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Port Maintenance Handbook

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Figure 2.7 A typical suspended reinforced-concrete quay deck, supported on tubular steel piles

- Epoxies, of which there are varying types, are normally of the surface-seal type, and have a good record for chloride, carbon dioxide and water penetration. They can be applied to wet surfaces and are effectively the only material which can be use under water or in the tidal zone.
- Bitumen emulsion and solvent-based bitumen are of the surface-seal type and have excellent resistance to carbon dioxide, chloride and water. They are extremely durable, provided they are not exposed to ultraviolet light. They have a life expectancy of over 20 years and can be applied to slightly damp surfaces.
- Acrylics come in three types – emulsion, resin in solvents and unsaturated resins – all of which have good resistance to ultraviolet light and many chemicals. The emulsion type is the only acrylic which is applied to damp surfaces. They have good resistance to carbon dioxide penetration, and some resistance to chloride and water penetration. The durability is reasonable with a life expectancy of ten years.

Cathodic protection uses an applied direct electrical current to the reinforcement so that no part of it can be at an electrical potential, which would cause corrosion. Although effective, it is generally costly to install and the input current must be monitored and maintained carefully.

Cathodic protection can also protect steel piles (Figure 2.7) through use of zinc anodes bolted to the steelwork below low water. These have to be inspected on a two/three-year cycle and replaced when the anode decays.

2.2.3.6 Timber structures

MAINTENANCE REMEDIES

Maintenance and repair of timber can be minimised by treating the timber before installation to discourage attack from marine organisms.

as under piers and jetties. Pumping concrete provides several advantages over the use of a tremie pipe as the concrete is directly transferred from a mixer to the formworks, thus preventing potential blockages in the pipe, as well as the risk of segregation.

Figure 2.15 shows a typical pipeline configuration for pumping concrete.

3. HYDRO-VALVE METHOD OF UNDERWATER CONCRETING

This method of underwater concreting, in which a flexible hose under hydrostatic compression is used to pour the concrete, was developed in Holland in 1969.

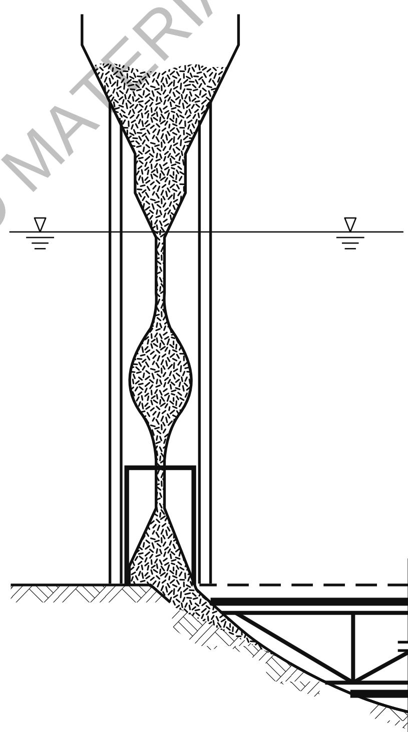
Immediately concrete is placed in the upper part of the pipe, both internal pipe friction and hydrostatic pressure is overcome by the weight of the concrete. This allows the concrete to move slowly down the pipe and avoids segregation of the concrete mix. A rigid tubular section is used to seal the end of the hose when required. This is a relatively cheap and simple method.

Figure 2.16 shows a typical hydro-valve arrangement.

4. UNDERWATER CONCRETING USING PNEUMATIC VALVES

Pneumatic valves are joined to the end of the pipe line with different types of valves available, such as Abetong-Sabema and Shimizu valves. These two valves are similar except a sensor is attached to the latter and its function is to close the valve when the concrete reaches the required

Figure 2.16 Hydro-valve method of underwater concreting



should be sufficient for future occasions. The grain size and density of the material will have an influence on the percentage of material that will be retained within the hopper. Similarly, this information will be useful when considering the use of overflowing or side casting techniques and the effectiveness of these methods on material dispersal.

2.9.3 Available dredging plant

2.9.3.1 Trailing suction hopper dredgers

In recent years, the more traditional types of plant (e.g. bucket dredgers and grab dredgers) used for maintenance dredging have been superseded in many instances by the trailing suction hopper dredger (TSHD; Figure 2.23). This is probably because more significant improvements to the technology of maintenance dredging have been achieved with TSHDs than with other types of dredging plant. Considering the economic and operational advantages the TSHD has over most other types of dredging plant, it is not surprising the TSHD has become the standard tool for maintenance dredging.

The TSHD is essentially a small vessel which loads its hold (hopper) by pumping a mixture of dredged material and water through a pipe and drag head while the vessel is under way. When the hopper is full, the vessel sails to a designated dump ground, where the dredged material is dropped to the seabed through bottom-split or sliding doors or in some cases is pumped out of the hopper. Smaller TSHDs of the split hull variety have advantages when dumping some cohesive soils or dumping in shallow water.

With the advance of GPS and depth sounding technology, the positioning and operation of TSHDs has become very advanced and by its nature the TSHD is a very manoeuvrable vessel, especially when fitted with bow thrusters.

Figure 2.23 A trailing suction hopper dredger dredging a berth

Figure 7.6 ASC rail tracks on gravel beds (*by kind permission of DPW Antwerp Container Terminal and photographer Frank Bahmuller*)

Sensitive automated equipment requires targeted routine preventative maintenance programmes to ensure a proper operation, and maximum in-service lifespan. As a result, unscheduled corrective maintenance decreases, since potential machine failures can often be spotted before they occur. As well as this, the number of ad hoc repairs is reduced as there are likely to be fewer collisions, incorrectly handled equipment or human error. Pre-planned short-term maintenance checks are increasingly important since there are no drivers to report on the condition of the ASCs (or any other automated equipment).

When ASCs are used, maintenance needs to be taken into account in a detailed manner, when the physical design of a container terminal is at the planning stage. The most obvious requirement is that areas in which maintenance personnel are required to interface with the ASCs must be carefully defined and strictly separated from automated areas. Unlike RTGs, ASCs cannot be moved off their rail tracks (see Figure 7.6) and maintenance has to be undertaken in the container stacking area itself. ASCs generally operate in pairs, so when one machine is undergoing maintenance, the second ASC can continue to operate within the stack. In order to accommodate the out-of-service ASC, the stack layout should be long enough to accommodate maintenance areas at either end of the stack. In the maintenance of ASCs, maintenance schedules are based on actual usage of each separate component, which ensures no unnecessary maintenance is undertaken.

7.2.4.4 Advancements in ASCs

ASCs now use well established technology, but advancements continue in order to maximise terminal productivity, provide more environmentally acceptable emissions and reduce maintenance costs. Lighter materials could reduce energy consumption and maintenance work, as well as infrastructure costs, through a reduction in wheel loads. Research and development in this area

Figure 7.19 A typical cruise-ship passenger access gangway

Maintenance of these types of gangways requires a range of skills, including mechanical and electrical inputs. Most preventative maintenance can be undertaken in-house, or by an outside contractor for smaller ports. Specific maintenance, refurbishment or replacement of specialised items, such as control systems, is likely to have to be undertaken by the manufacturer of the gangway.

Figure 7.20 Cruise ship lower-deck access for loading luggage and supplies