ABSTRACT: Nowadays, different asphalt systems are used for the surfacing of timber road bridges. However, it is difficult to get adequate information about their load-bearing properties. The authors have participated in a research project to investigate the properties of different, asphalt-based road surfacing materials under service loads. First, suitable material combinations and layer structures were selected for detailed research. The transfer of horizontal forces through the composite construction was a special research interest. A number of test series was carried out to investigate the adhesion between the surfacing and the timber surface. The test results are comparable with those of concrete and steel surfaces. The necessary bonding strength can be achieved with similar systems such as in steel and concrete bridges. Structural recommendations for the practical application are presented in the paper.

KEYWORDS: timber bridge, road bridge, sealant system, blistering of asphalt, shear and tensile tests

1 BACKGROUND AND PROJECT AIMS

Nowadays, mastix asphalt and rolled asphalt are both used for the surfacing of timber road bridges. A durable sealant between the asphalt layer and the timber deck is of enormous importance for both systems [1], [2].

In systems without shear connection between asphalt structure and bridge deck, there is the risk of the development of “surface waves” caused by high braking and acceleration forces.

The authors have participated in a research project to investigate the properties of different, asphalt-based road surfacing materials under service loads. The two most important research topics were concerned with the shear resistance of the surfacing, as well as with the problem of “blistering” often feared when hot asphalt is on top of a timber deck.

2 MATERIAL AND METHODS

In order to determine the properties of various composite structures, shear and tensile bonding tests were carried out. Systems without shear connection and systems with a shear connection between asphalt structure and deck material are used for road bridges: the tests performed during the research work were limited to systems with shear connection as shown in Figure 1.

The following parameters were also investigated:

a) the deck material, such as steel, concrete, cross laminated timber and plywood.
b) the sealant system, such as polymer bitumen membranes and liquid synthetic sealants (based on polymethyl methacrylate, PMMA) together with various surface coatings.

![Diagram of sealant system](image)

**Figure 2: Sketch of a system with a bonded shear connection between asphalt and deck**

There was a practical aspect to the research work as well: The research work included the scientific observation and monitoring during the renovation of the surfacing of the Bubenei Bridge in Canton Berne, Switzerland [3].

### 3 RESULTS

#### 3.1 SHEAR AND TENSILE BOND TESTS

The shear and tensile bonding tests clearly established that there was a sufficient adhesion of the tested waterproofing systems to the wooden base plate. The bonding strength was comparable to that achieved with steel and concrete as base material. A clear difference in the failure mechanism was observed between different sealants were used (Figure 3). The ductile behaviour of the polymer bitumen membrane accommodates larger deformations of a timber bridge and thus reduces the risk of cracks in the asphalt layer.

In one parameter of the sealant and primer systems tested, during the pouring of the hot asphalt, a blistering of the asphalt was observed. The shear strength compared to an undisturbed sample was also reduced by approximately 10 - 15%.

![Stress-Strain-Diagramme](image)

**Figure 3: Stress-Strain-Diagramme for two selected sealant systems on a timber deck**

#### 3.2 PRACTICAL APPLICATION

The research team was allowed to scientifically observe the renovation of the surfacing of the Bubenei Bridge (Canton of Berne, Switzerland). The massive timber deck was surfaced with a 25mm thick asphalt structure [4] supplied with vent holes but without a shear connection. Despite the high wood moisture content, no increased blistering was observed. The temperature in the wooden deck was observed to rise very slowly during the application of the within temperature modified asphalt: a sudden evaporation of water could not occur according to the temperature measurements (Figure 4).

![Temperature profile](image)

**Figure 4: Temperature profile for a timber deck during asphalt coating**

### 4 CONCLUSIONS

A durable sealant between the asphalt layer and the timber deck is an important water protection for timber bridges. Shear tests have revealed that the bonding strength between asphalt structure and timber deck was comparable to that achieved with steel and concrete as base material. For timber bridges with a shear connection between the asphalt structure and the timber deck, a sealing with a vapour proof surface coating prior to the installation of the sealant or the pouring of the hot asphalt is essential.

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### REFERENCES


