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Survey Control Services

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REPORT Nº H2106-1	Movable booms in competition pools Investigation into distortions due to lane rope tensions

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Reference Documents

FINA Facilities Rules

Customer

(Research document)

Introduction

Most competition pools are presented for certification at the completion of the structural works. This is normally part of the contractual requirements between client and builder. As timing pads and lane ropes are not normally part of the main contract these items are usually not available at the time of certification.

On a few occasions it has been possible to carry out instrument survey on pools where lane ropes are available. It is apparent that booms are not as rigid as it is generally assumed and that significant deflections can be induced.

This document summarises the results of a short investigation into one boom.

Boom description

The boom investigated has a 21 metre span across 8 lanes and enables a 50 metre pool to be shortened to 25 metres. The boom width is about 1.2 metres with a depth of 2 metres below water level. At the 25 metre position the boom sits down onto a raised tiled upstand.

As initially installed it was found that tensioning the lane ropes caused the centre of the boom to deflect by about 2 centimetres. The boom was subsequently modified and stiffened, such that it takes up a concave crescent shape when the lane ropes are not attached.

As the lane ropes are tensioned the boom straightens and goes into compression against the end locating pins.

Test measurements

There are no laid down specific loadings for the lane ropes. General practice is to apply tension until the load springs are seen to be slightly open. This is somewhat subjective. The test measurements were carried out with the boom positioned at the 25 metre location in the pool. This ensures that the back wall of the pool has no effect on the behaviour of the boom.

Initial measurements taken at three locations on the boom top edge indicated that a boom movement of around 1½ centimetres could be expected once the lane rope tension was applied.

The lane ropes were fixed and tensioned by the boom manufacturer's staff. The initial tensions were set such that the springs appeared to be just opening. I inspected the springs and can confirm that they were all just open, although in my opinion the tension appeared to be less than I would expect. An instrument survey of the boom face at 0.3 above water level, at water level and at 0.8 below water level was then undertaken.

A different member of the manufacturer's staff was then asked to inspect the ropes and adjust the tensions if necessary. This resulted an a small additional tension being applied to each rope. Again, I inspected the springs. In this case they appeared to me to be close to the upper limit of load which should be applied.

The instrument survey was then repeated. The results are shown in the following diagram.

Results

Significant movement occurred between the two sets of tensions. The results also produced an unexpected extra source of distortion.

The maximum change recorded between the two tension settings was 5 millimetres.

Marginal movement occurred at each end of the boom. The end pins have a small amount of clearance in the sockets, but the first measuring points on the boom are set some ½ metre inboard of the pins, so slight movement would be expected.

What was unexpected is that the bottom of the boom did not distort in the same way as the top, but adopted a scallop shape: three shallow arcs forming. These positions are marked as A and B on the diagram. With the pool full of water this has not been investigated on site, but inspection of the data suggests that the structure of the boom may well have snagged on slightly uneven tiles to the top surface of the boom rest upstand. This would have retained the base of the boom at the points A and B (note that these are below lane rope positions). The loading of the boom top would then have induced the observed shapes.

Diagram of changes

Deflection caused by change in lane rope tension between upper and lower load limits

(Boom pin centres approx 21½ metres)

300mm above WL	-2	-3	-4	-4	-4	-5	-3	-4	-4	-4	-4	-3	-3	-3	-3	-2	-1	300mm above WL
WL	-1	-2	-4	-3	-4	-4	-4	-4	-4	-4	-4	-4	-3	-3	-2	-2	-1	WL
800mm below WL	-2	-2	-3	-4	-5	-3	-2	-3	-3	-3	-4	-2	0	-2	-2	-1	0	800mm below WL
							B						A					

8 7 6 5 4 3 2 1

Provisional conclusion

Lane rope tension is critical to the length of course when a movable boom is in use. The adjustment of the lane ropes to an appropriate tension is not straightforward and there does not appear to be any absolute definition of that tension. In any case, the ropes are installed and tensioned by pool operating staff, not by qualified engineers, so it is unlikely in practice that any close control of the rope tensions is possible.

Consideration should be given to requiring the boom face to be aligned to a straight line (which would be a certified line) by adjusting the lane rope tensions to bring the boom face to that line. This could be achieved by a visible laser device fitted to attachments built into the boom and intermediate points fitted in a similar manner.

Such a system would have the advantage that the correct positioning of the boom would be immediately obvious and would enable quick checks to be made at any time during competitions. It would not depend upon a measuring laser device, just an alignment.

Existing booms are unlikely to have been constructed with a built-in deflection to allow for lane rope tension. If constructed as straight booms, the lane rope loads will place the boom into tension, rather than compression and I would expect the subsequent distortion changes to be higher than those found on this test.