Initial cable forces for a cable-stayed bridge

Using CSiBridge, initial cable forces may be obtained for a cable-stayed bridge by one of the methods outlined in this article.

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Method 1: Use CSiLoadOptimizer tool
The CSiLoadOptimizer tool is described on the CSiLoadOptimizer page. The manual for this tool contains a detailed example for cable-stayed bridge.

Method 2: Estimate forces from a beam model
This method involves the following steps:

- Setup the model as a beam model with vertical support at each cable location.
- Run the analysis to obtain vertical forces at the support locations.
- Calculate cable forces from the magnitude of the vertical forces and cable inclination.

Method 3: Modify undeformed geometry (for a preliminary estimate only)
For a very preliminary investigation, the following approach could be used.

- Model the final geometry of the bridge in its deformed configuration.
- On the Cable Shape Definition menu, select the option for Relative Undeformed Length.
- Use a nonlinear load case to analyze the bridge under applied dead loads.
- Run analysis again by selecting Analysis > Shape Finding > Modify Geometry. Iterate until deformed shape converges to the geometry desired.
- Extract the cable forces.

Method 4: Use the unit-load method to tune cable forces
The cable forces could be determined by constructing an influence matrix to determine the influence of applying a unit strain load to each and every cable on the rest of the structure. The influence matrix would be then used to calculate the magnitude of the cable forces needed to obtain the desired displacements. This is essentially what the CSiLoadOptimizer is doing automatically.

Verify cable forces
The procedure used to verify these cable forces is as follows:

- Apply the dead loads and the cable target forces (previously determined), then run a nonlinear static analysis for this loading condition.
- If the cable forces are optimal, then the structure, when modeled in its final configuration, should experience negligible deflection under dead-load and target-cable forces.

See also

- Accounting for deformed shape in staged construction article
- Cable-stayed bridge first steps tutorial
- Cable-stayed bridge FAQ article