MCG Health & Safety Strategy

Lessons Learned Data Collection Form

Project Location: Manchester, UK

Brief description of Incident

The incident comprised of failure to the ballast platform. This took place as the self-erecting tower crane, hired from Mantis Cranes Ltd Co Durham, was being dismantled on site to be off hired. Two operatives, employed by Mantis were dismantling the crane.

In dismantling the crane, a crack which had been known to be present for some time on the platform base opened up further resulting in failure on the left hand side of the platform base block which subsequently brought down the remaining blocks on this side of the ballast pile.

This failure at first appeared to have taken place on release of the turnbuckle and rods that secured the crane's concrete counter ballast blocks together and in lifting off the top block. This top block was lifted off by a forklift truck and in doing so the remaining 5 No 1770kg blocks fell to the side of the crane.

Photo 1
Crack in concrete and fallen ballast blocks.

The photographs detail that there was a significant crack formed in the ballast, which had further opened when it failed.

As a result of this failure, the crane was left unstable.

No one was injured or property damaged resulting from the failure

The crane was a Mantis 35-10 Self-erecting crane and another crane of the same type showing evidence of similar cracking to the blocks was immediately taken out of action.

Photo 2
Crack in concrete and unstable ballast blocks.

Investigation

White Young Green Consultants undertook a full structural investigation into the concrete failure and described the crane as having an overall weight for the assembled ballast block as approximately 25,000kg for the Mantis 35-10 crane. The bottom of the ballast block weighs approximately 4000kg and straddles over the chassis beam to cantilever outwards to form a platform where the remaining ballast blocks are stacked in six pairs on top of the base block. The complete ballast stack is held together by a single steel rod passing vertically through the blocks and tied by a steel bar arrangement.

The concrete ballast blocks are comprised of high-density reinforced concrete with the matrix having a dark coloured appearance with fine grained aggregate there was evidence of metallic inclusions and synthetic admixtures to increase the density of the blocks.

Testing carried out by Queens University Belfast on two sets of core samples demonstrated that compressive strength varied from 24N/mm2 to 57N/mm2.

Destructive testing carried out at the Mantis factory revealed that the block had a number of manufacturing defects.

- “The reinforcement bar arrangement had been incorrectly positioned in the concrete and this greatly compromised the effectiveness of the section to resist shear forces and bending moments induced by the weight of the ballast”.
- “The cover to the top reinforcement was 70mm” although the reinforcing bar was bent to allow 35mm to the top and bottom surfaces.

Lesson Learned:

White Young Green concluded that:

- "The failure of the ballast base block and associated collapse of the ballast stack was due to structural failure of the reinforced concrete base block". "The reinforcement was incorrectly positioned within the concrete section during manufacture thereby reducing the effectiveness of the section to resist bending moments induced by the upper ballast blocks".
- "On examination of the structural drawings for the Type 1 ballast block, we would have reservations that the reinforcing bars specified is adequately sized and correctly detailed for a section supporting over 10.5 tonnes of ballast on each side plus its own dead weight".

RECOMMENDATIONS:

White Young Green recommended that:

- "A short term remedial solution for cranes currently in service is employed and that 3 No enhanced steel box sections be fitted to the underside of the crane chassis beams to provide additional support to the ballast base section", as fully detailed in their report.
- "Recommend that all existing ballast blocks are thoroughly checked for defects by a qualified structural engineer (having removed all upper ballast first). Where there is evidence of structural cracks the ballast should be discarded. It would be prudent to consider replacement of all ballast blocks on existing cranes with products designed, tested, and quality certified by the manufacturer".
- "Recommend that Mantis Crane Ltd examine steel support pads for the concrete base block to rest on. A rubber bearing strip placed between the steel and concrete would ensure a better contact area and reduce "hard points" and concentrated stresses on the ballast element which could possibly damage and over-stresses to the concrete".