Railway Underbridge Renewal at Granville

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ABSTRACT

Over the Christmas – New Year period 2014-15, Sydney Trains Engineering staff were called on to renew a major railway underbridge at Granville. The Granville underbridge spans Parramatta Road, carries four busy rail tracks and spans four very busy lanes of road traffic. This paper outlines the role played by surveyors in the project, viz:

- *Detail surveys of the existing bridges – key structural components and surrounding topographical detail.*
- *Pre-fabrication of girders and track panels – setting out and checking of sizes and dimensions.*
- *Measuring deformation in a 'dummy' set-out situation.*
- *Abutment alterations, headstock and bearing pads installation.*
- *Installation of new bridge components.*
- *Track restoration.*

There was a short period of time available for bridge installation, and (like other field staff) the surveyors had to work to challenging deadlines, using total stations and digital levels under difficult conditions. The works were successfully completed and trains running to timetable at the planned times – due in no small part to the critical work done by the survey teams.

KEYWORDS: *Railway surveys, underbridge, deadlines, role of surveyors.*

1 INTRODUCTION

The project was to upgrade an underbridge on the Main Western Line at Granville. The existing bridge consisted of four separate structures, each continuous over two spans with a length of about 33 m. The plan was to replace the two inner superstructures, built in the 1920s, with new steel girders and retain the outer steel girders. The existing timber transoms would be replaced with pre-cast deck units, which would also be on the new girders. Complete replacement of the bearings would also be carried out. Various other works also formed part of the scope, e.g. installation of hand rails, signalling and electrical works, abutment and pier strengthening.

Conventional methodology for bridge removal and install (i.e. lift sections out and in by crane) would not work in this location as there was insufficient time to remove and replace the overhead wiring, so a new methodology was adopted: The new girders would be jacked up from underneath using hydraulic jacks that run along rails positioned on the road below (Figure 1). For this to work, the existing eastern girder had to be removed and replaced after the centre girders had been positioned.

Figure 1: The jack on its rails on Parramatta Road.

The work was carried out on 26-31 December 2014, and surveyors were required to provide 24-hour support and guidance throughout the installation process as well as prior surveys to ensure the construction process was smooth and successful. Project Surveyor was Robert Thyer under the supervision of Senior Surveyor Michael Athorn. Other key survey staff included David Lang, Matt Friend and a large team of volunteers and draftees who assisted during the closedown works.

2 DETAIL SURVEY

The design process is a long one, and the initial detail surveys were done 5-6 years prior to works being carried out. Existing plans of the bridge were typical of the time (Figure 2), and current practice required a full detail of the existing girders, abutments and piers, ballast walls, tracks, overhead wiring and overhead wiring stanchions, bearings and holding-down bolts to create a model that could be used by all affected designers.

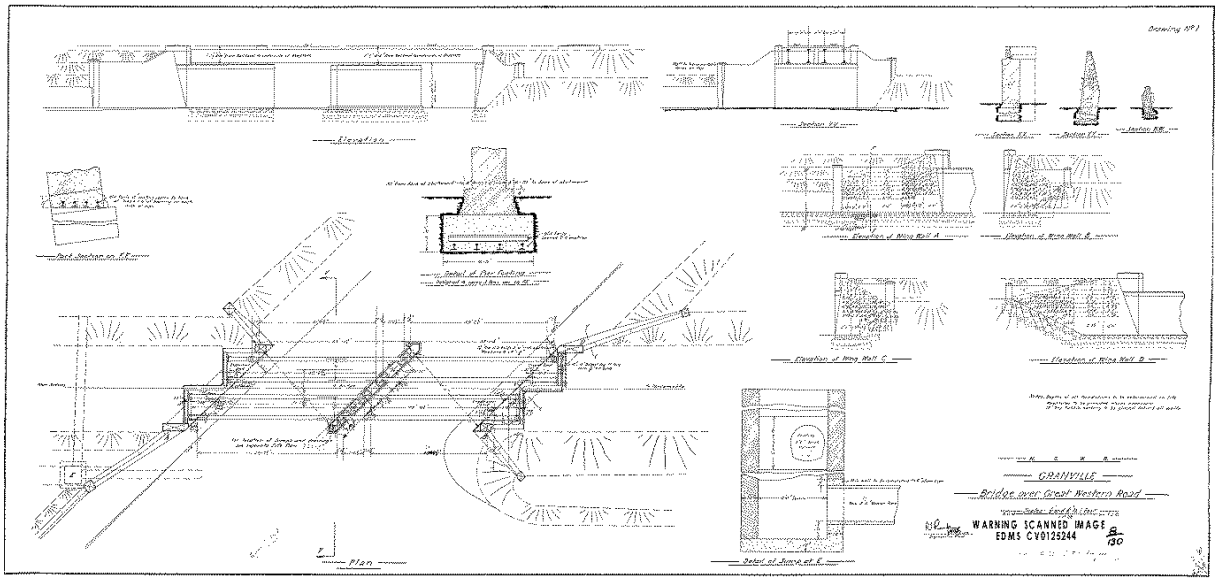

Figure 2: Old design drawing.

Track access in that area is limited, so a number of weekend possessions were needed. Parramatta Road access is even more limited, so night closures of Parramatta Road in March/April 2014 were used to get additional detail requested by the designers and to update the original survey. Current alignments in that area are related to ISG/MGA, so that was the coordinate system adopted.

3 PRE-CLOSEDOWN WORKS

As the closedown time was limited, it was necessary to complete as much of the work as possible prior to Christmas. Tasks that were completed included signal troughing lowering, OHW adjustments, erecting scaffolding and, importantly from the surveyors' point of view, strengthening of the piers and abutments. The strengthening work involved coring 36 mm by 4 m vertical penetrations into the piers and abutments and these penetrations had to be set out by the surveyors during road and rail night possessions in October/November 2014.

The bridge was actually pre-assembled, off site, prior to Christmas. The girders were positioned correctly relative to each other and the pre-cast concrete slabs installed to make sure everything fitted together. Correct positioning of the rails depended on correct positioning of the slabs and attached sleeper plates, so spending the time to get the sleeper plates correct was critical. All the girders and slabs were marked at this time to make the 'lining up' easy when installation occurred. The surveyors would be required to get the base of the girders correct for line and height and, in theory (and in practice), the slabs and track would be 'on design'.

Bridge deformation and deflection was also an issue to be addressed – not the deformation of the bridge that occurs when a train travels across it, but possible deformation (either permanent or temporary) that might occur when the girders were moved along the rails and jacked into position. The worry was that any deflection might affect the bridge ends and they may not fit into the pre-cored holes. The surveyors worked closely with the jacking contractor to simulate the proposed movement of girders (using smaller jacks) and to measure any deformation – fortunately there were no significant problems.

The surveyors also needed to set out the rails for the jacking system – the setting up of the jacking system in a timely manner was critical to the whole project. Line marks and recovery marks were placed on Parramatta Road early one Sunday morning a few weeks prior to Christmas.

4 CLOSEDOWN WORKS

The construction of the rails for the jacking mechanism started in the early hours of Boxing Day, and the survey teams successfully worked closely with the contractors to ensure the jacking mechanism was positioned to the required tolerances (Figure 3). After the existing girders were stripped down and removed and the abutments exposed (Figure 4), the surveyors were involved in marking out bearer plate locations, core holes and the beam locations in both the horizontal and vertical dimension, ready for the new girders to be brought in.

Figure 3: Mark that!

Figure 4: Removing the old girders.

Prior to the girders being introduced into position via the jacks, the pre-cast concrete segments had to be lined in and bolted down under the instruction of the surveyors – making use of the centreline marks placed on the segments during the 'dummy' build. When the girders were finally moved into position, the surveyors again were front and centre making sure the girders were positioned correctly. After the placement of each girder, the sleeper plates (about 100 on each girder) had to be levelled, packed and re-checked to ensure that the final rail level would be correct.

As each girder was installed and rails placed, it was time for the tampers to pull/lift the track to its new design. The surveyors assisted in this work by placing recovery marks using RoadRunnerRail. This work would normally be carried out prior to the closedown, but in this case the restricted access and the sheer amount of construction work going on made placing of recovery marks too early a waste of time.

Many of these tasks were happening concurrently, often in the dark and certainly always with people and machinery obstructing and complicating the process.

5 CONCLUDING REMARKS

Sydney Trains surveyors were an integral part of the whole design and construction process. Instruments used were Leica TS30 total stations and Leica DNA03 digital levels.

On the construction site, challenges that had to be overcome included:

- Providing two survey parties 24 hours a day, 5 days a week during the holiday season.
- Finding places to put control marks that were safe, secure and useable.
- Working amongst up to 100 construction staff and their associated machinery and equipment.
- Working to the project's tight timescale.

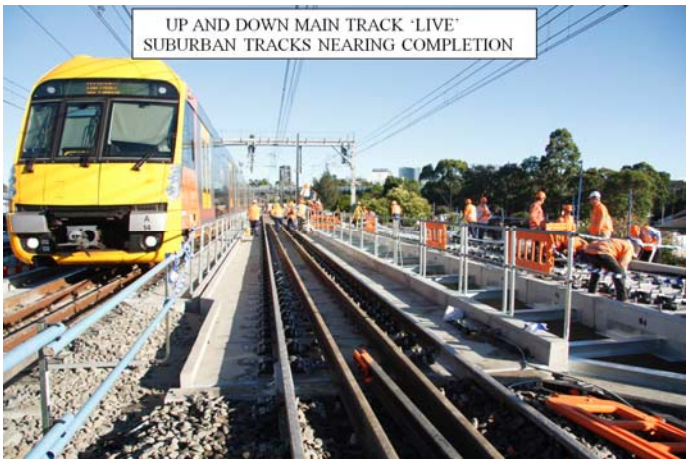

Figure 5: Work nearly finished.

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