Geotechnical statement of Rio Negro bridge foundations

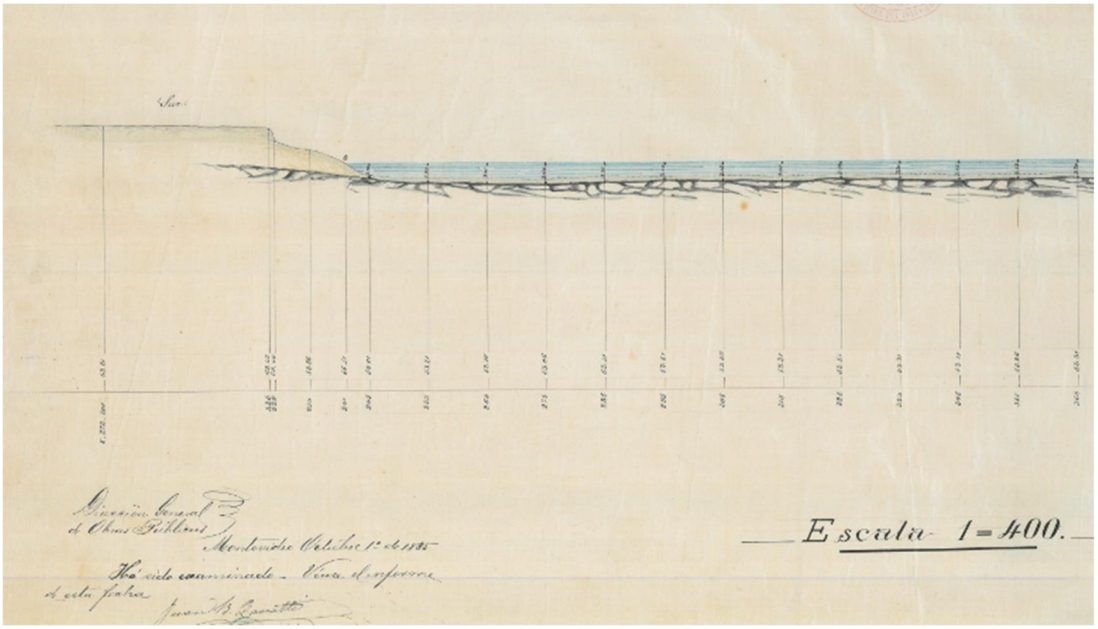
The meaning and the content of the Geotechnical Statement

The statement in the pre-engineering phase based on the available information gathered from different sources. In this phase, the goal has been to give the statement upon available information and to point out the to the uncertainties to the detailed design phase and to define next steps in the investigations. The pre-engineering has experience based estimation including:

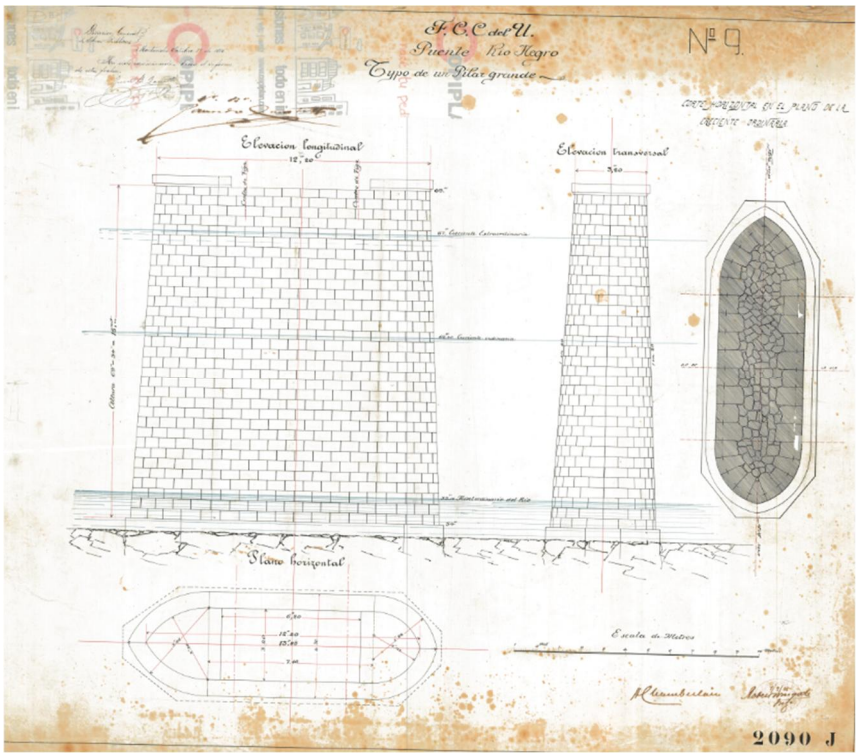
- Gathering of available drawings and information of possible soil investigations
- Evaluation of visual inspection data
- Geotechnical evaluation, including
  - reliability of available information
  - estimate of soil and foundation types
  - estimate of possible damages and deviations to original situation
  - needed actions in next phase.

General

The Rio Negro bridge is built on stone foundations. In old original drawings 1885 there are details of columns. According those drawing columns are probably founded in bearing layer.



Visually there has not been any bigger damages detected on foundations. Abutment on bridge ends and middle looks straight.



The upper structures are planned to be strengthened. The strengthening and bigger axel loads will increase the loads to foundations.

For bearing calculation needs proper soil and rock parameters. Old drawings are quite reliable to find out foundations dimensions but there is not enough information about soil conditions under foundations. To make sure the estimation on foundations durability it is necessary to do additional investigations.

Planned soil investigations

The planned investigations of the next stage include soil investigations for bridges. Beside every abutment is programmed deep drilling to find out soil and rock circumstances on foundation level and under foundation level. Investigations are done also beside abutments located in water.

Underwater surveying is needed to find out if there are some damages in abutments itself or if water erosion has eaten material near structures.

On the grounds of investigation results should make sure that existing foundations can carry load from repaired bridge. From investigations receives information about soil so that the design bearing resistance may be calculated according Eurocode EN 1997-1.

Loads to Existing bridge

Main dead loads

The existing bridge has spans of 11*18,67 meters (Truss) +9*36,98 meters (Truss) + 11*17,27 meters (Truss) The estimated weights of old bridge spans are as follows:

- Truss span 18,67 meters
  - 2,0 tons / meter = total of 37,4 tons
- Truss span 36,98 meters
  - 3,4 tons / meter =total of 125,0 tons
- Truss span 17,27 meters
  - 2,0 tons / meter = of 34,5 tons

The wooden sleepers and the rails add to the weight of the bridges approximately 0,4 tons / meter.

Traffic loads

The Traffic Load used in the designs to old structures is LM71-22,5. The old load model to the bridges is 18 ton axles. The load increase to the track and bridges is 25 % in the project scope.

The capacity of older structures must also be evaluated with safety factors. The safety factors must be sufficient as old load models had very moderate safety factors. The design traffic loads may increase more than 25 % due to safety margins.

The Traffic loads need to include vertical loads such as traction, breaking and rail forces, since the new track structure is continues rails.

Other loads

There are no significant changes to other loads.

Other studied options

A possible new 37-meter truss span with new design criteria is estimated to weigh 5,0 – 6,0 tons/meter, which is an increase of 20-40 % compared to the old span. In the shorter spans the increase is 10-25 % compared to the old spans. New spans are recommended to be constructed with a ballast layer, and the total weight of the truss spans with a ballast layer are estimated to be 9-10 tons / meter (90-100 % increase in total dead loads).

A concrete deck with a ballast layer is estimated to be too heavy for old columns and piers. The weight is very dependent on the optimized cross section and possible tensioning of the bridge, but it is estimated to be at least 15 tons/meter (concrete) + 5 tons (ballast and rails) = 20 tons / meter.

These options are estimated to require new foundations.