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Monitoring of a Bridge over the Paraná River during the Launching Phase

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Abstract

The railway bridge spanning the Paraná river, located between the states of São Paulo and Mato (Brazil), plays an important socioeconomic role for a vast region of the country and is one of the largest national engineering works of the last few years.

The road/railway bridge spanning the Paraná river located between the states of São Paulo and Mato Grosso do Sul (Brazil) is the major bridge combining road and railway systems to be built in Brazil, it consists of a 2,600m long steel structure (twenty-six 100m spans), besides two 720m and 450m concrete access viaducts located, respectively, on its left and right sides.

Of the total of 29,000 cubic meters of concrete used, 25,000 were used for the foundation, which consists of large 25 to 62m water column concrete-filled steel pipe piles. The entire 20,650 ton steel structure was made of high-strength low alloy steel (high resistance to corrosion).

The steel structure is made up of two truss beams, with the railway and roadbed, respectively, at the upper and lower chords. Four parts in earth, two 600m long (six spans) and two 700m (seven spans) long, were built on the ground and then push out to their definitive position.

In the launching phase, the ends of the spans reached a 100m cantilever, and exerted a strong force that was concentrated on the lower chord at positions far from the nodes. One of the spans was instrumented using strain gages and, during the launching operation, strains were measured and the stresses evaluated at several points of the structure and compared against the theoretical values.

One of the parts was monitored with strain gages. Strains were measured and stresses were evaluated at several points of the structure during the truss launching phase and then compared to the theoretical values.

The objective of the experimental analysis was to evaluate the strains in the steel structure during the launching phase, comparing the results with those obtained in the theoretical analysis, thus verifying the suitableness of the theoretical model and the launching procedure.
Six of the truss bars were instrumented with strain gages to measure the strains of the steel structure described in table 1. A temperature compensating strain gage was placed on each bar, fixed to a small plate made of the same material as the structure. Figure 1 indicate the position of the bars and the instrumented points.

Table 1 – Description of the instrumented bars

Bar	Description	Number of points instrumented
1	Lower chord – left truss	17
2	Upper chord – left truss	12
3	Diagonal – left truss	12
4	Lower chord – right truss	11
5	Upper chord – right truss	6
6	Diagonal – right truss	6
Total		**64**

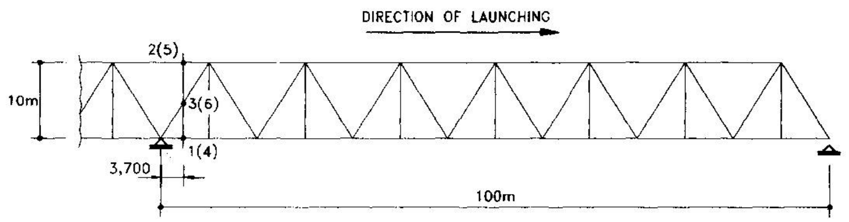
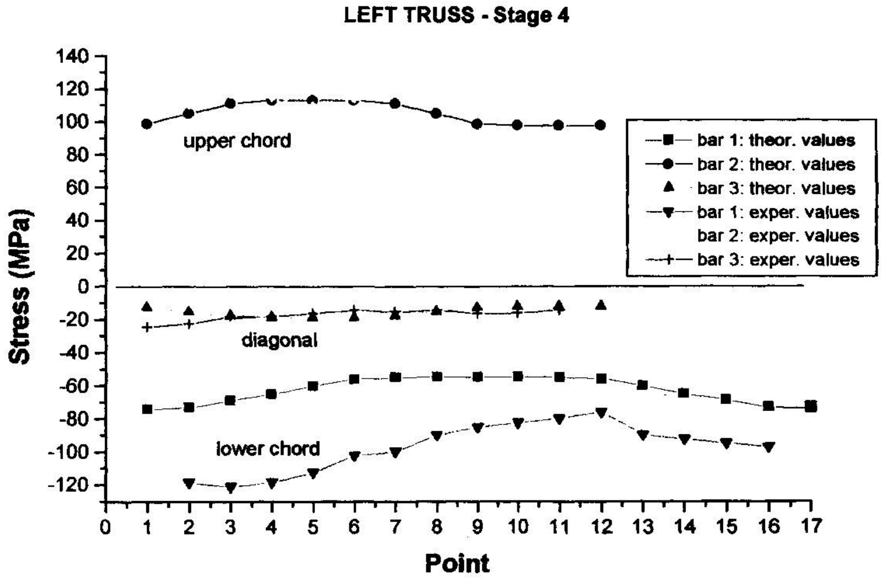


Fig 1 – Location of the instrumented bars (1 to 3: left truss / 4 to 6: right truss)

The stress were evaluated based on the measured strains, assuming the steel presented a linear elastic behavior, with modulus of elasticity E = 205.000MPa. Graph 1 illustrates the theoretical and experimental values for strain in the three bars of the left truss.



Graph 1 - Theoretical and experimental strain values in stage 4 - left truss

To conclude, it can be stated that the stress evaluated experimentally in the launching phase of the steel structure were below those of the limit of proportionality of USI-SAC 50 steel, and that its average values presented relatively small differences in relation to the theoretically evaluated average values. This leads us to believe that the procedure employed to launch the steel structure was entirely satisfactory and did not jeopardize the structure's safety.