



# NO TIME FOR ERROR

**Four days, 96 hours - this was all one French contractor was given to complete the monitoring and guiding operations during a major railway bridge shift project. Authorities could only allow for a major train route to be out of service for four days before causing significant strain on the country's transportation system.**

SCP Bertheau Saint-Criq, a chartered surveying firm with extensive experience in rail operations, was hired by the project surveying company on record, civil engineering company GTM Sud-Ouest, to ensure the Toulicou Bridge in southwest France safely underwent several repositioning procedures to move 47 metres to its final location. The undertaking wouldn't be easy as the bridge measured in at 75m long, 12m wide and 9m high.

The Toulicou Bridge was built between February and October 2014 to provide a safer crossing for the RN21 train between Tarbes and Lourdes. The bridge was constructed at 47m away from its final location, resting on a concrete slab. The existing track portion of the Toulouse-Bayonne railway needed to move for better maintenance of the line.

#### A LONG WORKING WEEKEND

From 7 to 10 November 2014, several tasks had to be completed to ensure the Toulicou Bridge was shifted to its new location in the short time the Toulouse-Bayonne train would be out of service. First, the railway tracks of the bridge had to be removed along with the overhead lines. Next, the existing embankment slope



had to be levelled to accommodate the bridge plus another slope had to be created. After the shifting was completed, the tracks needed to be replaced. Finally, a concrete wall had to be poured.

To accomplish all this on such a tight deadline, 200 people were mobilised on a scheduled that covered 96 hours:

- 15 hours for the removal of the track and overhead lines
- 26 hours of earthworks
- 13 hours of skidding
- 9 hours of filling
- 31 hours of replacing the catenary

Between the interruption and restart of the circulation for the construction accounted for two more hours.

If everything went to schedule, the bridge would be ready for turn over to the customer one hour before deadline.

#### ENSURING A SMOOTH SHIFT

Planning for the shift, SCP Bertheau Saint-Criq had to ensure when the bridge was lifted that its 8,000 tonnes wouldn't sag and risk breakage. To do this, the firm conducted a preliminary as-built survey of the structure to verify that it was built to plan specifications. Also, the surveyors needed to ensure the concrete slab the bridge rested upon hadn't moved during the nine months of construction and the batteries axes were in alignment with the planned trajectory of the shift.

During this first phase, SCP Bertheau Saint-Criq used the Leica Viva TS15 targeted to 10 Leica GMP104 prisms set up on the bridge piers. With the high accuracy and dedicated lock-on capabilities of the total station, the firm was able to accurately verify the integrity of the structure and calculate the bridge's final position.

Another concern the firm had to address was the capability of the cylinders that would guide the actual shift. Two cylinders per line would push 1,000 tonnes each. The cylinders would act in parallel to ensure the direction of the skid as it is essential to avoid an offset, which can cause a blockage.

In the next phase, the actual shifting, the Leica TS15 was set up on a concrete pillar and six prisms were fixed on known points, consistently retargeted to the total station to account for temperature and humidity

changes. These adjustments allowed SCP Bertheau Saint-Criq to avoid costly errors that would have thrown off the entire schedule, causing the whole project to fail.

The shifting was a slow process, moving only 5m every hour. With the precise calculations provided by the monitoring solutions of the total station and prisms, the firm was easily able to predict how far the bridge would move.

Far less easy for the surveyors was determining how the structure would react to the actual shift due to angle and weight. The greatest fear was the structure breaking and nose-diving into the gorge below.

“Confidence in the accuracy of measurements and the material used is paramount. Especially when the results do not match the expectations of different stakeholders and can be challenged. It is then important to quickly prove the reliability of what is ahead,” said Nicolas Bazerque, the SCP Bertheau Saint-Criq surveyor in charge of the project.

#### **AUTOMATING FOR ACCURACY**

To precisely understand the strain on the bridge from the shift, the surveyors made an inventory and consistently re-measured all the prisms. This provided a baseline to compare against where the bridge should be and where it actually was. These measurements were taken at every 4m of the shift. The discrepancy in the theoretical and actual results was recovered with mechanical adjustments to the trench bottom.



“For such a repetitive but critical process, automation is the best option to avoid operator error due to fatigue or stress,” said Bazerque. “We were able to use the auto set-up of Leica Viva, avoiding costly errors.”

At each cycle, the surveyors got a picture of deviations and compensation made. The table allowed the firm to keep a written record of the transactions.

These challenging operations are often under particular conditions, such as at night or in difficult environments, adding stress to the issues. The methods used are then cobbled together in-house, and, unfortunately there are no records. This time, however, SCP Bertheau Saint-Criq was able to provide its customer a specific progress report with the hours of measurement and results, which is a guarantee of quality.