

Non-Contact Laser Vibrometer System for Bridge Cable Force Measurements

Structural engineering professionals at Construction Technology Laboratories, Inc. (CTL) have developed a new method to measure the forces in bridge cables. This non-destructive methodology allows rapid and accurate measurement of forces in stay cables, and is expected to benefit the growing global highway bridge market.

The procedure relies on a laser vibrometer mounted at bridge deck level. The laser is focused on the mid-length region of the cable from a distance of up to several hundred feet. Small vibrations of the cable due to ambient wind conditions are measured with the laser sensor, and the cable's frequency spectra are analyzed. CTL researchers developed a mathematical equation that can relate vibration frequency to tension force. This equation includes exacting parameters such as mass, length, cross section, and damping in determining the actual force in the cable. The analytical algorithm makes allowance for equipment measurement tolerances. The system can continuously monitor force changes among cable arrays to reveal changes in cable condition attributable to construction progress, deterioration, long-term bridge foundation settlement, accidental bridge impact, superstructure modifications, and the like. This technique permits accurate measurement of forces in more than 20 to 50 cable stays per day, while employing only two individuals, and without need for anchorage staging and rigging, application of forces that impact the cables, or attachment of sensors.

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