



Title: "Structural Safety in Cable-Stayed Bridges when a Failure of a Rope Occurs".

Author: Pau Graell Roura

Tutor: Ángel Carlos Aparicio Bengoechea

Abstract

A structure collapse is always a truly clue that everything can fail at any time. Although it could seem impossible that so grand structures like a cable-stayed bridge could break down, there are some factors which can weaken their resistant properties and could bring some of their elements to ruin or could produce the failure of the whole structure anyway.

Among the main resistant elements of a cable-stayed bridges, at first sight, the most susceptible to be damage are the ropes. In the same way that occurs in the most part of the steel structures, the corrosion is the main aggression for the steel. However, the foremost difference is that the ropes of a cable-stayed bridge are submitted to other factors like important variations of the stresses, the friction between strands,... This factors produce an increasement in the deterioration of the cables. These damages develop with a gradual loss of steel section on the wires which constitute the rope and, eventually, can weaken them till the point of produce the total failure of the cable.

With this research report we intent to analyze the effects of a cable-stayed's cable failure and prove if there is some alteration on the behaviour of the rest of elements that form the brige. Afterwards, we would quantify this effects. However, we also want to see if it would be possible to go on using the structure when a failure is produced or, on the other hand, the bridges should be out of order. This is an important aspect for a succesful management of the way.

With this aim we have modelized the structure according to an existent case, and we have suggested two sections completely different for the deck, which is an element as important as the cable themselves in this kind of structures. We have modelized a flexible section and a stiff one. These type of sections are, respectively, a slab with two stiffening border girders and, on the other hand, a box-girder section. This choice pretend to show if it is possible to improve the structure response at the early age of project.

With this hypothesis we have done a finite element model with which we have simulated the cases of failure of some differents cables to observe their effects on the deck and also on the other cable that remains.

To sum up, we have obtained that when a failure of a rope occurs, the critical element is the deck because on the cables a redistribution of stresses is done and his individual stress does not increase in the way to be dangerous for their safety.

However, the response of one deck type and the other are completely different. In the case of the flexible one, the failure of a cable involves that in the deck the stresses increase over the ultimative strength value. On the other hand, in the stiffener deck the variation is minor.

To finish, we should say that at any time we have done the analysis from the point of view of elastic and linear behaviour.
