

World Heritage Site Illumination

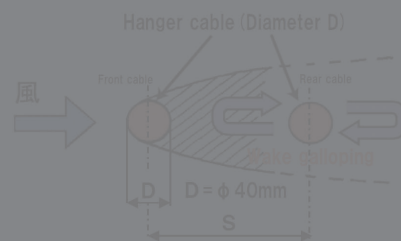
City Symbol: World Heritage Landscape Preservation — Participating in the Wakato Bridge Illumination Project —



Yawata in Kitakyushu City, a city of iron and steel, laid the foundation for the development of the industrial city of Kitakyushu and contributed to the modernization of Japanese industry. It was registered as a World Heritage Site in July 2015. The Wakato Bridge, a symbol of the city, was completed in 1962 as a landmark spanning the Tohkai Bay between the Tobata and Wakamatsu wards. At the time, it was the largest suspension bridge in the Orient and pioneered long suspension bridges in Japan. Following its toll abolition in December 2018, plans were made to illuminate it as a symbol bridge more closely connected to the community. At Josei, we verified the installation structure for lighting facilities capable of withstanding heavy traffic and strong winds, and participated in the illumination project.

Vibration Effects Due to Strong Winds in the Bay

The primary lighting for the Wakato Bridge illumination consists of pillar lighting and cable lighting. Among these, cable lighting plays a central role in the suspension bridge illumination. It was proposed that the most effective lighting installation position would be at the center of the four suspension cables. However, parallel cables like suspension cables raise concerns about wake galloping phenomena caused by strong winds. Indeed, visual inspections confirmed paint film cracking due to this phenomenon (upper right photo), and vibration measurements revealed significant rear cable vibration behavior (lower right diagram). Consequently, installing cable lighting between the suspension cables had to be abandoned.



※Judgment : $2 \leq S/D \leq 5$ ・ ・ ・ NG
 Bridge axis direction : $S=240\text{mm}$ $S/D=6>5$
 ⇒ May occur (small)
 Right angle direction : $S=200\text{mm}$ $2 \leq S/D=5 \leq 5$
 ⇒ May occur (Big) NG



Innovative Approach to Mounting Cable Lighting Brackets on Upper Stringing Material Surfaces (Using Bolts That Do Not Loosen Even Under Vibration)

To effectively ensure adequate illumination for the cables, the cable lighting brackets were mounted on the upper surface of the upper chords (right photo). High-strength bolts are generally used for component fastening. However, the Wakato Bridge experiences extremely high traffic volume, exceeding 50,000 vehicles per day, raising concerns about traffic vibration effects. For structures subject to vibration from vehicles and wind, the use of 'double nuts' is a common anti-loosening measure for bolts. While Japan lacks clear standards for bolt/screw/nut/washer anti-loosening methods,

testing based on the US National Aerospace Standard 3350 (NAS3350) for screw loosening was conducted using 1. single nuts, 2. double nuts, and 3. NEW lock nuts. The results confirmed that 2. double nuts provided almost no anti-loosening effect, performing at the same level as 1. single nuts. Conversely, the NEW lock nut demonstrated no loosening issues even after 30,000 cycles (over 15 minutes of vibration), confirming its suitability. Therefore, it was adopted for this installation project(See video below). By adopting this NEW lock nut, the Wakato Bridge—a symbol of the steel town of Yahata—has been vividly restored to its former glory. Now glowing red, the bridge draws crowds who pause to admire it, take commemorative photos, or simply gaze at it, each enjoying the moment in their own way.



Video⑨ : Single nut

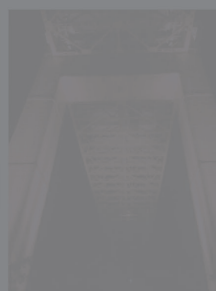
Video10 : Double nut

Video11 : New lock nut

シングルナット 振動試験

ダブルナット 振動試験

NEWロックナット 振動試験



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