A maintenance revolution for the UK - update

Plasser UK's Mark Simmons details the latest on the Robel Mobile Maintenance System for Network Rail.

Since the update in the last issue of *Rail Infrastructure*, when Robel got the first Mobile Maintenance System (MMS) back following Network Rail's training, the commissioning staff have not had too much time with the machine. That would seem strange except that - during a visit to the Plasser & Theurer factory in Linz for another project - I had a strange sense of déjà vu. As pictured right, peeking out behind the wall of the entrance to the shipyard in Linz was the Robel MMS!

The reason for this slightly surreal juxtaposition is that the machine had to have its approvals testing done - static and ride testing. Ride testing is carried out in Austria on a routinely measured stretch of track between Salzburg and Linz - Salzburg is only a very short trip across the German/Austrian border from Freilassing where the Robel factory is situated. Conveniently, the Plasser & Theurer factory at Linz also has all the facilities in place for the static testing required.

Static tests

The approval testing of the MMS covers the following static tests:

- **Twist test**
  - Check wheel loading at different values of bogie twist.
  - To determine the dQ/Q - used in vehicle modelling.

Jacks are applied under each wheel (or for convenience axle box). Each is raised and lowered individually and for each position all the individual wheel loadings on the track are measured. This allows you to determine how the suspension system handles twist and, specifically, the point at which the twist causes a wheel to unload.

- **Bogie rotation test**
  - To determine that the bogie can rotate as required without any fouling or pulling any hoses or cables etc.
  - To determine the force required to rotate the bogie at specific speeds.

The machine is positioned with the bogie to be tested over a small turntable in the track. The turntable is fitted with sensors to measure the force required to turn it and a control system to turn at a specific programmed speed. Turning the bogie relative to the vehicle frame to the maximum extent required for the curve the vehicle is rated to travel over, allows a visual check to ensure there are no restrictions to the movement. Testing the force required to turn the bogie relative to the frame at the specified speeds allows a chart to be produced - from which a value can be calculated - named X-factor. This describes how the machine handles curves. If it is too stiff, it may potentially not follow the curve quickly enough and could derail. If it turns too freely, small changes will result in movement which could lead to hunting - which can be unpleasant.

The bogie rotation and twist test help to confirm in principle that the vehicle will be able to negotiate the specified track features (twists and curves etc), but are also carried out with some additional measurements and used in the initial validation of the vehicle simulation model.

- **Parking brake**
  - To determine that the machine, when parked, will hold on the required gradient.

As the gradients required are the steepest on the UK network, they are not available at the factory. This test is therefore carried out by applying the parking brake, then connecting a locomotive to the vehicle with a force transducer in the coupling. The locomotive attempts to haul the vehicle with the parking brake applied and the force transducer measures the force at which the vehicle begins to move, or if it does not move the maximum force applied. From this test the gradient that would produce such a force can be determined by calculation.

- **Holding brake**
  - To check that when pulling off while on a hill, the machine will hold on the gradient until the traction force has taken over.

The test is the same as the parking brake, but with the standard brake system active at the pressure at which holding occurs.

- **Braking curves (normal and slow speeds)**
  - To check that when brakes are applied at different travelling speeds, the machine stops within the required distance.

The machine is run at the specified speed and the brakes applied. Stopping distance is measured for each speed and then corrected for the gradient on which the test was carried out and these matched to specific curves in the group standards.

- **Working mode light barrier braking**

Unusually with the MMS, in working mode, there are people on the ground between the two bogies of the MMU. In this mode, the machine's speed is limited to a maximum of 2kph. However, even at this speed, a

Left: Bogie rotation testing on the MMS.

Left: Further bogie rotation testing in Linz.

vehicle of this mass takes some distance to stop (a little short of one metre). The machine is set-up with light barriers at a position of one metre in front of the steps. If an object breaks the barrier (for example a person working in the MMU), the brakes are applied immediately and the vehicle stops before the steps would hit the person. Naturally, it is vital that this is proved to be accurately set-up.

Dynamic tests

As mentioned earlier, dynamic testing is carried out on the OBB network between Linz and Salzburg. This covers:

- **Noise and vibration testing**

Noise and vibration at full speed and in working mode. This is both to ensure that staff are not exposed to too much noise or vibration during a working shift, but additional measurements were taken to allow tests to be carried out in the UK to prove that detonators placed on the track (to indicate a worksite) can be heard in the driving cab even at full speed. Placing detonators is only used in the UK and, in fact, is not allowed in Germany, so this test can only be carried out in Britain.

Microphones and accelerometers are placed at various positions occupied by staff around the machine.

- **Dynamic ride testing**
  - To prove the vehicles riding behaviour remains within the allowed characteristics.

Accelerometers are positioned at key locations around the vehicle to measure how the various parts of the vehicle move on different track stretches.

In order to avoid the risks to cost and project timing that would result if ride testing would have to be carried out in the UK, standards permit that the vehicle can be modelled in a dynamics simulation package. Robel, in conjunction with Interfleet, uses VAMPIRE although there are other accepted packages available.

The model is used to predict the behaviour of the machine; initially, during the twist and X-factor tests and then during the ride test - which is why it is so important that this test is carried out on a regularly measured track, as the track detail is also entered into the simulation package. Once the model can accurately predict how the machine will behave, it is considered validated and can be used then to predict how the machine will ride in the UK.

Early indications from all results are that the MMS has passed all its tests - although the VAMPIRE model validation and UK ride prediction is still ongoing.

Final stages

The first MMS has now travelled back to Robel for the commissioning team to get a brief hands-on before progress meeting number 12. This took place in Freilassing during the last week of May, once again giving Network Rail, Colas Rail, Plasser UK and the Independent Safety Advisor (ISA) for the working mode element of the project - Lloyds Register Rail (now Ricardo Rail) - another chance to check it over.

Robel has recorded over 200 visitors who have come to see the machine during its build and commissioning and the machine is due very shortly to transit to the UK for final test, commissioning and training at Plasser UK before it moves up to its home at Darlington. I expect it will be welcoming many more visitors before it even begins its first shifts!