Structural Cable Systems
Tokyo Rope is the leading company of structural cable systems.

We have manufactured PPWS since 1960’s. In 90’s, we challenged to apply our technology to the world longest suspension bridge, Akashi Kaikyo Bridge. We developed new product, called NEW-PWS, in the 1980’s. NEW-PWS is specialized for stay cables, main concept is fully prefabricated parallel wire cable with high fatigue strength sockets and high density polyethylene sheathing. NEW-PWS has been applied to a lot of cable stayed bridges.
**PPWS**

Prefabricated Parallel Wire Strand

PPWS consists of high tensile strength wires that are bundled in a hexagonal shape; sockets are fitted to both ends of the strand, and the strand is bound with a special plastic tape. Gauge wire measured based on the design length at stable conditions is arranged at a top of hexagonal section, and Red wire is arranged at the other top to check no twist during the erection.

### Erection of PPWS

1. The strands wound on reel are set on the unreeler.
2. The strands are drawn from unreelers, and unreeled on catwalks by hauling systems.
3. The sockets at both ends are fixed at the anchor frames. The tension and sag are adjusted by pulling socket.
4. After all strands are in place, compaction work is carried out by squeezing machine with hydraulic jacks to be circular shape.
5. Cable bands and hanger cables are installed.
6. After erection of deck, wires are wrapped on main cable for corrosion protection.

### High Tensile Galvanized Steel Wire

<table>
<thead>
<tr>
<th>Major Applications</th>
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<tbody>
<tr>
<td>Main cable for Suspension Bridge</td>
</tr>
<tr>
<td>Stay Cable, Hanger Cable</td>
</tr>
<tr>
<td><strong>NEW-PWS</strong></td>
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</tbody>
</table>

**Property of Galvanized Wire**

- **Class of G.U.T.S.**
  - 1570MPa class
  - 1770MPa class
  - 1960MPa class

- **Range of tensile strength**
  - 1570-1770
  - 1770-1960
  - 1960-2160

- **0.2% offset proof stress**
  - 75% of G.U.T.S.

- **Elongation**
  - 4.0% or more

- **Ductility**
  - 5mm: Min. 14 times / 7mm: Min. 12 times
  - 3d x 8 times, No fracture

<table>
<thead>
<tr>
<th>Zinc or ZnAl alloy coating</th>
<th>1570MPa class</th>
<th>1770MPa class</th>
<th>1960MPa class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mass</td>
<td>300g/m² or more</td>
<td>300g/m² or more</td>
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</tr>
<tr>
<td>Adhesion</td>
<td>75% of G.U.T.S.</td>
<td>4.0% or more</td>
<td>5mm: Min. 14 times / 7mm: Min. 12 times</td>
</tr>
</tbody>
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**Structural Cable Systems**

- Minami Bisan Seto Bridge
NEW-PWS

NEW-PWS possesses all the superb characteristics of PPWS, plus good handling ability, excellent corrosion proofing characteristic, and high fatigue resistance socket for stay and hanger cable.

High Elastic modulus

NEW-PWS consists of parallel galvanized wires 7mm in diameter assembled while being twisted at a pitch designed to maintain optimum tensile strength and modulus of elasticity. $E=196,000\text{N/mm}^2(20,000\text{kg/mm}^2)$ is secured even twisting.

High Fatigue Strength

Sockets with high fatigue strength are developed for the stay cables. This socket called as "NS socket" is composed of zinc-cupper alloy and epoxy resin. Fixing mechanism of the NS socket consist of adhesion between wire and zinc-copper alloy and wedge effect of an integrated cone composed of wires and zinc-alloy.

Standard Type of Socket

Front bearing  Middle bearing  Nut bearing

Excellent Corrosion Proofing

High density polyethylene sheath is assembled to eliminate corrosion-proofing work. Polyethylene is resistant to acids, alkalis and other chemicals, and a carbon content of about 2% ensures greater weatherability.

Aerodynamic Measure for mitigating the Rain Wind Vibration

Small Drag Coefficient, even the surface treatment (Indented surface) is applied on the cable. Indented cable can achieve a counter measure without external damper against the rain wind vibration.

Erection of NEW-PWS

1. Setting a cable reel on Unreeler
2. Unreeling of cable
3. Drawing & fixing of dead anchor
4. Tensioning
**Tuff Coated Rope**

- High anticorrosive function due to two corrosion proofing layers, galvanizing and modified saturated polyester resin.
- Various colors available.

**Locked Coil Rope**

- **Type C**
  - Shaped wires (Z and T wire) are used in the outer layers.
  - Rope itself has an excellent anti-corrosion performance.
  - Endfitting is limited to socket type.
  - Modulus of elasticity: ≥1.57×10^5 N/mm²
  - Diameter: 34~100mm

**Spiral Rope**

- **1×91**
  - The strength is higher than any other structural rope of the same diameter, except PPWS and NEW-PWS.
  - Swaged socket is applicable up to 40mm
  - Modulus of elasticity: ≥1.57×10^5 N/mm²
  - Diameter: 14~100mm

**Strand Rope**

- **7×37**
  - Good flexibility, easy handling.
  - Swaged socket is applicable.
  - Modulus of elasticity: ≥1.37×10^5 N/mm²
  - Diameter: 9~71mm

**End fitting**

- **Socket Type**
  - Nut bearing socket
  - Open socket

- **Swaging Type**
  - Swaged socket with thread
  - Fork end type swaged socket

**Color Coated Structural Wire Rope “Tuff Coated Rope”**

- Tuff Coated Rope has a high anticorrosive function due to two corrosion proofing layers, galvanizing and modified saturated polyester resin. Various color is available.

**Exposure test at Mt. Aso.**

- At first
- 6 months later
- 1 year later
- 2 years later
### S-shaped Wrapping Wire

**Corrosion Protection System for Main Cable**

The new corrosion system that gives longer service life to the main cable, the key components of a suspension bridge, consists of Galvanized wire + Wrapping wire + Heavy-duty corrosion protection coating.

**Wrapping Wire**

The new wrapping wire has an S-shaped sectional configuration, and its standard size is as shown in the figure below.

This S-shaped wrapping wire prevents cracking of coating by mean of the effect of interlocking of turns. The adoption of coating agent having an excellent elongation performance prevents from cracking due to expansion of cables and at the same time prevents the infiltration of rain water and others.