A Bridge of Corrugated Steel Webs with High Durability

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PC corrugated steel web bridge with span 47m
PC extradosed bridge with corrugated steel web (span=180)
The cable stayed bridge with corrugated steel web girder integrated by steel box girder (span 235 m)
Around the pylon
Integrated connection between steel girder and corrugated steel web girder

- shear connector
- composite girder
- steel girder
- PC girder
- corrugated steel web
- PC bar (φ32)
- external cable 19S15.2
PC Bridge with Corrugated Steel Web

- **Concrete upper deck**
- **Concrete lower deck**
- **Corrugated steel web**
- **Galvanization**
- **External cable**
- **Deviator**
Characteristics of corrugated steel web

10 times higher shear resistance than concrete web per kg

Local buckling  Total buckling

Failure mechanism of corrugated steel web is called Coupled buckling.
A bridge with corrugated webs requires less tendon than that of concrete webs.

A bridge with corrugated webs is 20% lighter than that of concrete webs.

A bridge with corrugated webs has 10 times higher shear resistance than concrete web per kg.
According to experiments, corrugated web does not resist the axial force. Accordion effect enables upper deck or lower deck to be prestressed effectively. No resistance in web unlike concrete web. It means less PC strands than PC bridge. Inexpensive!
A bridge with corrugated webs emits less CO2 than a steel bridge and concrete bridge.

per 4 lanes, 1km

<table>
<thead>
<tr>
<th>Material</th>
<th>CO2 Emissions (10^3 ton)</th>
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<tbody>
<tr>
<td>Concrete</td>
<td>15.9</td>
</tr>
<tr>
<td>Corrugated Web</td>
<td>11.8</td>
</tr>
<tr>
<td>Steel Box</td>
<td>16.6</td>
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</tbody>
</table>
Corrugated steel web is simply made by press
Sophisticated Press designed for corrugated steel web can fabricate wider and longer panel easily.

Inexpensive!
A wider and longer panel is easily pressed.

Corrugated webs are piled just like steel plates after press work.
Proposed durable external tendon
Innovative wire coated epoxy strand covered by black polyethylene for external tendon (The SC Unbond)

Since black polyethylene is durable against ultraviolet rays, SC unbond can stand the ultraviolet rays for the external tendon.
Innovative wire coated epoxy strand

Each wire is coated by epoxy resin.

A metal touch of the wedge is easily performed since the thickness of the epoxy coating is 0.2 mm. Any kind of wedges of many makers might be applied.
The wire coating epoxy strand shows great anti-corrosion since each wire is uniformly coated by epoxy resin.

No corrosion has been confirmed for five years according to the exposure test in heavy salty area.
The SC Strand can be easily applied to the internal and external tendon since it is flexible.
Proposed Durable Shoe
Corrosion protection of a shoe by hot-dip zinc has good durability under heavy traffic except salty area in Japan since 1978.
Corrosion prevention by hot-dip zinc coat is not durable under salty condition.
Innovative heavy duty protection (Core pack)

ultraviolet  water  salt

epoxy resin (mistcoat)
thermal spray (Al+Mg)
steel

sealing of pin holes of spray deposit
good corrosion prevention
The shoes in salt water are dipped and dried repeatedly.
A shoe with hot-dip zinc May 12, 2010

The shoe model corroded more heavily than the plate, The durability of the shoe can not be confirmed only by the plate.
The Core Pack: \((Al + Mg(5\%))\), flame spray + mistcoat

May 12, 2010

No corrosion on shoe model and the plate!
Life cycle cost

cost

hot-dip zinc coating

durable shoes

year
Conclusion
1. A bridge with corrugated webs 20% lighter than a bridge with concrete webs.
2. An accordion effect requires the PC strand 20% less than a bridge with concrete webs.
   Therefore a bridge with corrugated webs more inexpensive than a bridge with concrete webs for a span longer than 50 m.
3. A girder with corrugated webs can be connected to a steel box girder.
   That makes a long span hybrid bridge made of a girder with corrugated webs and steel box.
4. A bridge with corrugated webs emits the carbon dioxide 20% less than a steel bridge and concrete bridge.
   A bridge with corrugated webs is eco-friendly.
5. The external tendons and shoes essential to a bridge with corrugated steel web bridge is greatly protected by the innovative material.

Such external tendons and shoes can be applied to such a severe corrosive area as in South (East) Asia where it is humid and hot.