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New berth 306 expands capacity of Richards Bay Coal Terminal

The construction of berth 306 at Richards Bay Coal Terminal, involving 11 caissons, has increased the capacity of the terminal from 72 to 82 million tons per annum. Extensive monitoring of the dredging operation was carried out, and it appears that the construction had very little negative effect on the environment

BACKGROUND

The Port of Richards Bay, situated on the eastern coastline of South Africa, 170 km north of Durban, is one of the country's premier ports. It was opened in 1976 for the exporting of 10 million tons of coal over a three-year period. Since then the

port has grown continuously and today handles more than 80 million tons of cargo per year, which is 50% of the total tonnage of cargo handled in all the ports in the country. Sixty-five million tons of coal is handled annually by the Richards Bay Coal Terminal (Pty) Ltd (RBCT), which is one of the largest coal terminals in the world. Coal is transported to the terminal by Transnet Freight Rail in 200-wagon trains from the mines in the Mpumalanga region.

In 2001 RBCT approached the Transnet National Ports Authority to provide an additional berth which would increase the capacity of the coal terminal from 72 to 82 million tons per annum. Approval was granted in 2003 for the provision of the additional berth. Tenders were called for in April 2004 and the construction was awarded to a consortium, BRSB Joint Venture, which consisted of Basil Read (Pty) Ltd, Sivukile Construction (Pty) Ltd, Bhode Construction (Pty) Ltd and Van Oord ACZ Marine Contractors, in April 2005, with a value of R250 million.

PROJECT DESCRIPTION

The berth to be provided had to accommodate a bulk carrier of 150 000 tons with a draft of 18,5 m. It was to be 320 m in length, which would increase the total length of the coal terminal's berths to 1 950 m.

The provision of the berth required the following: excavating a caisson pit; casting 11 caissons; flooding the pit and floating the caissons to the quay wall site; improving the soil in the area where the caissons were to be founded; sinking the caissons; backfilling behind the caissons; constructing the mass capping and proving the bollards and fenders; dredging the caisson foundation trench; dredging the basin and disposing of the spoil; obtaining approval to mine sand offshore; sand winning offshore; and conducting environmental monitoring throughout the process.

CAISSON CONSTRUCTION

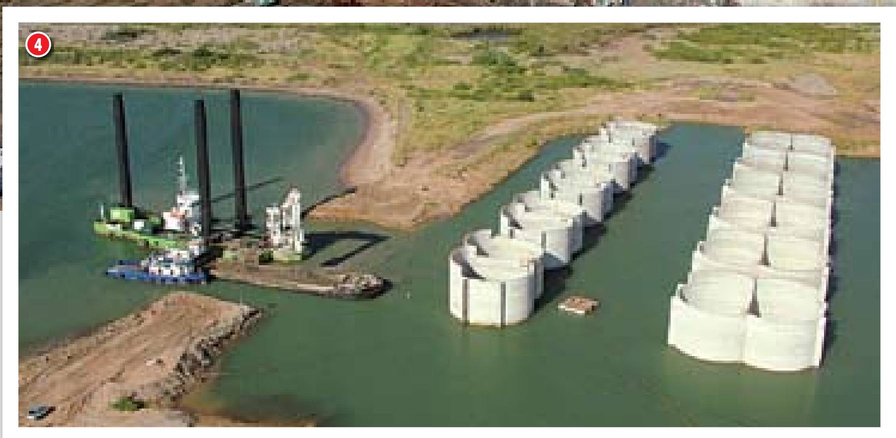
It was decided to construct the caissons in a pit because land was available in the port, port operations would not be adversely affected and this method had been used successfully in the past. The internal dimensions of the pit were 185 m long, 85 m wide and 15,5 m deep. Groundwater seepage into the pit was contained by creating a trench along the sides of the pit from which seepage water would be removed since the only source of seepage water was along porous layers found in the sides of the excavation. As a portion of the pit had been used as a caisson pit in the past, the pit first had to be closed off by constructing a berm

1 Quay wall site before construction
2 Caisson under construction

across the entrance – this was later removed to allow the caissons to be transported to their final resting place.

Eleven caissons were required to construct the quay wall. Each caisson had a base which measured 27,9 m by 19,8 m and was 1,5 m in depth. Onto these bases the caisson walls of 22,7 m in height were cast. Each caisson consisted of two circular cells which were joined by a dividing wall and required 2 130 m^3 of concrete. Casting the eleven caissons took 8 months to complete. Once the caissons had been cast, the basin was flooded which allowed them to be floated. Flooding of the basin was carried out by inserting three pipes of 900 mm in diameter into the berm wall with an invert level of +0,5 m, which allowed the variations in tidal levels to fill the basin in a controlled manner within five days. Once the basin had been flooded, the berm wall was excavated, allowing the caissons to be towed from the basin.

Due to their uneven wall heights, the caissons did not float in a vertical plane but listed at an angle of 20 degrees. This tilt was reduced to 3 degrees through a process of ballasting the chambers, inserting



12 concrete blocks and 92 tons of sand into each caisson. Once the required degree of tilt had been reached, the caissons were towed 5,5 km to the construction site.

EXCAVATING THE CAISSON TRENCH AND SOIL IMPROVEMENT

Before the caissons could be placed into position, a trench had to be excavated to a depth of 18 m and the soil improved to ensure the stability of the caisson wall. This excavation was carried out by dredger. Where there was insufficient water depth for the dredger to pass through, a water-injection dredging technique was used which fluidised the material and allowed it to flow to areas that the dredger could traverse. Due to the poor soil conditions under the proposed quay wall, soil improvement was required. This was carried out by a combination of constructing stone columns in the silty or clay layers and deep vibration of the sandy layers to reduce settlement and improve bearing capacity.

PLACING THE CAISSONS

The caissons were placed in their final position by flooding the cells and filling them with sand. The sand was, in turn, compacted by lowering a compaction probe into the saturated sand at 23 positions over the entire area of the cell. The joints between the caissons were sealed with a concrete-filled sock in the front and a sock filled with graded stone at the rear of the caisson. Once the caissons had been placed and fixed, the construction of the mass capping could commence and the bollards and fenders could be fitted.

DREDGING AND RECLAMATION

The project required 3,8 million m^3 to be dredged and spoiled, and 0,53 million m^3 to be dredged offshore and reclaimed. Two trailer suction dredgers were used during this process. The dredging of the basin and spoil disposal took 22 weeks and the offshore winning and reclamation took one month to complete. The dredged material was dumped in a designated area approximately 3,5 km from the harbour

entrance, which had also been used for dumping dredged spoil from normal maintenance since 1987. The disposal of material resulted in two mounds forming offshore, 5 m in height. This was due to the fact that a large amount of material was being dumped in one position in a very short period and there was therefore no time for nature to disperse it quickly enough. Since then, these mounds have been eroded and the sea bed is exposed again. Sand winning was done at a site 7 km offshore and stockpiled in an area behind the quay wall, from where it was spread along the newly placed caissons to create the berth.

ENVIRONMENTAL EFFECTS

As large volumes of dredged material would have to be disposed of for future expansion projects, the Record of Decision (ROD) for this project required extensive monitoring of this dredging operation to be carried out, the results of which would assist in formulating the basis for future similar projects. In the past, all dredged material was disposed of onto the beaches surrounding the port. Due to a concern raised by Interested and Affected Parties (I&APs) as to the possible impact on the environment of continuing with this practice, the tender documents made provision for two areas where the dredged material could be disposed of. The areas of concern included the port confines, the Mhlatuze estuary adjacent to the port and the offshore marine waters. It was, however, decided to dispose of all the material on the offshore dumpsite to minimise costs as the allocation of 0,5 million m^3 allotted to beach disposal did not warrant the cost incurred per m^3. This was the first time since the port had been opened that dredged spoil as a result of capital dredging was required to be dumped offshore.

Since the start of construction of the port in 1974, the beaches in the vicinity of the port had been used for disposal of dredged spoil. The spoil would be piped from the dredger to a point above the high-water mark on the beach and the spoil would be pumped into the surf zone. To date 98 million m^3 of material have been pumped onto the beaches. Dumping the spoil onto the beaches in this way reduced the cost of the project and also allowed the beaches to be nourished with sand, which assisted in reducing the erosion that is a characteristic of KwaZulu-Natal beaches.

The required monitoring had to take place before, during and after dredging. Data was to be collected before dredging which would form the baseline against which the effects of dredging operations and recovery times could be assessed in the various stages of construction and after construction had ceased. Sampling sites were situated at various locations within the port and offshore.

The parameters that were to be monitored were: water quality (physico-chemical, nutrient and metals); sedimentation; sedimentation quality (metals); benthos (soft substrate); benthos reef; fisheries; mangrove swamps; and zostera.

The results of the sediment monitoring showed that the highest levels of turbidity and deposition occurred closest to the dredging operations and at the dumping site. The greatest impact was restricted to a distance of 500 m from the dredging operations, where 5 mm of deposition took

3 Constructed caissons in excavated pit
4 Caissons in flooded pit
5 Caisson listing 25 degrees in flooded basin
6 Caissons being placed at quay wall site
7 Heavy reinforcing of mass capping

8 Completed quay wall and basin

place. The turbid plumes that were visible in the port were due largely to wind. From the data available, this could have occurred 11% of the time that dredging took place. There was no evidence of sediment entering the estuary as a result of dredging activities at the coal berth. At the dumpsite there was significant evidence of sediment deposition, as could be expected, and mounds had formed where the material had been dumped.

The water quality was monitored to establish whether any changes had occurred to the physico-chemistry of the water as a result of any increase in turbidity and/or the potential release to the water column of nutrients, metals and organic contaminants. Pre-dredging data indicated a high level variation in these characteristics, which is considered normal for a port or estuarine environment. The results of the monitoring did not give a clear indication as to whether or not the physico-chemistry parameters had been affected by the dredging, other than in one instance. This was at a site next to the dredging operations which was in a sacrificial zone. Where non-compliances did occur, it was difficult to distinguish whether they had resulted from normal port operation activities or the dredging activities.

The change in sediment granulometry and the total organic content parameters were also monitored. There was no evidence that the sediment suspended during dredging operations had significantly altered the sediment granulometry. Similarly, no evidence was found of changes in the total organic content that could be ascribed to the dredging operations.

The degree to which sediment was contaminated by the following metals was also assessed: arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc.

Pre-dredging and post-dredging data showed no evidence that surface sediment from five sites within the port was contaminated. The same applied to samples taken offshore, where little evidence of any contamination was found after dredging had been completed.

The monitoring of offshore fisheries showed that the spoil disposal had not obviously benefited or compromised the fishes retained by offshore fisheries. In fact, there is evidence to suggest that the catch rate increased in the vicinity of the disposal site and commercial fishermen were not concerned about the possible impacts of disposal of dredged spoil.

The one area on which disposal did have a negative effect was the offshore benthic reefs. Monitoring showed that spoil disposal smothers the reefs in localised areas. As this practice had been taking place for many years and there were other factors that were influencing the condition of the reefs, it was difficult to determine exactly what the effect of the construction of berth 306 had had on the reefs in the area. It was, however, suggested that the dump site be moved further offshore to deeper water.

CONCLUSION

The construction of berth 306 at Richards Bay Coal Terminal, involving 11 caissons, has increased the capacity of the terminal from 72 to 82 million tons per annum.

The results of the monitoring programme suggest that the construction of berth 306 had very little negative effect on the environment and that natural events play a larger role in changing the environment. It is hoped that with the results obtained, there will be far fewer uncertainties to be investigated and taken into account when a similar project is undertaken in future. □