Future possibilities for the handling of LWR in the UK

Andrew Keens, Track Consultant, AJK Rail, details the equipment Robel has developed and its worldwide use.

Take a train journey in the UK, look out of the window at the adjacent track and it will not be long before you see long strings of scrap rail waiting for recovery. Modern track renewal systems have revolutionised the capability to relay track with greater productivity than ever before, but this has left a problem - a backlog of scrap rail to recover. This issue is not just a case of the trackside looking untidy. Long Welded Rail (LWR) strings obstruct and hamper maintenance activities and can present a significant safety risk. An unrestrained rail string can gradually migrate on gradients, particularly in hot weather, becoming wedged against obstacles, damaging lineside equipment and, in extreme cases, presenting a risk to the running line.

So, is the current capability to manage the recovery of long welded rail sufficient in the UK? I spoke to a Network Rail Works Delivery Project Manager (Track) to better understand the situation. He explained: 'There is currently no effective method of removing scrap rail other than to resort to the use of Road/Rail Vehicles (RRVs), cropping rail into short lengths, loading on to trailers and moving to access points for road recovery. This process is not only inefficient and expensive, typically costing between £15-£20 per metre of rail to recover, but also removes the opportunity to recover and cascade serviceable rail to secondary routes. In previous years, conventional track renewal methods removed the scrap rail as part of the process. However, with the new high output track relaying train, the old rail is left on-site and there is the challenge of collecting it.'

It is clear there is currently not the fleet to deliver and recover rail to the required volumes. So, now is the time to review the processes of long welded rail management in the UK and look to the latest developments in rail delivery, exchange and recovery from around the world to maximise production, safety and efficiency savings.

I recently had the opportunity to talk to the technical team at Robel - a world leader in long welded rail delivery, exchange and recovery, with over 50 years' experience and many rail trains delivered worldwide - to gain an understanding of the work processes and the latest development in rail management.

Robel rail delivery train working with the adjacent line open to traffic.

The drive for safety and efficiency in the new rail train

The latest designs of rail trains are driven by the customers' desire to improve operational safety, production and efficiency, and this applies to all three main elements of the train - namely, the rail manipulator, chute wagon and transport system.

Production capabilities.

A modern rail train system can typically deliver a pair of 180 metre rails in two minutes and recover in four minutes. That is approximately 2,700 metres of rail pairs per hour! The system can manage up to 50 x 500 metre rail lengths, depending on the gauging envelope, and a full range of rail sections up to 70kg/m.

Safety features.

Modern rail train designs focus on minimising manual intervention and keeping rail and operator separate with all functions coordinated by radio remote control by an operator from a safe distance.

The chute wagon set typically consists of two specialised wagons with channels for rail positioning. Two rails can be handled simultaneously, unloading to either the trackside or centre. An integrated rail feeder on the chute wagon allows a fully automated remote controlled set-up and feed of the rail to assist the offloading process. Universal roller heads prevent tilting during manipulation in tight radii down to 180 metres with high super elevations which avoids the need for additional manual work. During rail delivery and collection, the yield and bending stresses are not exceeded, which mean the rail is kept in excellent serviceable condition.

The rail manipulator is a self-powered gantry vehicle which runs on rails mounted on the outer edge of the transport wagons and can run the full length of the rail train. It has two hydraulic rail clamps on the end of articulated booms for holding rails. The rail manipulator turning and securing (for transport) has also been automated to ensure minimal manual intervention and fast set-up and lock-down times. Slew limiters are fitted on the rail manipulator booms to permit adjacent line open and rail handling under live overhead line. Sensors are

The train's manipulator unloading rail (above) and inside its cabin (right).

Above: Rear view from the manipulator showing the long welded rail strings on the train's wagons.

Below: Rail delivery from the end wagon of the train showing the resilience chutes (in yellow).

fitted in the operator seat to prevent uncontrolled movements of the boom when the seat is unmanned. Cameras are also employed to monitor the rear loading area and provide full control of the working process from the cabin.

The transport wagons are normally constructed from modified standard or container flatbed wagons with roller gates to house the rail and two running rails fixed to the outer edges to support the rail manipulator. At least one of the transport wagons will have a clamping system for securing rail strings during transit. New designs of rail train incorporate automated roller gates and clamping systems which prevent any requirement for staff working at height and/or to walk on rails, the main cause of serious injuries to staff during rail delivery operations. All roller gate and clamping operations can be controlled from either side of the train in a position of full safety to permit both adjacent line working and working under live overhead opportunities.

Operational cost reduction, efficiency savings and return on investment.

With rapid set-up and lock-down times and fast offload and load rates, the processing of rail is maximised and possession times minimised. The time and expense of isolations is avoided and, with adjacent line open options, less train disruption and greater midweek work opportunity is possible.

On the latest rail trains, just three operators are required. One for the chute wagon and normally two for the rail manipulator. Using the cutting-edge rail train technology, Robel can show a rail recovery unit rate of £8 per metre, a 50% reduction in unit rate when compared to current processes using RRVs.

Probably the most significant saving associated with the rail train is the potential to recover and cascade serviceable rail to secondary routes. New rail costs £50 per metre. If just a small percentage of the annual volume of rail generated from the high output system (approximately 200 rail km per year, currently cut and scrapped) can be safely recovered and cascaded, the benefits could be enormous and generate a fast return on investment.

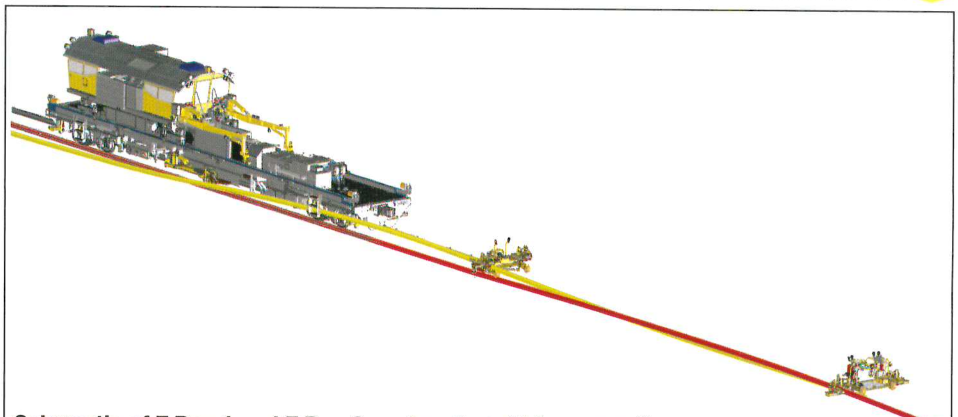
To gain a greater understanding on how these developments have been implemented, I was given an insight into a recent Japanese rail train project delivered by Robel in cooperation with Plasser & Theurer.

Shinkansen Rail Delivery, Exchange and Recovery Project

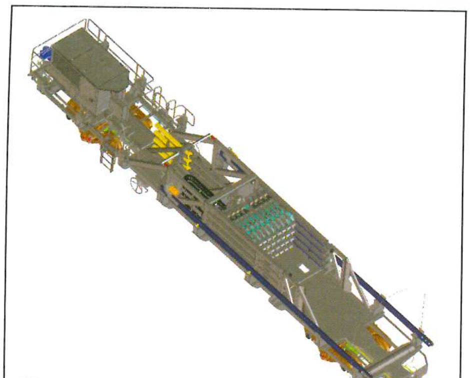
The changing demands of customer requirements, country-specific regulations and differing railway design and environment, mean that no two rail train systems are ever alike. One example of this is the rail delivery, exchange and recovery system that Robel and Plasser & Theurer designed and built for the Shinkansen Rail network in Japan. By joining the components delivered by both companies, a custom-made system solution with considerable additional benefit was reached.

The challenge for this project was to develop a rail delivery, exchange (including stressing and welding) and recovery process capable of renewing 1,200 metres of rails in two four-hour possessions. A joint venture between Plasser Nippon, Robel and Plasser & Theurer developed a self-propelled rail delivery system with integrated flash-butt welding capability and two specialised rail exchange trolleys to automate and synchronise the rail renewal process. The train consists of a standard PCU power and control unit car, a second power car (fitted with two cabs for bidirectional working) with an integrated robotic mobile flash-butt welding unit APT-1500RA, transport wagon set, rail manipulator and a self-propelled chute wagon with rail positioning units. The transport wagon set consists of six standard transport wagons, a length compensation wagon, a clamping wagon and an end wagon with integrated turntable for rotating the rail manipulator. In total, the transport system is designed to carry twenty 150m rail strings and run self-propelled up to speeds of 70km/h.

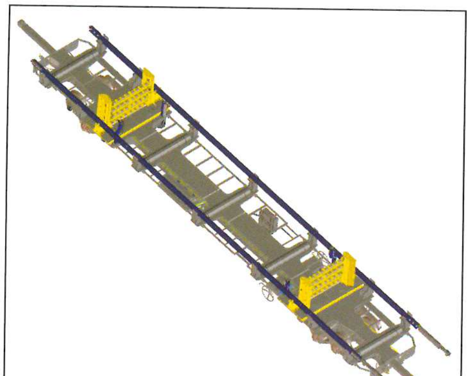
The working process starts with the offloading of the 150m rail strings. The APT-1500RA mobile flash-butt welding system is disconnected from the chute wagon, the rails are unclamped and the rail manipulator employed to take rails in pairs from the transport wagon to the chute wagon. From the chute wagon, the rails are carefully fed to the trackside and, as the train then pulls away, the rail strings are offloaded. The offloading cycle takes three minutes per 150 metre rail pair. Rails are connected with universal fishplates which are then removed just before welding the rails together. Once the first



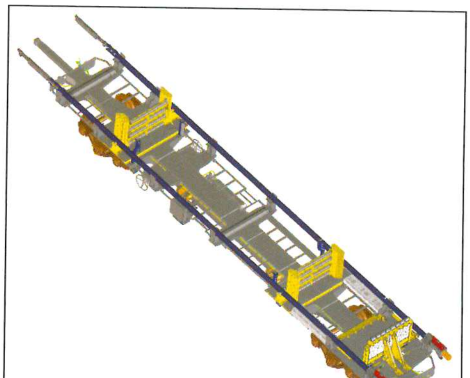
Schematic of T-Rex 1 and T-Rex 2 exchanging old for new rail.



Clamping wagon.



Length compensation wagon.



End transport wagon.

pair has been offloaded, the APT mobile flash-butt welding system can then follow through and flash-butt weld the rails into one long string. The set-up time for the flash-butt welder is five minutes and the production rate is 13 minutes per pair of joints.

Whilst the flash-butt welding takes place, the PCU power car, together with the transport system, chute wagon and rail manipulator, continues to offload the remaining pairs of rails. When offloading is complete, the rail train then moves 1,200 metres and is deployed to pick up the scrap rail strings from the previous night shift. The old rails are pre-cut into 150 metre lengths and then uploaded at a rate of four minutes per 150 metre rail pair. The rail manipulator is used to position rails through the chute wagon and on to the transport system. Then, whilst the rail manipulator maintains a stationary position holding the rail, the PCU power car propels the transport system and loads the old rail. When all the rails have been loaded, the clamping wagon is used to secure the load ready for the return to depot.

On the second four-hour shift, the REX1200 system is deployed to exchange the old for new rail. The exchange system consists of two rail-mounted threading machines coupled together and propelled via linkage to the self-propelled chute wagon. The new rail is installed using positioning arms mounted on the chute wagon which, in turn, feeds into the trolley for Exchange 1 (T-Rex 1) which lays the rail on to the sleepers. T-Rex 2 runs on the newly-installed rail and turns out the old rail. The system takes approximately 15 minutes to set-up and can then rail exchange at 3km/h or around 30 minutes to exchange the 1,200 metre pair of rails. To dismantle and secure the exchange system for transit, takes a further 15 minutes.

Finally, the APT-1500RA power car follows up and completes the re-railing process with the last closure welding and stressing. To avoid hot tears, the weld and hold cycle for these stressing welds takes 15 minutes each.

In summary

The UK rail industry has a huge opportunity to explore new rail management technology to greatly improve lineside safety and efficiency improvements in rail recovery and recycling. The Shinkansen project demonstrates that the expertise and technology exists, not only to deliver but also to exchange and recover rail with safe and efficient working methods. The process really focuses on maximising safety by keeping staff and rail handling separate with remote control rail handling, automatic roller gates and clamping systems.

Efficiency savings can be explored with the potential for working midweek nights with adjacent line open and under live overheads. With improved access opportunity and higher production rates, modern rail train systems can help to manage the level of scrap rail, therefore greatly improving lineside safety and, with careful recovery, the potential is also there to make huge efficiency savings by cascading this rail.