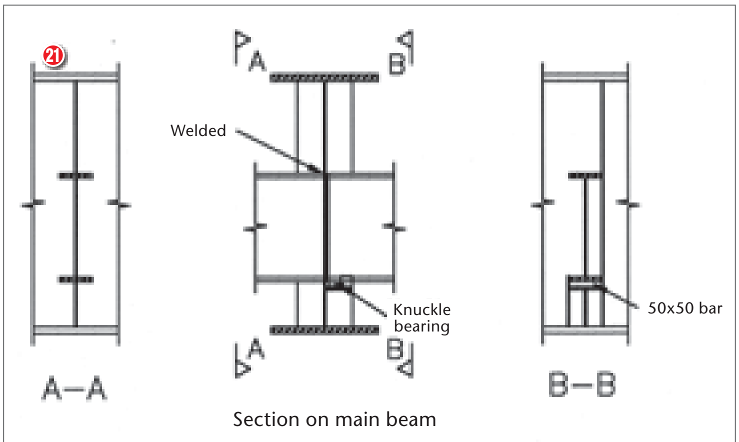
Cape Town is not a terminal port. Today it is effectively a regional port. While a large number of tramping reefers do call at Cape Town to load fish, fruit and wine, few of these are in docking condition when they arrive. Ship repair in Cape Town is dominated by working vessels, fishing, offshore diamond dredging, oil exploration and recovery, and Antarctic supply and research vessels. These vessels, by their nature, with large amounts of kit on board, involve very much larger turnover of ship repair than cargo vessels.

Ships are mobile and can pick and choose where it suits them to dry dock. They also represent very large capital investments with competent back-up management staff able to plan the operation and maintenance of their vessels. Owners actively seek the best deal on ship repair they can get, sometimes planning up to a few years ahead. Irrespective of the set-up in any particular port, there is no such thing as a monopoly in ship repair and ship repairers have to be competitive on an international basis.

Currently the overt situation in the NPA that led to the reaction I got from the ship repairers appears to be much the same as that in the MCM. While current public service staffing policies are a significant factor in the immediate situation and the source of much dissatisfaction in the industry, they are not a matter for this article, particularly so since there are deeper issues of much greater long-term relevance.

Ultimately, the only people who should be in dry docking are ship repairers. By and large, ship owners will tolerate a docking charge up to 10% of the total cost of the repair bill without complaining. That may be enough to cover the operating costs, but it is not enough to amortise the capital cost of the docks. Operating dry docks is not in itself a profitable business, but without dry docks ship repairers cannot stay in

Figure 21 *Hybrid shiplift platform – part articulated, part welded continuous*
Figure 22 *Damage to articulated platform from rope failure*
Figure 23 *Damage to continuous shiplift platform from rope failure*
Figure 24 *Sturrock Dock showing poor management of block stock at the sides of the dock*



business. Ship repair is a variable and high risk business that tends to run at an overall profit of about 30% of turnover. If the ship repairer owns the dock he can add a third of his profit, 10% of turnover, and perhaps more, towards amortisation of the capital cost of the dock. That way he pays off the dock fairly quickly. What he forgoes in profits, he gains in capital appreciation. The money is not lost.

Usually, in practice, when a ship repairer owns the dock, he includes in his account a docking charge that tends to 10% of the repair bill, but is subject to his marketing policy. If, on the other hand, he does not own the dock, the whole docking charge including any excess levied by the dock owner is charged directly to the client. If the excess is not contributing to the company assets, then the ship repairer cannot afford to subsidise these charges. The first shiplift in London was initially prohibited from undertaking ship repair itself. For the first two years it ran at a substantial loss until the restriction was rescinded. Thereafter it ran at a profit.

For some time now the NPA and its predecessor, Portnet, have attempted to run each cost centre at a profit. What this means in practice is minimum expenditure on maintenance and staff and maximum charges. A recent study commissioned by the provincial government of the Western Cape shows that current NPA docking charges are running at some five times the international norm. The state of the equipment has deteriorated to a point where foreign owners are starting to baulk at the risk assessments of dry docking in these facilities. Dockings have been falling, as shown in table 5.

Reasons given include:

- Poor cost competitiveness
- Inadequate maintenance and no reinvestment
- Inadequate cranage
- Poor service delivery
- Inadequate facilities
- Conflict of interests between the NPA and industry
- Low productivity
- Skills shortage

The problem of physical condition is worst with the mechanical equipment, gates, pumps, cranes, capstans, etc. I am not aware of any recent assessment of the cost of bringing these and the civil works back to best international standards – it is bound to be enormous, many millions of rands, but this is a drop in the ocean compared to the potential turnover of ship repair in South Africa. In fact, it may well be less than the amount DPW has already spent on refurbishing the fishing harbours. From the public perspective, the long-term cost should be very much less than the return to the exchequer of tax over the whole of ship repair activity.

The value of the Western Cape ship repair industry to the economy in 1999 was estimated at R1 200 million, growing to more than R1 800 million the following year. The breakdown is given in table 6.

Fixing the physical infrastructure, on its own, is not sufficient. The staff need to be upgraded and motivated but above all, a whole new organisational structure is needed to implement these changes.

Although not unique, public dry docks are not common. Aside from South Africa, they tend to be found in places like France and New Zealand. In the South African case, the problem can be traced back to the geopolitical needs of the British Admiralty in the late 19th and early 20th centuries. An effective way to get the dry docks they needed was to subsidise the South African government into building them. The NPA have inherited this situation and basically they are riding a tiger with no way of getting off. Now that the NPA has been restructured on a commercial basis, the only practical way to resolve the issue is for the state to come to the table and put up the funds, in the first instance to get the facilities restored as it has done for the fishing harbours and, subsequently, to cover the excess of operating costs over income from docking charges set to no more than the 10% figure. Various models come to mind whereby this could be done, but this is not the place to discuss them. It is worth keeping in mind, however, that the same situation exists with respect to the slipways in the fishing harbours. When these harbours were built by the Fisheries Development Corporation, the influence of the SAR&H was ubiquitous and everyone just 'knew' that the state provided dry docking.

Whatever machinery is put in place to manage the dry docks, it should encourage private sector investment in new dry docking facilities – as Elgin Brown Hamer have done when they brought the 8 500 t Eldock floating dock to Durban. An active policy of encouraging privately owned dry docking facilities will allow the NPA and

Table 5 Recent dry dockings

	2003	2004	2005 (Oct)
Synchrolift	294	265	192
Robinson Dock	45	45	32
Sturrock Dock	45	35	19

Table 6 Contribution of the South African ship repair industry to the economy in 2000

	R-million	As %
Crew spending	29	1,6%
Port revenue	36	2,0%
Repairers' revenue	450	24,7%
Purchases from ship suppliers	560	30,7%
Subcontracted repair work	750	41,1%
Total	**1 825**	**100,0%**

the state to reduce their participation in dry docking. Whether this will allow them to get out of dry docking completely or what the optimum balance of public and private dry docks should be is a separate issue.

Currently DCD Dorbyl have committed themselves to building an 8 000 tlc shiplift and transfer yard in the Schoeman Basin in Cape Town, but have had to put the project on indefinite hold because the NPA still need the site for containers and cannot say when they can release it.

The booming oil industry in West Africa is creating a demand for a considerable increase in dry-docking capacity. The DCD Dorbyl project in Cape Town would handle the service vessel business, but it cannot handle the big money, the drill rigs, semi-submersibles and FPSO (floating production, storage and offloading) vessels. A supertanker-sized dock would be needed to handle all these vessels, although a shorter dock limited to the drill rigs and semi-subs may well prove more cost effective.

At present, the restricted width of the harbour entrance at Durban generally limits vessel that enter the harbour to panamax size. The big money in ship repair on that coast lies in the Cape bulkers used for the Richards Bay coal trade arriving in ballast. Now that the project for the widening of the entrance to Durban harbour is going ahead these vessels will be able to enter the harbour and it may be expedient to build a new, larger dock in Durban. This is, of course, the Richards Bay proposal, but the necessary infrastructure already exists in Durban. If the vessels can be got into Durban, that would be the better location.

The Nambian Port Authority (Namport) does not suffer from the malaise that afflicts the NPA and, amongst other initiatives, is actively building its ship repair industry. At the beginning of 2006, in conjunction with Elgin Brown Hamer, it acquired a sister to the Durban Eldock. If the current situation vis-à-vis the NPA and Namport continues, the entire Cape ship repair industry can be expected to relocate to Walvis Bay.

References are available on request

Keith Mackie has written two textbooks, *Dry dock manual*, the basis of his course on the practice of dry-docking ships, and *Basic coastal and harbour engineering*, the basis of the SAICE CPD roadshow on the subject. He has read numerous papers on these subjects at national and international conferences. Keith is a member of SAICE and a fellow of the SA Institute of Marine Engineers and Naval Architects and is also involved in restoration engineering.

Figure 25 *Poor condition of keel blocks at the Sturrock Dock*