Manual Corrugation Measurement: bi-CAT

bi-CAT

RailMeasurement's **bi-CAT** (Corrugation Analysis Trolley for two rails) has been developed so that a single operator can measure irregularities at walking speed on two rails simultaneously. The instrument is based closely on RailMeasurement's CAT and has similarly excellent technical performance.
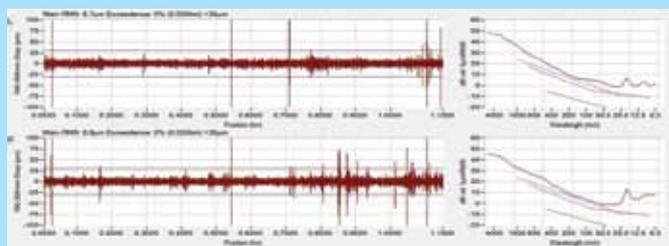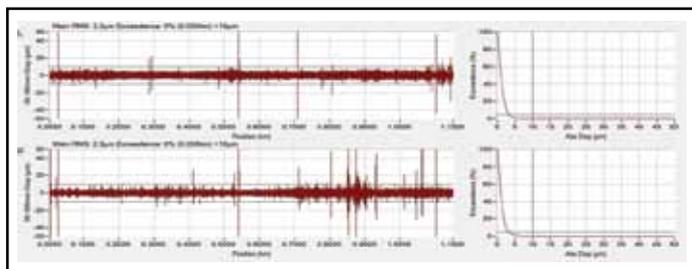

bi-CAT in use. The equipment is used by a single operator and is suitable for both conventional flat-bottomed and embedded rails.

As is the case with RailMeasurement's CAT, the bi-CAT is typically used at a steady walking speed of about 3.6km/h. The equipment is powered by a USB lead to a laptop computer, so only the laptop needs to be charged to run the equipment. The bi-CAT is packed in a convenient wheeled instrument case and the frame collapses into the equivalent of a ski-pole bag, which is easily slung over a shoulder. The equipment in total weighs about 29kg and can be transported and used by a single person.

The bi-CAT uses the same technology as RailMeasurement's CAT to measure irregularities on the rail. The equipment is also calibrated in the same way. The repeatability and accuracy of the bi-CAT is therefore identical to that of the CAT.

A measurement of over 1km of a metro line after grinding. The grinding site has been reprofiled well within the requirements of EN13231-3:2012 in the 30-100mm and 100-300mm wavelength ranges shown (0% exceedence in both wavelength ranges on both rails). The one-third octave spectra (lower graph, right-hand-side) show that irregularities exceed the limit for "smooth rail" in EN15610:2009. This is primarily because of the shorter wavelength (<30mm) irregularities that are left by conventional grinding, and in particular the periodicity that exists because of the so-called "grinding signature". Evidence of this is the peak in the one-third octave spectra of rail roughness at a wavelength of 20mm.

The measurement was made by a single operator in 20 minutes: an average speed of over 3.3km/h.

The bi-CAT equipment and software have been developed over a couple of decades to cater for the needs of many different types of users. Although it is useful to have this diversity of applications, some users would prefer simpler and more straightforward software, so they can go straight to the task in hand. To this end, the bi-CAT software now has modes for an "expert" and "standard" user. The former includes the ability to change all parameters, whereas the latter has reduced functionality e.g. the system setup settings cannot be changed and a standard analysis is undertaken on measurements.

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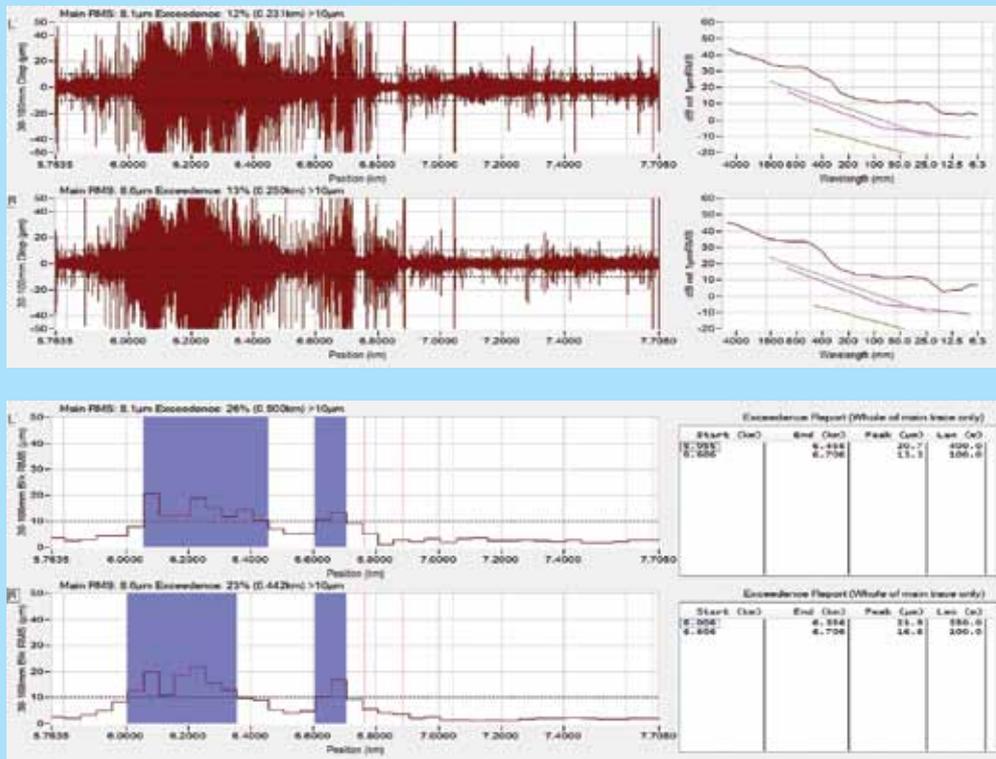
bi-CAT records from about 1.3km of a light rail line. In the upper graphs, the "filtered displacements" are shown in the 30-100mm wavelength range, together with the one-third octave spectra. These show two broad wavelength ranges of corrugation, at about 40mm and 500mm. In the lower graphs the same measurements have been processed in a manner that highlights areas that should be prioritised for grinding: about 550m overall or 28% of this section.

Bi-CATs can be purchased or hired from RailMeasurement Ltd. The equipment is supplied with a full suite of review software that can be applied to many uses including quality assurance of rail grinding, acoustics work and prioritisation of reprofiling. We also provide a service to undertake corrugation surveys and measurements to EN15610:2009 / EN ISO3095:2013. Please contact us to discuss your requirements.

Technical Data: bi-CAT			
interval at which data are saved	1mm or 2mm	Output compatible with requirements of	• EN 13231-3:2006 and 2012 • EN ISO 3095:2013 • EN 15610:2009
Measuring speed (within +/-25%)	• 0.5m/s (1mm interval) • 1m/s (2mm interval)	Output	• raw and filtered displacements • moving average amplitudes (RMS and peak-to-peak) • percentage exceedences • one-third octave spectra • exceedence reports (to assist grinding) • ASCII data • PDF reports • graphs to cut-and-paste directly in reports
Precision of measurements (displacement)	0.01μm		
Data storage requirements	< 4MB per kilometre of track		
Accuracy (measurement of 2.5m calibration beam)	Better than • 0.2μm RMS 10-30mm • 0.5μm RMS 30-100mm • 2.0μm RMS 100-300mm	Filters, built-in	• 10-30mm, 30-100mm, 100-300mm, 300-1000mm, 1000-3000mm • 30-300mm, 300-3000mm • 30-150mm, 150-1500mm • 150-1000mm, 1000-1500mm
Options	• measurement of track with different gauge • training course	Weight	• 23kg in carrying case • additional 6kg for poles

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