Mega train manufacturing ramps up in Dunnottar

On Thursday, 25 October 2018, South African President Cyril Ramaphosa officially opened Gibela's train manufacturing plant in Dunnottar, east of Gauteng. *MechChem Africa* talks to systems integrator, David Blackwood of DESign about the modern systems installed to ensure high integrity fabrication.

Gibela's flagship Dunnottar train manufacturing plant in Ekurhuleni, Gauteng, was officially opened by Cyril Ramaphosa last month. The first of its kind on the continent, over the next 10 years, this facility will construct 580 Alstom X'Trapolis Mega commuter trains.

The X'trapolis Mega is designed to be compatible with South Africa's Cape gauge and, by virtue of its light-weight stainless steel construction and the use of modern inverter-based drives with regenerative braking, is 31% more energy efficient than its predecessors.

Gibela's 53 000 m^2 green field plant is spread over a 78 ha site and was built at a cost of R1-billion. Its manufacturing workshops, covering 33 000 m^2, are designed in a modular format to facilitate lean manufacturing and, at peak production by the end of 2020, two cars a day, one and a half trains a week and 62 trains a year will be produced.

At the official opening, Gibela CEO, Thierry Darthout, said that the world-class plant features advanced manufacturing innovations involving 250 linked industrial activities and the assembly of at least 10 000 parts. Notable innovations include:

- A drawbench for shaping 5.0 mm stainless steel that can pull 22 m long side sill profiles and fabricate roof corrugations and various stiffeners for the train.
- Seven-axis Yaskawa MOTOMAN robotic welding systems installed to work in otherwise hard-to-reach welding places.
- Mechanical and electrical rotating fixtures for improved ergonomics and increased speed.
- A scissor lift table to replace overhead cranes, eliminating safety risks during installation while increasing efficiency and accuracy.

"We are immensely proud of what we have achieved and we commit to delivering trains to PRASA that will both improve the lives of South Africans and provide a valuable platform for South Africa's industrial rebirth," said Darthout in the presence of President Ramaphosa.

The Cathedral or main framing line at the flagship Gibela Dunnottar train-manufacturing plant, where the under-body, end-frames, roof and sidewalls are loaded together and framed to complete the shell.

The car body shell assembly area

David Blackwood of DESign, the systems integrator for Gibela's car body shell workshop, says that the construction of a train body shell is not dissimilar to that of a motorcar. "A train body structure is made up of an under-frame, body-sides or sidewalls, a roof, end-frames and closures such as windows and doors.

"What we do is to design and manufacture the tooling jigs and the infrastructure to allow OEMs to produce the sub-assemblies and build these into completed rail or car bodies. The under-frame, for example, is made up of a front, centre and rear floor, which are manufactured in smaller jigs and welded together before being loaded into the under-body complete jig. Once welded, the floor gets moved into the main framing line, where the complete side walls and roof – which will have also been welded as sub-assemblies in their own purpose built jigs – are loaded, clamped and accurately positioned to give the final geometry.

"In broad terms, we are responsible for the infrastructure that puts the sheet metal shell of the passenger trains together for Gibela and we provide the tooling, technology and the infrastructure to do that," Blackwood tells *MechChem Africa*.

Describing a typical sub-assembly area, he says that components welded in the body shell workshop area of the plant are typically loaded into jigs and manually spot- or MIG-welded by station operators. "Gibela chose resistance spot welding guns from Nash in India for the plant, based on their successful use in Alstom's Sri City plant in India as well as the Lapa plant in Brazil," says Blackwood.

"In Gibela's body shell main sub-assembly area, there is an under-frame, sidewall, end-frame, roof and letter-board welding assembly area, which, from a welding perspective, relies on manual and robot spot welding for the assembly.

"The main framing lines, called cathedrals because of the height of the tooling and structural steelwork, are most impressive," he continues.

After the car under frame and roof have been loaded, moving framing gates are used to enable the side-walls to be loaded before moving them into position. Assembly involves a complex piece of welding equipment that uses a double spot welding system developed by DESign in conjunction with Nash.

The system moves down the right and left sides of the car under servomotor control, welding both sides simultaneously giving excellent positioning accuracy and repeatability, which in turn improves cycle times," Blackwood explains.

There are two main framing lines, each equipped with four Yaskawa MOTOMAN MH600 robots, which have a massive 600 kg payload for carrying the custom-designed robotic welding guns along the 60 m lengths of each side of the train.

Supplied by Yaskawa Southern Africa, these eight MOTOMAN robots are among the largest ever supplied into South Africa. They have a payload of 600 kg and a reach of 2.942 m and are especially suited to handling large and heavy work pieces or tools. The robots themselves offer 6-axis control and a repeatability of within 0.3 mm across their working range.

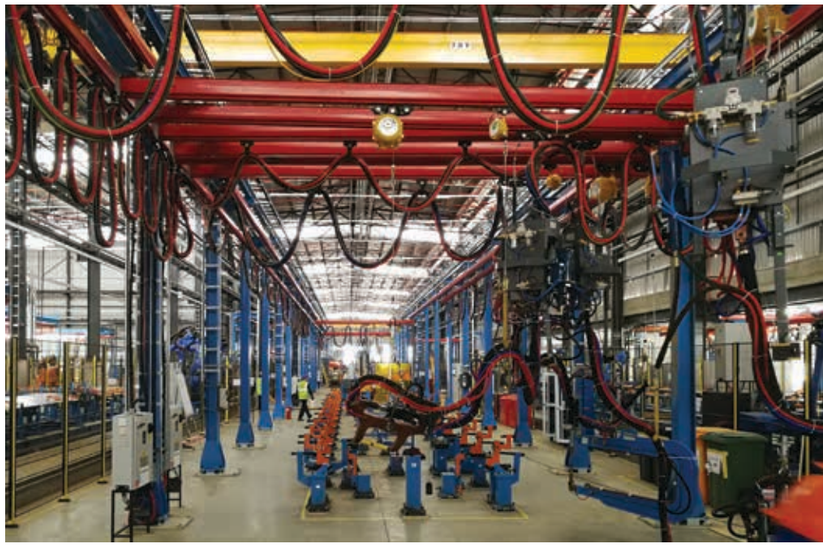
The seventh axis is achieved using Yaskawa's TSL-4000 high-performance servo powered floor-mounted tracks, which have a maximum payload of 4 000 kg and a maximum speed of 1.8 m/s. These are used to transport the robots up each of the 60 m sides of the two cathedral lines.

Blackwood continues: "The plant operates a good balance between automated and manual welding, with most of the sub assembly welds being manually spot welded. Even the manually operated Nash welding gun weigh around 160-200 kg, however, so they are balanced on KBK overhead rail suspension systems, with Endo balancers that can be set to counter balance the welding gun weight. So the operator feels a zero net balance," he explains. "You can move these manual systems with minimal effort," he adds.

As well as the design, manufacture, supply and commissioning of the equipment for the car body shell area, DESign's scope is to commission all equipment and ensure that milestones are met by their required dates. "We provide all of the maintenance and warranty support and, if anything fails within the warranty period, we are contractually obliged to replace it.

"All of the equipment is robust and, where possible, designed to last for at least 10 years, after which we can generally do a facelift to extend the plant's useful life. As long as the overall size envelope is the same, we can even rework the jigs and fixtures to accommodate upgrades to train designs," Blackwood says.

Gibela's first Proudly South African trains will begin service in 2018 and all 580 should be completed by 2028. DESign's maintenance contract continues, however, until project completion in 2035. ❑



The Underfloor Mainline showing a Nash welding gun balanced on the KBK overhead rail suspension system.

A view of Gibela's car body shell main sub-assembly area showing the sidewall (far left), under-frame (centre); and roof/letter-board (right) welding assembly areas.