

## Dynamic response of cable-stayed bridges subjected to sudden failure of stays – the 2D problem

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**Abstract.** A significant problem met in engineering practice when designing cable-stayed bridges is the failure of cables. Many different factors can lead to sudden failure of cables, such as corrosion, continuous friction or abrasion, progressive and extended crevice created by fatigue and finally an explosion caused by sabotage or accident, are some of the causes that can lead to the sudden failure of one or more cables. This paper deals with the sudden failure of cables in a special form of cable-stayed bridges with a single line of cables anchored at the central axis of the deck's cross-section. The analysis is carried out by the modal superposition technique where an analytical method developed by the authors in a previous work has been employed.

**Keywords:** cable-stayed bridges; dynamic response; cable failure; sudden failure

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### 1. Introduction

Cable stayed bridges have been known since the beginning of the 18<sup>th</sup> century, but they have been of great interest only in the last fifty years, particularly due to their special shape and also because they can serve as an alternative solution to suspension bridges for long spans. The main reason for this delay in their use was the difficulties in their static and dynamic analysis, the involvement of various types of nonlinearities, the absence of computational capabilities, and the lack of high strength materials and construction techniques. Numerous studies exist concerning the static behavior, such as the works of Bruno and Grimaldi (1985), Fleming (1979), Khalil (1999), Kollbruner *et al.* (1980), Gimsing (1997), Michaltsos *et al.* (2003), Virgoreux (1999), the dynamic analysis, such as the works of Freire *et al.* (2006), Chatterjee *et al.* (1994), Nazmy and Abdel-Ghaffar (1990), Abdel-Ghaffar and Khalifa (1991a,b), Fleming and Egeseli (1980), Bruno and Golotti (1994), Achkire and Preumont (1996), Michaltsos (2001), Konstantakopoulos *et al.* (2002), Wang *et al.* (2010), and the stability of cable-stayed bridges, such as the works of Ermopoulos *et al.* (1992), Bosdogianni and Olivari (1997), Michaltsos (2005), Michaltsos *et al.* (2008).

A significant problem arising from the engineering practice is the failure of cables. There are many factors that can lead to sudden failure of stay cables. Corrosion, continuous friction or abrasion, progressive and extended crevice created by fatigue, and finally an explosion caused by

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