Crack detection below the rivet head using the example of the Meißen railway bridge

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Riveted steel structures often look beautiful and are examples of impressive engineering. Bridges for railway and road traffic or pedestrian bridges can still be found in many places in Germany and Europe. Many of these structures are around 100 years old and the question of their stability is becoming increasingly important. In addition to corrosion damage, it is mainly cracks that can occur due to large cyclical loads such as train traffic. The starting point of the cracks is often the rivet hole, so that the crack can initially grow undetected under the rivet head. The previous crack inspection at the rivet head is generally a visual inspection. With this, however, the crack can only be reliably detected when, on the one hand, it reaches the surface and, on the other hand, it is so long that it becomes visible next to the rivet head. By then, however, it is usually already so dramatic that prompt repair measures or bridge closures have to be undertaken. In a research project, the most heavily loaded riveted joints on the Meißen railway bridge were first identified by static calculations. The bridge over the river Elbe has 30 cross girders with two connection points each, at which four critical riveted joints are located. A load simulation showed that there can only be one defined direction of crack propagation. Favourably, this was accessible for ultrasonic testing with the phased array method due to the structural conditions. With the help of reference samples with the same geometry and defined grooves, the phased array test could first be tested and calibrated in the laboratory. In the laboratory, even cracks with a length of 1 mm were detectable. Subsequently, all 320 rivets on the Elbe bridge were tested in the field. The results of both tests are presented and the influence of the practical conditions is discussed.