The First European Approval for an Expansion Joint Flexible Plug Joint System with New Material

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Summary

Up to now the common material used for flexible plug joints of bridges is based on bituminous mixtures consisting of aggregates and polymer-modified binders. All existing national regulations and also the upcoming European Guideline for Expansion Joints ETAG 032 are restricting flexible plug joints to these traditional bituminous mixtures.

The new expansion joint system uses a new material based on polyurethane and shows essential improvements in the intersection pavement/joint by mechanical means. It offers a longer working life, larger movements up to 135 mm, allows for installation both in cold and hot climate and enables new applications, e.g. in railway bridges and building construction.

Due to the existing restricting regulations complete new approaches both for a national and the European Approval (on basis of a CUAP) had to be found to demonstrate the fitness for use and to verify the different requirements on expansion joints. The paper covers reports on material and system tests executed and shows an example of installation.

Keywords: new material for flexible plug joints, larger movement flexible plug expansion joint, road and railway bridges, European approval procedure, CUAP, ETAG 032.

1. Introduction

Flexible plug expansion joints, based on modified polymeric bitumen and aggregates, are widely used in concrete bridges for small movements up to 40 mm, This is due to their excellent noise behaviour, easy and quick installation – if necessary lane by lane – and rather simple design.

However, due to the properties of the asphaltic plug material, there are also several disadvantages in practical operation: short working life of often less than 5 years, leakages especially in not trafficked areas, high reaction forces at low temperatures and plastic deformation at high temperatures.

This was the starting point for us to develop a new system with a new material. Cornerstones: better material behaviour throughout the whole operating temperature range of – 40°C till + 60°C, increase of the movement to more than 100 mm and increase of working life, but maintaining existing advantages of the traditional flexible plug joints. The solution was found by a new design and using advanced polyurethane as filling mixture.

Existing national regulations and the upcoming European Guideline for European Technical Approvals on Expansion Joints (ETAG 032) could only be used as reference for requirements because they specify polymer-modified bituminous binder/aggregate mixtures. So extensive research on material and design, followed by verification and tests harmonised in a CUAP procedure between all European Approval bodies had to be done.

Calculation alone was not feasible because of the variety of materials and components. In the

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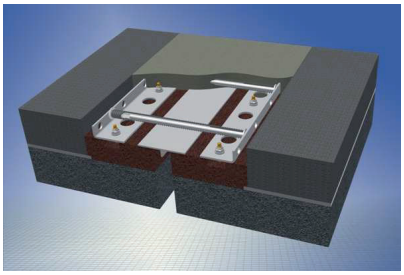
following verification and-performance related methodology as part of the European approval procedure is described. As a result the first European approval for an expansion joint was awarded in July 2012.

2. Description of System and Verification



The system consists of a flexible plug joint filling mixture in advanced polyurethane, supported by either concrete or polymer concrete, with perforated steel angles freeing the flanks from loads, a coverplate over the structural gap with sliding element and optional stabilisers.

In a few trial installations in Austria, the United Kingdom and Italy the new flexible expansion joint system has been working now properly for nearly 3 years and does not show any wearing effect.

Fig. 1: Axonometric view

Materials and components as well as the whole system in scale 1:1 specimen were subjected the following tests at recognized European institutions such as BAM-Berlin and TUM-Munich:

- Dynamic stability after ageing from -60°C to +250°C
- Bond strength to various surfaces for the whole operating temperature range
- Mechanical resistance - 150 kN pneumatic tyre at full opening position, record of deformation and recovery
- Resistance to fatigue – 3030 cycle rollover test at elevated temperature, with 10 % braking >15 year working life category, record of deformation and recovery
- Resistance to fatigue – rutting test acc. to EN 12697-22 at 60°C, record of deformation
- Movement capacity inclusive determination of reaction forces from -40°C and +60°C, fast movements in 7,600.000 cycles with small amplitude and 5 Hz, all of them proving sufficient evenness for safety in use.
- Watertightness test, skid resistance and durability tests on susceptible materials over 3030 hours for oil, fuel, de-icing agents, ageing resulting from temperature, UV-radiation, ozon and freeze-thaw completed the scope.

After having passed all tests and verifications, the product has received in July 2012 the European Technical Approval (ETA) from the responsible EOTA approval body and bears, after passing the certification procedure based on the ETA, the CE-mark.
A description of a trial installation in Greater London, UK at a junction between M25 and A2 under severe conditions in February 2011 illustrates the practical application of the new system.

3. Conclusion

Further to the advantages of the new joint system, such as longer working life, higher mechanical durability and mechanical stability, larger movement capacity up to 135 mm, wider range of application including railway bridges, no rutting effects, no deformation at higher temperatures, no de-bonding or cracking with leakages at low temperatures, no noise the new system has not only the first European Approval for an expansion joint but has also proved in practice its excellent performance for more than 3 years now.

It can be recommended for movements up to 135 mm even substituting mechanical joints.