R·M·D KWIKFORM

Bringing structures to life

Asry Basin Quay Wall

Client:	ASRY
Contractor:	Nass Contracting
Location:	Manama, Bahrain
Products:	Special Formwork

Case Study

Engineers from RMD Kwikform have developed specialist steel moulds to create a range of giant mega-blocks for use by Nass Contracting for its $80 million Asry Basin Quay Wall project in Bahrain. The scheme will create a 1,380 metre long, 12 metre deep sea wall defence system, as part of a major extension to provide over 1 km of wharves for shipbuilding and repair yard specialist, ASRY.

The $80 million contract comprises the construction of a 1,200m quay wall, with a water depth of up to 12m, designed to receive 300,000 DWT vessels as well as a 180m berth for 40,000 DWT vessels.

The quay wall will be equipped with all services, utilities, and crainage required for providing efficient alongside repairs. The project also includes the construction of all support facilities and infrastructure necessary to ensure a high level of reliability for ASRY.

Faced with creating a new quay wall by placing some 4,600 concrete 'mega-blocks', weighting up to 80 tons contractor, Nass Contracting turned to RMD Kwikform to design a number of specialist steel mould solutions for the project.

Having secured a site for its casting yard, adjacent to the quay wall, Nass Contracting engineers worked with RMD Kwikform's engineering team in Bahrain to develop 10 separate interlinking steel mould solutions for the project.

Commenting on the solution, RMD Kwikform Bahrain's engineering manager, Shekhar Sawant said: "Once Nass Contracting had worked out the design of the quay wall itself, using blocks, the team approached us for a solution to the challenge. We recognised that we needed to take a simple yet flexible approach, so came up with a series of moulds that could cope with the speed of block production needed to achieve the programme deadlines.

"Having to create a minimum of 20 blocks a day for 180 days, the reliability and productivity of the moulds was crucial, as was determining the number of moulds required that could be housed within the designated casting yard. In order to make this process as smooth as possible, members of the RMD Kwikform design team assisted with the layout of the yard and how Nass could get maximum efficiency from the mould design.

In order to deliver to the quay wall design, the flexibility of the moulds and therefore blocks was critical. RMD Kwikform engineers designed 10 very different adjustable moulds for the creation of the quay wall, which alsoincluded the cast in-situ coping beams. Shekhar: "Each mega-block mould was challenging, as its design required a great deal of complexity for the adjustment in height and length needed to deliver the different sizes.

"We therefore designed each mould to cater for two different heights of block and a minimum of three to four different length adjustments. In addition, within the design we had to cater for the position of the top and bottom shear key, which varied along the length of the quay wall to suit the four different zones along the 1.20 km project.

The make up of the blocks designed by RMD Kwikform's engineering team incorporated a special cantilever rail mounted steel mould design, which could be struck safely. The mould itself consisted of two main fixed length 9.50 metre tall by 2.75 metre wide steel side panels, with 2.75 metre tall by 1.88 metre wide end plates, both 120mm thick. The four panels were then mounted onto a specially designed base plate, complete with hinge arrangement for ease of use.

Fixing points were built into the vertical supports of the side and end panels to allow retractable turnbuckle operated rods to be located. With similar fixings from the base of both panels, an effective cantilever support mechanism was achieved, enabling all of the panels to be struck safely, once the concrete was cured.

Shekhar: "What is important to remember with mould design is the tolerances are very small, you are talking millimetres, so getting the balance between having a movable mould with a very precise fit is extremely challenging. Once we had worked out how to operate and support the panels, we needed to make sure the mould could deliver the versatility and flexibility required by Nass Contracting. In order to achieve this we had to ensure all of the variations in block length, height and shear key position could be achieved.

"In order to make this possible we had to overcome a number of challenges. The first was to design and manufacture a 9.79m long by 2.75m high side panel, with tolerance less than 3mm to suit the maximum length of the mega-block. Following on from this, end panels were designed to travel on the concrete filled base frame chamfers, to allow for the adjustment of various lengths of mega-blocks. These panels incorporated special shear bolt connections to the side forms, with the vertical height of the block achieved by the adjustment of the bolt on the chamfer and lowering the top shear forms to required height.

The next challenge was to design robust hinged end side form panels, witha maximum 45 degree inclination to allow for 2.0m height of concrete dead weight. In support, additional crank panels where introduced to cover the shapes of the moulds, with significant design time spent on making sure the moulds were adjustable to incorporate the varying location of base and top shear keys.

On completion, the mould designs allowed for the creation of mega-blocks varying in heights and widths from 1.90 metres high by 1.98 metres wide, to 2.75 metres high by 1.88 metres wide."

Once all of the mould designs were agreed , RMD Kwikform were tasked to deliver48 block moulds in phased deliveries to site within a 16 week time frame in order for work to commence as planned.

Shekhar: "As we went through the design process with Nass, once we new we had a workable solution, we were challenged to come up with a viable way to reduce the weight of the blocks, without affecting their structural integrity. Because each block was solid concrete with no steel reinforcement, we worked together with Nass to design a number of void units that could be inserted into the moulds, at predetermined points."

With support from colleagues in its Sharjah head office, RMD Kwikform's engineering team designed and tested a number of cylindrical void units to achieve the best balance between concrete reduction, ease of use and structural integrity. Shekhar: "Creating the void sections was a sensible idea, as it reduced concrete use by up to 6 cubic metres per block. More importantly it also reduced the weight of each block by up to 15 tonnes. However, by creating a void, additional factors came into play, namely what shape the void could take, its size and critically how easy it was to remove once the concrete was cured.
"Technically all of these elements could be designed into the overall solution, but it was only when it came to practical use onsite that we could determine whether the void units would work. The key 'sticking point' was how to remove the void units once cast. With the first trial units proving to be difficult to extract from the moulds, our engineering teams got together to see what could be done to improve the removal process.

"The simple solution was to insert an additional striking Unit section into the overall void cylinder design. A 15mm striping bar was introduced to the void design which was suitable for the various combination of void forms developed.

The stripping bar extruded 5mm along the full length of the outside of the cylinder with a 50 mm wide overlap inside the unit. With slotted holes and the addition of a fixing plate to inner forms the stripping bar design allowed for the simple introduction of a turn-buckle for ease of striking. Overall this created a much easier to extract void and coupled with site training on void insertion and extraction techniques, the use of the void units was extremely successful."

With a very tight schedule to meet, the final programme efficiency phase was determined by Nass Contracting's use of a specialist faster setting hardened concrete. Shekhar: "Before we even started the project, we knew the key to its success would be the quick turnaround of the mega-block sections. It was then only down to Nass to find a concrete mix that could support the required strength of the mega-blocks and aid in the quick turnaround."

Now complete the Asry basin is fully operational boasting docking space for 300,000 dead weight tonnage vessels.

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