CORROSION AND SEVERAL PROBLEMS IN FANS ON ROAD TUNNELS OF A-67 HIGHWAY

Collazos-Arias F. (Ministry of Development, Spain)
Pascual-Muñoz P. (University of Cantabria, Spain)
Ayres Janeiro L. (Imesapi, Spain)

Lecturer: Luis Ayres Janeiro
TECHNICAL DIRECTOR IMESAPI, S.A.
INDEX

• INTRODUCTION
• LOCATION OF THE TUNNELS
  – A-67 Highway.
  – Winter road maintenance.
• BACKGROUND
  – Ventilation the problems .
  – Other equipment problems.
• TECHNICAL SOLUTIONS
  – Ventilation system.
  – Other equipment.
• CONCLUSIONS
LOCATION OF THE TUNNELS

• Autovía Cantabria-Meseta A-67:
  – From Cantabrian Coast at Santander to Palencia.
  – Through the Cantabrian mountain range.
  – 2 separate carriageway.
  – Length: 205 kms.
LOCATION OF THE TUNNELS
### LOCATION OF THE TUNNELS

#### Geometric characteristics:

<table>
<thead>
<tr>
<th>Tunnel</th>
<th>Length [m]</th>
<th>Tube (# fans)</th>
<th>Direction</th>
<th>Start Chainage</th>
<th>End Chainage</th>
<th>Altitude [m]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Riocorvo</td>
<td>660</td>
<td>Tube 1 (6)</td>
<td>Palencia</td>
<td>174+038</td>
<td>173+378</td>
<td>110</td>
</tr>
<tr>
<td></td>
<td>685</td>
<td>Tube 2 (6)</td>
<td>Santander</td>
<td>173+378</td>
<td>174+063</td>
<td></td>
</tr>
<tr>
<td>Gedo</td>
<td>2,453</td>
<td>Tube 1 (22)</td>
<td>Palencia</td>
<td>166+883</td>
<td>164+430</td>
<td>200</td>
</tr>
<tr>
<td></td>
<td>2,431</td>
<td>Tube 2 (20)</td>
<td>Santander</td>
<td>164+430</td>
<td>166+861</td>
<td></td>
</tr>
<tr>
<td>Pedredo</td>
<td>1,063</td>
<td>Tube 1 (14)</td>
<td>Palencia</td>
<td>162+901</td>
<td>161+838</td>
<td>290</td>
</tr>
<tr>
<td></td>
<td>1,061</td>
<td>Tube 2 (14)</td>
<td>Santander</td>
<td>161+838</td>
<td>162+899</td>
<td></td>
</tr>
<tr>
<td>Somaconcha</td>
<td>1,500</td>
<td>Tube 1 (8)</td>
<td>Palencia</td>
<td>148+305</td>
<td>146+805</td>
<td>650</td>
</tr>
<tr>
<td></td>
<td>1,573</td>
<td>Tube 2 (16)</td>
<td>Santander</td>
<td>146+805</td>
<td>148+378</td>
<td></td>
</tr>
<tr>
<td>Lantueno</td>
<td>732</td>
<td>Tube 1 (6)</td>
<td>Palencia</td>
<td>142+632</td>
<td>141+900</td>
<td>750</td>
</tr>
<tr>
<td></td>
<td>694</td>
<td>Tube 2 (6)</td>
<td>Santander</td>
<td>141+938</td>
<td>142+632</td>
<td></td>
</tr>
</tbody>
</table>
LOCATION OF THE TUNNELS

• Winter road maintenance:
  – 15 snow ploughs.
  – 1 snow blower.
  – 15 salt storage bins (1.260 T).
  – 4 FAST installations.
WINTER ROAD OPERATIONS EQUIPMENTS:
REINOSA-PESQUERA
WINTER ROAD OPERATIONS EQUIPMENTS: PESQUERA-TORRELAVEGA
LOCATION OF THE TUNNELS

• Winter road maintenance:
  – The Fixed Automated Spray Technology (FAST) Tool for anti-icing at key locations (tunnels)
  – Reliable Environmental sensors:
    • Atmospheric.
    • Pavement.
BACKGROUND

• Chronology:
    • Tunnels put into service.
    • Fans manufacturer thorough checkup.
    • Manufacturer reported problems in 12 fans in Lantueno, Somacocha, Gedo and Pedredo.
    • Failures repaired.
    • Fans working in acceptable condition until.
  – March 2013.
    • Problems in 3 fans in the Lantueno tunnel.
  – July 2013.
    • Manufacturer issued a report. Problems attributed to the corrosive environment.
    • Fans working with problems and higher reparation costs.
    • Fast degradation: out of order 38 of the 122 fans of the five tunnels.
BACKGROUND

• Salt and brine in the winter road treatments: Corrosion of fans.

• Ventilation problems:
  – Corrosion of various parts of the fans.
  – Breaking of blades.
  – Breaking of contactors.
  – Breaking and corrosion of anchors.
  – Vibrations in the fans.
BACKGROUND

- Corrosion of various parts of the fans

Stator corrosion of fan engine in Lantueno tunnel
BACKGROUND

• Breaking of blades

Broken blades of impellers in Lantueno tunnel
BACKGROUND

• Breaking and corrosion of anchors

Fan support break in Lantueno tunnel ceiling
BACKGROUND

• Vibrations in the fans

Fan support affected by vibrations in Lantueno tunnel
BACKGROUND

- Frequent storms: failure optical controller fire detection

- Other equipment problems:
  - Breaking of the OTS optical controller for fire detection.
TECHNICAL SOLUTIONS

- Ventilation system:
  - 38 stainless steel fans to avoid corrosion.

<table>
<thead>
<tr>
<th>Tunnel</th>
<th>Direction</th>
<th># jet fans</th>
<th>Engine</th>
<th>Diameter</th>
<th>Enclosure</th>
<th>Insulation class type</th>
<th>Observation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lantueno</td>
<td>Palencia</td>
<td>6</td>
<td>30 kw</td>
<td>1,000mm</td>
<td>IP55</td>
<td>H (2 hours 250°C)</td>
<td>stainless steel impeller</td>
</tr>
<tr>
<td>Santander</td>
<td></td>
<td>6</td>
<td>30 kw</td>
<td>1,000mm</td>
<td>IP55</td>
<td>H (2 hours 250°C)</td>
<td>stainless steel impeller</td>
</tr>
<tr>
<td>Pedredo</td>
<td>Palencia</td>
<td>4</td>
<td>30 kw</td>
<td>1,200mm</td>
<td>IP55</td>
<td>H (2 hours 250°C)</td>
<td>stainless steel impeller</td>
</tr>
<tr>
<td>Santander</td>
<td></td>
<td>4</td>
<td>30 kw</td>
<td>1,200mm</td>
<td>IP55</td>
<td>H (2 hours 250°C)</td>
<td>stainless steel impeller</td>
</tr>
<tr>
<td>Gedo</td>
<td>Palencia</td>
<td>6</td>
<td>30 kw</td>
<td>1,200mm</td>
<td>IP55</td>
<td>H (2 hours 250°C)</td>
<td>stainless steel impeller</td>
</tr>
<tr>
<td>Santander</td>
<td></td>
<td>8</td>
<td>30 kw</td>
<td>1,200mm</td>
<td>IP55</td>
<td>H (2 hours 250°C)</td>
<td>stainless steel impeller</td>
</tr>
<tr>
<td>Riocorvo</td>
<td>Palencia</td>
<td>4</td>
<td>37 kw</td>
<td>1,200mm</td>
<td>IP55</td>
<td>H (2 hours 250°C)</td>
<td>stainless steel impeller</td>
</tr>
<tr>
<td>Santander</td>
<td></td>
<td>4</td>
<td>37 kw</td>
<td>1,200mm</td>
<td>IP55</td>
<td>H (2 hours 250°C)</td>
<td>stainless steel impeller</td>
</tr>
</tbody>
</table>
TECHNICAL SOLUTIONS

• 38 New stainless steel fans

Instalation of new fans Riocorvo tunnel
TECHNICAL SOLUTIONS

• 38 New stainless steel fans

Instalation of new fans Lantueno tunnel
TECHNICAL SOLUTIONS

• Ventilation system:
  – Remaining fans revised and repaired:
    • Anchors
    • Frames
    • Blades
    • Engines
    • Instruments
    • Electrical wiring
TECHNICAL SOLUTIONS

• Repaired fans

Disassembly and assembly repaired fans Gedo tunnel
TECHNICAL SOLUTIONS

• Repaired fans

Disassembly and assembly repaired fans Somaconcha tunnel
TECHNICAL SOLUTIONS

• **Other equipment:**
  – Replaced OTS in technical rooms:
    • North Pedredo.
    • North Gedo.
    • South Gedo.
  – Updated hardware and software of OTS optical controllers of fire detection.
  – tunnel control building equipped with lightning protection
CONCLUSIONS

Salt necessary in winter road safety
× Corrosion problems in bridges and tunnels
  ✓ Stainless steel in design

Tunnels are in mountainous zones
× Frequent thunderstorms
  ✓ Tunnel control building equipped with lightning protection
THANK YOU ALL FOR LISTENING