Zeitschrift: IABSE reports = Rapports AIPC = IVBH Berichte

Band: 82 (1999)

Artikel: A new model for cable-stayed bridges control and adjustment

Autor: Cruz, João Sérgio / Almeida, João F.

DOI: https://doi.org/10.5169/seals-62128

A New Model For Cable-Stayed Bridges Control and Adjustment

João Sérgio CRUZ
Assistant Professor
Civil Eng. Depart./IST
Lisbon, PORTUGAL

João Sérgio Cruz, born 1961
Received his civil engineering degree in 1985, the MSC in 1989 and the Ph.D. in 1998
Partner of JSJ-Consult

João F. ALMEIDA
Associate Professor
Civil Eng. Depart./IST
Lisbon, PORTUGAL

João F. Almeida, born 1957
Received his civil engineering degree in 1981, the MSC in 1985 and the Ph.D. in 1990
Partner of JSJ-Consult

Abstract

The present work concerns the analysis and control of cable-stayed bridges during construction. The most currently used construction procedures and adjustment criteria are briefly summarised, illustrating how they can induce important geometrical and stress variations that cannot be neglected.

A model for the non-linear incremental analysis during construction is presented. The model is three-dimensional and takes into account all relevant time-dependent and geometrical non-linear effects.

Based on the model, new techniques for the adjustment of cable-stayed bridges are formulated. Those techniques simulate the construction sequence, allowing the direct definition, in every phase, of the segments geometric position and the calculation of the forces that should be applied in each cable, in order to achieve an appropriate internal forces distribution and the required longitudinal profile.

This paper presents an alternative adjustment technique based in a convergent iterative process, which lies on a structural analysis simulation model, regarding all the relevant issues, such as:

- The structure tridimensional nonlinear geometrical behavior is modeled through the establishment of the equilibrium and compatibility equations on the structure deformed shape.
- The geometrical nonlinear cable effect is evaluated through the tangent Ernst and secant moduli.
- Structural system evolution and modification along the time construction is considered.
- Loads and action variations are taken into account.
- Concrete time-effects like creep, shrinkage, prestress losses due to steel relaxation, are evaluated with a time incremental analysis. Concrete creep is modeled with an association of ***n*** reological Kelvin models and one Hooke model.
- Bearings are modeled with geometrical and physical nonlinear behavior. The effect of the top plates relative slip displacement with friction is considered.
- The prestress cables inside concrete can be considered with or without relative slip friction inside the gains.

Based on a convergent procedure, an important improvement in the convergence efficiency of this process is made by the introduction of a well known influence matrix, differentiating the stay-cable mounting forces reciprocal influence. Nevertheless, in the present technique, the influence matrix concept, has a tangent matrix significance, including all the information concerning the erection sequence, nonlinear physical and geometrical effects and specially the influence of the initial conditions of iteration ***i***.

The procedure is generalised to include the correction of geometrical and cables tensions deviations occurred during or after construction.

A practical application concerning a case study of a composite cable-stayed bridge recently built is presented. The results are compared with values obtained from the construction site, showing the adequacy of the proposed models.

The present example refers to the adjustment and geometric control study made for the construction of the new cable-stayed *Pereira-Dosquebradas* bridge in *Colombia.*

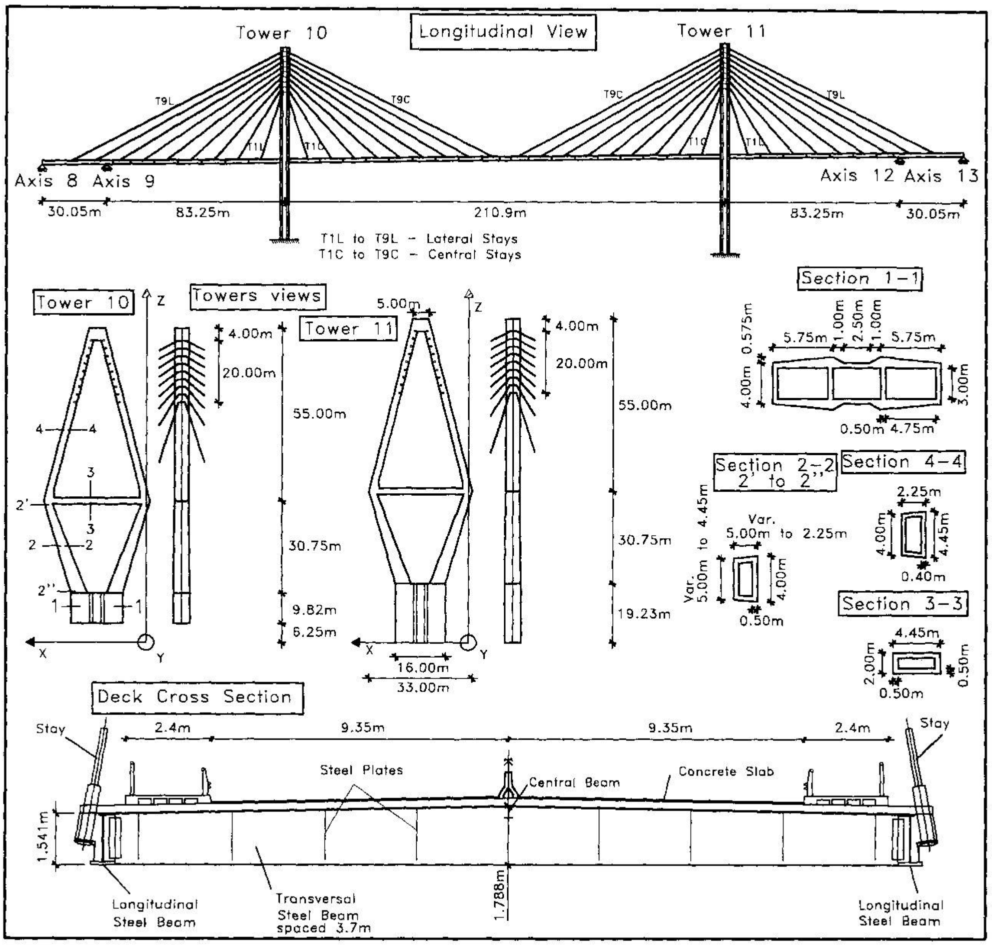

Figure 1 – General geometry of the Pereira-Dosquebradas bridge

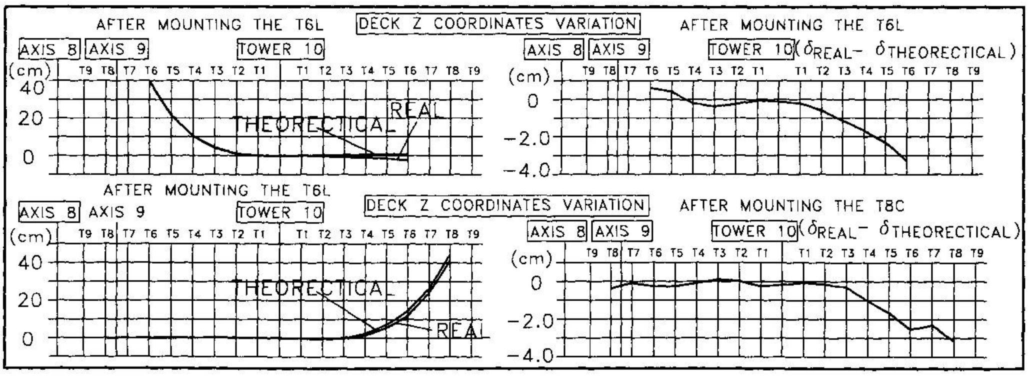

Figure 2 - Theorectical and measured vertical deck displacements