

RAINBOW Footbridge

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Summary

An innovative design concept for a cable-stayed footbridge has been studied, alternative to the classical Pratt or Warren truss-girders type footbridges. This footbridge is provided with an arch (so called “Rainbow”) that is detached from the whole structure and carrying the cables to support the deck, making the footbridge a two-span structure. The idea is providing a footbridge with the features necessary to produce energy by itself, by means of piezoelectric sensors placed at the floor and activated by the pressure of the foot and photovoltaic panels to supply the lifts for disabled persons. Two mechanical systems are placed right under the deck, in proximity of the maximum sagging moment of the two spans and designed to develop energy from the vibrations induced by the pedestrians and store into battery chargers or used for lighting.

Keywords

Frequency; damping; vibration; cables; fatigue; photovoltaic panels; piezoelectric sensors.

1. Introduction

In a world where sustainability has become at paramount attention to everyone, especially to designers, the concept of the Rainbow footbridge is to produce as more energy as possible in order to be considered “green”. Structural engineers in fact can play a role in this and are also expected to deal with other areas of the engineering (e.g. mechanical, electrical, etc) to deliver more efficient and sustainable products. Referring to this, we can quote the large use of photovoltaic panels which are becoming more and more fully integrated with the structures, the recycling of raining water for domestic use and more.

The footbridge described herein is capable of developing energy by itself thanks to photovoltaic panels, piezoelectric sensors and a mechanical system placed under the main beams to “catch” energy coming from the vibrations due to the live load. The work presented should be considered only as a sort of theoretical studies for a “quotation” of the amount of energy developed.

2. Description of the structure

Rainbow footbridge is a “concept design” tailored for crossings of wide streets and deemed to be highly crowded by pedestrians. It can be considered, for instance, as a connection of a department store with its parking area. The architectural design includes a deck made of light timber sitting on beams which are connected to the main longitudinal aluminium beams. The choice of aluminium is due to the fact that its resistance is similar to steel but it’s approximately three times lighter and three times more flexible. This is important for the considerations at the following sections because higher vibrations will develop more energy. It has been considered the deck to be 2.5 m wide and 40 m long over two spans. A light parapet has been designed without any solid surface, such to consider a lesser wind force (see fig. 2.1).