Construction News: Horse 'monorail' targets training revolution

11 January, 2017

By Paul Thompson

The training track sits in an Area of Outstanding Natural Beauty

It will be the first of its type built in the UK

The cars each accommodate two horses and are hung from a central steel rail with a guide beam either side

The cars are hung from the centre steel rail with the outside steel beams working as guide beams

A trainer’s cabin follows the horse cars and will enable them to assess performance

The steel frame for the track supports the roof as well as the horse ‘cars’

The cars are suspended from a steel running track beneath the cross beam

At its deepest the track has been cut 2.5 m into existing ground level

Contractor faces once-in-a-lifetime challenge to deliver a futuristic scheme that could revolutionise UK racehorse training.

Scheme: Kingwood Stud Equine Training Track
Client: Kurt Systems UK
Architect: Sutton Griffin, part of Carter Jonas
Main contractor: Raymond Brown
Drive cabin/running gear supplier: Mack Rides
Horse cars supplier: Revolve Technologies
Contract value:£4.9m
Overall development value:£10m
Start date: October 2015
Completion date: Q1 2017

For those with an interest in horseracing, the area of west Berkshire around the pretty village of Lambourn is revered as one of the country's main centres for thoroughbred training.

Labelled 'The Valley of the Racehorse', there are more than 1,500 stables in the area and almost everyone in the village is involved in racing in one way or another.

The Kingwood Stud, owned by Turkish businessman Mehmet Kurt, is situated just outside Lambourn and is an enterprise typical to the area.

Stud with a difference

It doesn't look like a centre for innovation, but in a highly conservative industry, the Kingwood Stud most certainly is. Here, Hampshire-based contractor Raymond Brown has been busy working on a project aimed at further elevating racehorse training from fine art to science.

It is installing a covered 1.2 km-long artificial-surface training circuit. Nothing unusual in that you might think, but this circuit features a monorail hung training system which sees horses harnessed into specially designed 'cars', which travel the track as part of a train.

At the rear of this train, a drive cabin sets the pace and is full of trainers monitoring hi-tech feedback on every aspect of the horse's performance without the need for jockeys.

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Ian Blake, Sutton Griffin

To the casual observer it looks like a very staid roller coaster. It may be unsurprising then that the company brought in to install the monorail, drive cabin and undercarriage for the cars is German rollercoaster specialist Mack Rides.

The cars have been designed by Essex-based automotive engineer Revolve Technologies. They are capable of speeds of more than 48 kph as they travel around the circuit and enable trainers and scientists to monitor every aspect of the horse's development in a controlled environment.

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The cars each accommodate two horses and are hung from a central steel rail with a guide beam either side.

"It is about taking some of the guesswork out of training and taking a more scientific approach," says Ian Blake, director at Newbury-based architect Sutton Griffin. "The new system will enable the training team to take a detailed look at the horses they have and develop training regimes specifically suited to each."

His firm was contacted out of the blue by client Kurt Systems UK – an equine training vehicle specialist – in late 2011 and asked about designing and delivering the innovative project.

Sympathetic design

"It was a complete surprise. We knew immediately it would be a challenge," he says. "The development is in an Area of Outstanding Natural Beauty and there are plenty of public footpaths that cut through the land, so we had to come up with a scheme that would be as sympathetic as possible to the landscape surrounding it."

In fact there have been several alterations the team has had to make to get the project through the planning process. These included scaling back the circumference of the oval track from the initially proposed 1.5 km down to 1.2 km, camouflaging the roof as much as possible, and a wide-ranging landscaping and tree-planting regime.

Planning hurdles

The horseracing industry pumps huge amounts of cash into the economy around this part of the UK.

So fundamental is the industry to the area's wellbeing, local authority West Berkshire Council has a planning officer devoted specifically to dealing with the racing sector.

At Kingwood Stud the new training circuit sits in an Area of Outstanding Natural Beauty. But with a few changes to the initial design and the imposition of some planning clauses, the team managed to clear the first hurdle.

"Permission was finally granted in February 2013. The consultation process took a very long time and went to a very high level," Mr Blake says.

"It is against policy to build in AONB and it skirts an ancient woodland. There are footpaths around and through the site. We changed the length of the circuit, camouflaged the roof, kept height to a minimum, temporarily rerouted footpaths and have a landscaping regime that includes planting 15,000 trees.

"There is also a clause in the permission that says the whole track has to be dismantled if it is not used."

For Raymond Brown senior project manager Ben Alford, the challenges of constructing the UK's first system of this type are far from conventional. "We usually work on civils and marine engineering projects, so this has been a very different test for us, but one that we have risen to and enjoyed."

The site falls from north to south, with the track being cut about 2.5 m into the ground at the northernmost curve and sitting on a slight embankment at its southern tip. The two 300 m-long curved sections of the track are linked to similarly sized 300 m-long straights.

"Tests showed it could be bearing material, but once moved it became a paste"

Ben Alford, Raymond Brown

Making it level would have meant areas sitting on embankments of as much as 1.5 m – potentially causing more issues with planning and certainly requiring fill to be imported.

Poor compaction reaction

Poor weather conditions and the clayey nature of the ground have caused some concern as construction has progressed. The material had become wet, and although tests said it should compact to the required bearing, the site team was unconvinced.

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“Tests showed it could be bearing material, but once moved it became a paste,” Mr Alford explains. “In the long term we knew it would dry out, but we couldn’t guarantee how long that would take.”

In an effort to create some certainty, the team elected to carry out lime stabilisation work around the track bed, mixing cementitious material with the existing ground to boost its strength. “We were looking for a 5 per cent bearing capacity, but CBR tests after the stabilisation showed we had reached around 30 per cent,” Mr Alford says.

The roof and frame of the system are effectively a series of portal frames repeated around the full 1.2 km of the course and a further section of sidings where horses are fitted into the training cars. There are around 200 portal frames in all. These are constructed using 355 mm-diameter, 10 mm-thick CHS steel columns coupled with 400 x 200 x 8 mm RHS beams. Each frame straddles the track with the columns set at 7 m centres.

Given the nature of the loads being transferred through the steelwork (see box), the wall thickness of the columns in particular has increased over those that might normally be used. “They are much thicker than you would expect,” says Sutton Griffin director Simon Turl. “If we had used sections with a standard wall thickness we would have required a much larger-diameter column to give us the same load bearing capability.”

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Those columns are fixed into mass concrete pad foundations using 600 mm bolts. These pads each feature 2 cu m of concrete – their large size negating the need for any ground beams.

The track itself will feature a 150 mm-thick layer of artificial, all-weather running material, which is a mixture of small cotton strips saturated in an oily wax and mixed with sand and fine aggregate. This will be the final hurdle before the track is ready for the off.

And with the Royal Veterinary College apparently interested in using the Kingwood Stud's facility for research purposes, it might not be long before the sport of kings becomes the sport of scientists.

Frame strain

Although the structure of the roof is based around a simple portal frame design, the loading on that frame – particularly as it travels around the track's curves – became anything but simple.

With each car bogey weighing 1.7 tonnes and each car a further 2 tonnes, there are large loads passing through the frame. "The standard design loading of wind and snow is nothing out of the ordinary here, but there are issues of lateral restraint where the car is braking and cornering, hence the large foundations," Mr Blake explains.

There are also complications thanks to the expansion and contraction of the monorail track itself. It expands by as much as 300 mm over its full length; this movement is broken down and distributed through each individual length of frame, ensuring a smooth and safe ride.