Cathodic Protection for extending the life of concrete bridges

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• **Corrosion of reinforcement due to chloride (de-icing, sea) → serviceability, …safety**

• **Intervention options**
  – **Do nothing**
  – *(Conventional) Repair*
    • quick&dirty (short life!)
    • full, thorough
  – **Cathodic Protection, CP (repair)**
  – **Replace structure (element)**
Croatia
CP in a nutshell

- **Stops corrosion** (electrochemical process)
- **Needs low V DC power**, "anode" material on surface, circuit (cables, steel, concrete)
- **Test proves corrosion absent**, 2 – 4 / year
- **Life** (NL ~125) 90% > 13 y; titanium > 25 y
- **Costs less over total bridge life.**
- **Causes lower out-of-service time.**
- **..than conventional repair**
Design of CP

- **Check safety** (*CP=*/ structural)
- **Locate corrosion & damage**
- **Check continuity** (*steel, concrete*)
- **Choose anode location & material**
- **If critical: model performance**

- conductive coating
- titanium mesh, strip, shotcrete
Prepared surface, titanium mesh, shotcrete
CP trial Poland, titanium strip
CP trial Slovenia

Repair work
(quick & dirty = OK!)
CP trial SLO, 3 test areas

- test different anode materials & configurations
- check with FE modelling
FE model CP SLO

- **Geometry, steel**
- **Parameters**
- **2-D model**
- **Voltage, resistivity**
- **Output I,E (x,y)**
- **Agreement OK**
Life cycle cost

• **CP trial SLO (150 m²)**

• **Input**
  – **full repair** 540 €/m²
  – **CP** 405 €/m² + engineering 16 k€ + 1000 €/year

• **Output: CP saves 7000 € until year 13**

• **CP, Repair: maintenance after 13 years?**

• **Probability of failure: CP 10%; repair >50%?**
Conclusions

- **CP proven technique: corrosion is stopped**
- **More effective than conventional repair**
- **Prolongs lifetime of repair works**
- **Lifetime > 10 .. 25+ year**
- **Flexible design & materials and components**
- **Modelling beneficial in critical (slender) cases**
• Advantages of CP
• Less demolition (out-of-traffic, waste)
• Reliable & safe
• Lower maintenance costs
  • cheaper than replacement
  • more durable than conventional repair
• See ARCHES Guideline (soon)