WATERPROOFING OF BRIDGE DECKS

1. DESCRIPTION

We are all aware of the importance of good waterproofing of bridge decks to prevent deterioration that could occur as a result of water filtration through the road surface and the expansion joints of the deck itself.

The design of reliable and effective waterproofing, which ensures protection of the structure, is one of the keys to achieving greater durability of this, and therefore it plays a primary role in preserving the service condition of bridges. The first signs of deficient waterproofing are water stains, calcium carbonate accumulations, etc., but if this is not corrected in time, the defects can degenerate into fissures, cracks and spalling of the deck concrete.

This is why the waterproofing of bridge decks should be given the importance it deserves, whether on railway, highway or pedestrian bridges.

The requirements for materials to be used in waterproofing are the following:

- Impermeable.
- With stable and durable mechanical properties.
- Elastic.
- Compatible with the materials of the application surface and provides good adherence to same.
- No toxicity.
- Easy to apply.
- If possible, economical.

In any bridge deck waterproofing project, it is advisable to define the most appropriate technique considering the specifics of the structure and the effects of its use.

4.2. PURPOSE OF WATERPROOFING

The main function is to protect the upper part of the deck from physical-chemical actions generated by the water and the agents dispersed or dissolved in it.

In conception and application, all the specific points should be taken into account to create a true “umbrella” effect. The effectiveness of waterproofing is based on the following:

- Cleanliness and preparation of the surface.
- Use of quality products.
- Good application technique.
- Overall treatment of the application surface.

In the case of road bridges, waterproofing, located between the concrete deck and the asphalt pavement layer(s), indirectly supports traffic and transmits its demands to the bridge deck, and therefore requires proper execution.

In the case of railway viaducts, the aggregate layer will protect the main waterproofing against the mechanical aggression of the sub-ballast and ballast layer, especially in cases of high-speed railway traffic.
3. IN-SITU WATERPROOFING SYSTEM WITH COLD APPLIED BITUMINOUS MORTARS CONTAINING FIBRES (PROAMASTIC-FIBRA).

Consists of waterproofing the deck by cold application of a bituminous mortar containing acrylic fibres using manual techniques. This system is especially recommended for waterproofing bridges with smaller surface areas because of its manual application.

The combination of the emulsion with the fibres allows for a higher binder content without the risk of oozing and enhances the water tightness of the mortar. It also produces a substantial improvement in the mortar by reducing its thermal sensitivity and increasing its flexibility.

The application surface for Proamastic Fibra must be clean. To apply it, proceed as follows:

- Prime with diluted Promulsit (4 parts water to one part Promulsit) or APT diluted in water to 50% (200-300 g/m²) and let dry for at least 12 hours. (Photo 1).
- Blend the product before applying if necessary.
- As a general rule, do not add water to the product, although a small amount can be added to facilitate handling.
- Apply cold using a rubber squeegee or other mechanical utensil suitable for this product that enables coverage of the entire surface. Proamastic Fibra is generally applied in a single coat and coverage varies depending on the texture of the application surface. Coverage values on the order of 2 Kg/m² are typical. If applying the product in two coats, let the first coat dry completely (leave for approximately 24 hours, depending on the ambient humidity) before applying the product corresponding to the second coat. (Photo 2).
- Spreading of the aggregate coat after the Proamastic Fibra coat has cured completely.

Photo 1: priming with diluted Promulsit.

Photo 2: application of Proamastic Fibra.
3.1. CHARACTERISTICS OF THE MATERIALS

PROAMASTIC FIBRA BITUMINOUS MORTAR WITH FIBRES

This is a mixture with a pasty consistency composed of mineral fillers with controlled granulometry, a stable EAL-2 type bituminous emulsion with synthetic fibres:

<table>
<thead>
<tr>
<th>CHARACTERISTICS OF THE MORTAR</th>
<th>UNIT</th>
<th>STANDARD</th>
<th>RESULTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brookfield Viscosity (25°C, 5 rpm)</td>
<td>mPa.s</td>
<td>NIE-008</td>
<td>35000</td>
</tr>
<tr>
<td>Non-volatile material</td>
<td>%</td>
<td>ISO 3251</td>
<td>80</td>
</tr>
<tr>
<td>Aggregate size</td>
<td>mm</td>
<td>UNE 933-1</td>
<td>-</td>
</tr>
<tr>
<td>Relative density at 25°C</td>
<td>%</td>
<td>UNE 104-281/3-5</td>
<td>1.4 1.8</td>
</tr>
<tr>
<td>Synthetic fibre content</td>
<td>%</td>
<td>-</td>
<td>0.5</td>
</tr>
<tr>
<td>Emulsion content</td>
<td>%</td>
<td>-</td>
<td>18</td>
</tr>
<tr>
<td>Permeability</td>
<td>-</td>
<td>NLT-327</td>
<td>Non-permeable</td>
</tr>
<tr>
<td>Flexibility at 4°C</td>
<td>mm</td>
<td>ISSA 146</td>
<td>150</td>
</tr>
</tbody>
</table>

Table 2. CHARACTERISTICS OF PROAMASTIC FIBRA

This system is very widely used in waterproofing bridge decks in this country. Its main advantages are cold application that is continuous, joint-free and stable at a wide range of temperatures. It can be applied to both dry surfaces and slightly damp ones (although in the absence of precipitation).

It is easy to apply, provides good adherence to the material and the top aggregate layer, and is resistant to construction traffic.

Although the impermeability of these mortars has been called into question at times due to residual porosity after evaporation of the water, its water tightness has been verified through testing. In addition to the composition of the mortar itself, this situation is helped by the heating and compacting of the top coat(s), and the outstanding performance of decks protected against the action of the water with these types of membranes has been proven.
WATERPROOFING OF BRIDGE DECKS

CONCLUSIONS:

• Concrete bridge waterproofing systems that are continuous and totally adhered to the deck, without joints.
• Adherence to the deck, as well as to the covering layer, is total.
• It has high elasticity.

• Good resistance to cold/hot cycles.
• Crack-proof.
• Easy to apply.
• Durable.

Waterproofing in good condition is a guarantee of low-cost conservation, as repairs in these types of works can represent up to six times the original cost of the project.

If we consider the increase in heavy goods traffic on roads, we should adopt a mentality of waterproofing bridges and reducing the implementation time for maintenance work on them.