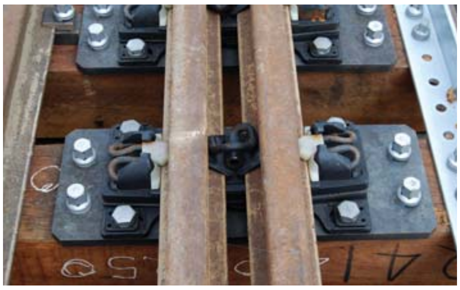
Port River Expressway Rail Bridge – Adelaide, Australia

CUSTOM DESIGNED PANDROL VIPA-SP BASEPLATE FOR DUAL-GAUGE APPLICATION.

A bascule rail bridge spanning the Port River in Adelaide, Australia was officially opened to rail traffic in June 2008. The dual-gauge track on the bridge has been installed using Pandrol VIPA-SP FASTCLIP baseplates to attenuate vibration and reduce noise from the structure in this urban location.

This was the first time that the VIPA system had been adapted for a dual-gauge configuration. Special baseplates were designed and tested by Pandrol Australia to meet the requirements for direct fixation and the track gauges of 1600mm and 1435mm. Due to space constraints, an 'e' clip was used between the two rails. Standard VIPA-SP baseplates were used on the common rail.

At specific locations, there was a requirement for the VIPA-SP baseplates to be fitted with Zero Longitudinal Restraint (ZLR) FASTCLIP fastenings to allow the rail and bridge to move independently and so minimize the stresses in both the rail and the bridge deck.



View of Dual Rail VIPA-SP Assembly with 3rd Rail Installed and 'e' clip fastening

ALIGNMENT

The track section on which the VIPA-SP baseplates have been installed is 1010m in length and consists of two curves of radius 385m (30m transition length and with 50mm superelevation), separated by a 57m tangent on the bascule bridge span. The vertical alignment has a maximum allowable rising grade of 1 in 70 (1.429%) up to the bascule section. Here it passes through a 1450m radius vertical curve on the summit before running down at a grade of 1 in 9.

View of the Bascule Rail Bridge with the adjacent Bascule Road Bridge

View of the bridge approach to the Bascule section with the mitre joint in the foreground

TRACK CONSTRUCTION

On the concrete viaduct sections, a 'top down' construction method was employed to install the track at the designed alignment. The 'Iron Horse' system was used to align and level the rails - with the VIPA-SP assemblies attached to them - before pouring epoxy grout to fix the baseplates to the concrete slab. Anchor bolts were grouted into holes drilled in the slab.

RAIL MOVEMENT JOINTS

The bridge design required four rail joints, in conjunction with the ZLR fastenings, to prevent excessive loads being transferred between the rails and the bridge due to differential thermal expansion.

Two mitre joints are provided at the bascule bridge. These were designed by CMI-Promex and feature a short length of manganese steel profiled to provide a ramp over the gap in the rails. The mitre is bolted to a machined rail web and is located during closure by guide plates that ensure alignment. Proximity switches, which are a critical control point in the bridge operating system, check vertical closure of the mitre.

A special design of lapped-mitre had to be prepared for the other two rail movement joints, because of the specified movement of 200mm and the restricted short length of tangent track in which to locate them. The lapped-mitred joint provides continuous support for each wheel across its whole operating range. The joint rails are supported and guided by rail-guides mounted on canted baseplates. These support arrangements were designed to maintain adequate track stiffness through the discontinuous rail at the joint.

View of dual rail VIPA-SP assembly on lift up bridge span without 3rd Rail

View of track on Bascule Bridge section

Iron horses used to level and align track
Prior to grouting of VIPA-SP assemblies

View of mitre joint

BASCULE BRIDGE DETAILS

The railway bascule consists of a through-steel box-girder superstructure. This was required because of the limited clearance between the top of the rail and envelope of the channel. Each is a welded steel box girder 60.5m in length, with 47.25m from bearing to bearing. The girders vary in depth from 2.9m in the main span to 4m deep through the counterweight. The deck is supported on two bascule girders.

The counterweight required to balance the rail bridge is approximately 460 tonnes. The single leaf bridge rotates about and is supported on two trunnion-shaft assemblies, one mounted in each bascule girder. Each trunnion-shaft is simply supported between two plain bronze sleeve bearings. The bridge is operated by drive machinery located beneath the track level. A 75kW (100hp) span motor has been selected to operate the span in normal conditions, through a 384:1 reduction ration gearbox. The machinery is also equipped with an 18kW (25hp) auxiliary motor that is operated by an independent electrical supply system to provide complete redundancy. In the event of an electrical supply failure, a back-up generator is located on site. The bridge-operating machinery consists of a primary reducer, which is coupled directly to the main pinion shaft. Each main pinion shaft is simply supported between two spherical roller bearings. The main pinions mesh with rack segments - which is the means by which rotation of the span is driven - mounted to the bottom flanges of the railway bascule girders. Two drum brakes, mounted on the motor shafts, provide braking for both bascule spans. To secure each span in the seated position, lock bars are driven by machinery mounted at each rest pier to a receiving socket located at the toe of each bascule. The actuator for each leaf is remotely operated during normal operation, but is also equipped with a manual hand crank for emergency operation.

View of Bascule span

FIXED BRIDGES

There are three types of fixed bridges – steel box girder with reinforced concrete deck for 60m spans over water; pre-stressed concrete box girders with concrete deck for 40m spans for high level bridge over land and pre-stressed concrete planks with concrete deck for 10m spans at low level. The bridge sits on reinforced concrete columns, which have piled foundations.

The bridges are conventional structures, with the exceptions that in order to transmit emergency braking forces to the ground, ‘lock up devices’ (LUD) are fitted to nine piers. These devices, typically used in earthquake prone areas, are silicone filled two-way pistons that have a small hole to allow gradual movement as a result of temperature changes. However, under shock loading the viscous silicone filler is unable to pass from one side of the piston to the other, effectively locking the girder to the substructure. ■