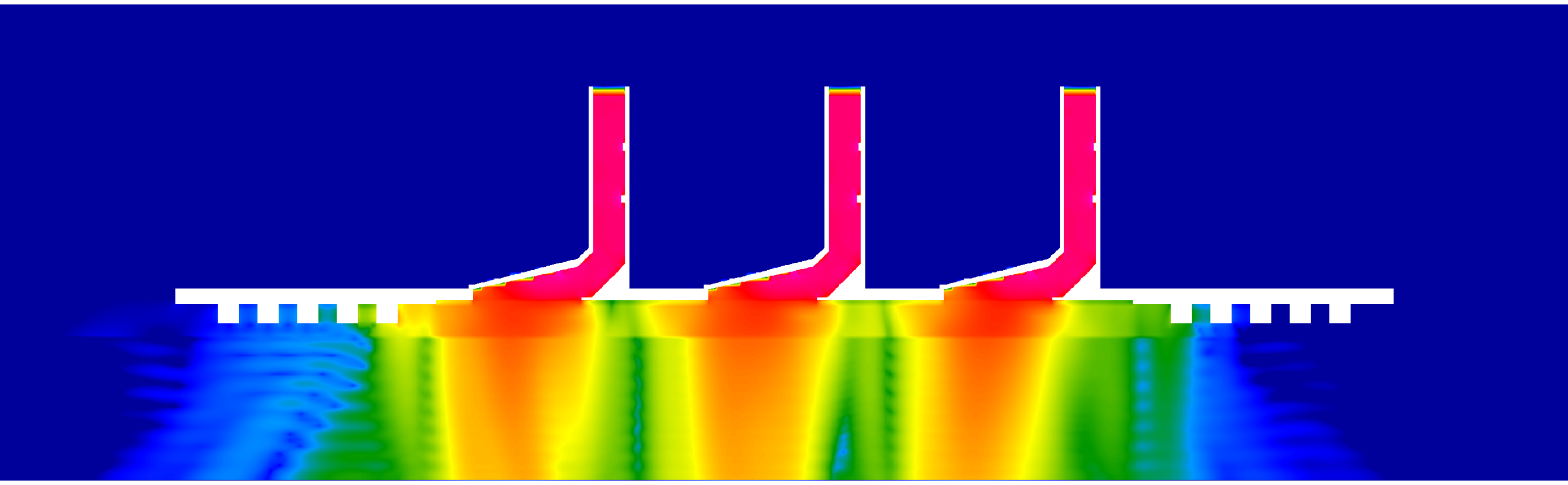
INNOVATIVE MICROWAVE TECHNOLOGY FOR THERMAL BONDING OF BITUMEN SURFACES



An Applicator for Microwave-Assisted Bituminous Surface Thermal Bonding

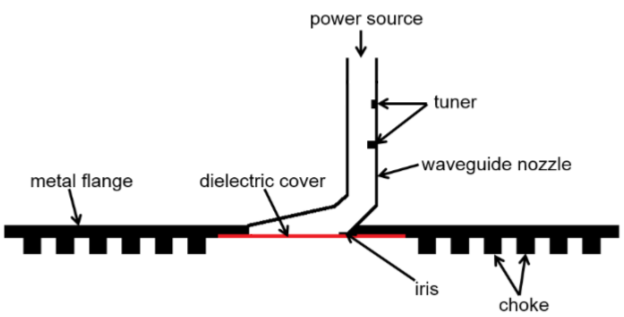
MICROWAVE APPLICATOR – THE PROTOTYPE

The aim of the NGAM2 project, coordinated by The Road and Bridge Research Institute (IBDiM), is to elaborate the model of a device for thermal bonding of bituminous surfaces that takes the advantage of a microwave heating phenomenon. The major goal will be thermal bonding of technological longitudinal joints occurring in bituminous road surfaces, such as joints of independently paved adjacent road lanes or cracks occurring on a road surface.

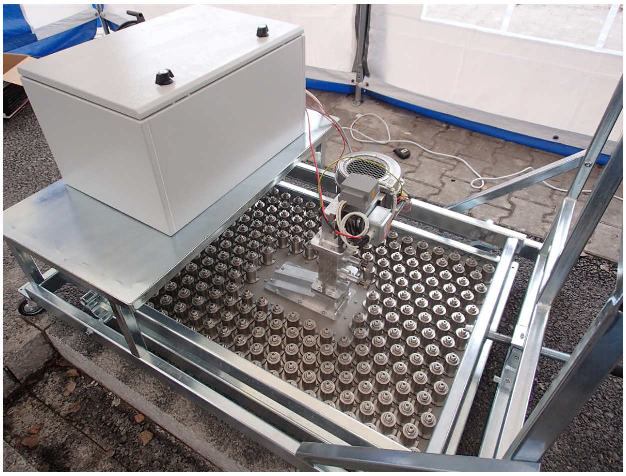
Innovation in the project will be the application of non–ionizing microwave radiation at unlicensed ISM band, 2400-2500 MHz, as an effective method of quick heating at technological joints of bituminous surfaces. The project will solve significant technological issues of effective bonding of bituminous surfaces, thus, remarkably influencing road durability.

This work presents an alternative approach to eliminating longitudinal cracks occurring in bituminous surfaces, inherent to standard road processing cycles. The disadvantages of typical bonding process performed with the aid of gas-jet are mitigated by adopting microwave processing in the near vicinity of the technological gap. For that purpose an applicator for microwave-assisted bituminous surfaces thermal bonding is designed.

The prototype of the applicator is equipped with a waveguide nozzle and a hexagonal lattice of cylindrical metallic chokes preventing microwave leakage. The design is performed with the aid of electromagnetic simulations, based on a finite-difference time domain method implemented in commercial *QuickWave* software for electromagnetic design and simulations. Simulation results are initially validated with experiments and a good agreement is achieved.



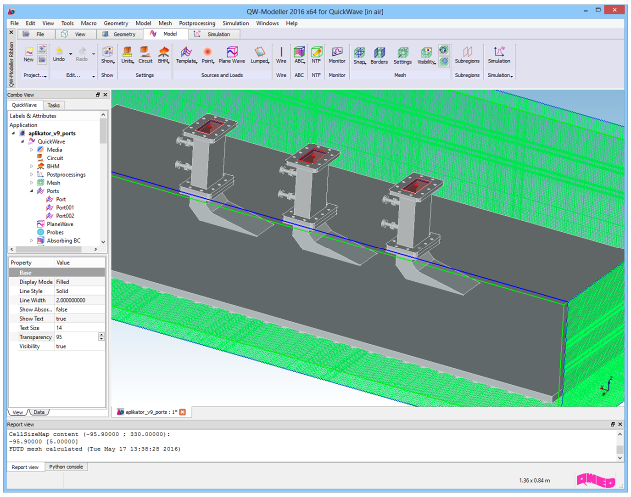
Side view of the prototype of an applicator.



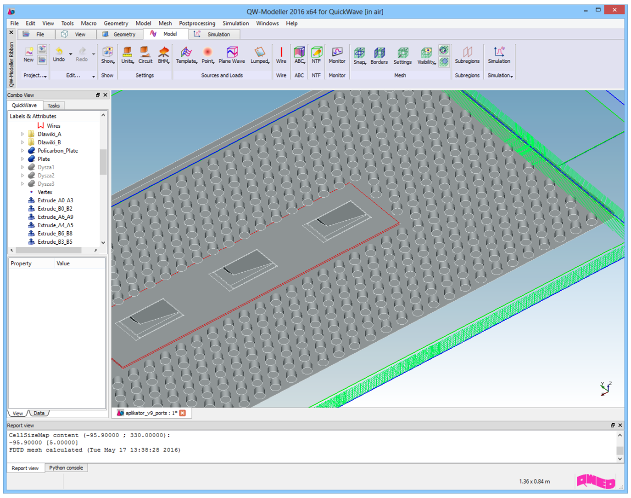
Photograph of an early prototype of the applicator.

Microwave Applicator – optimised structure

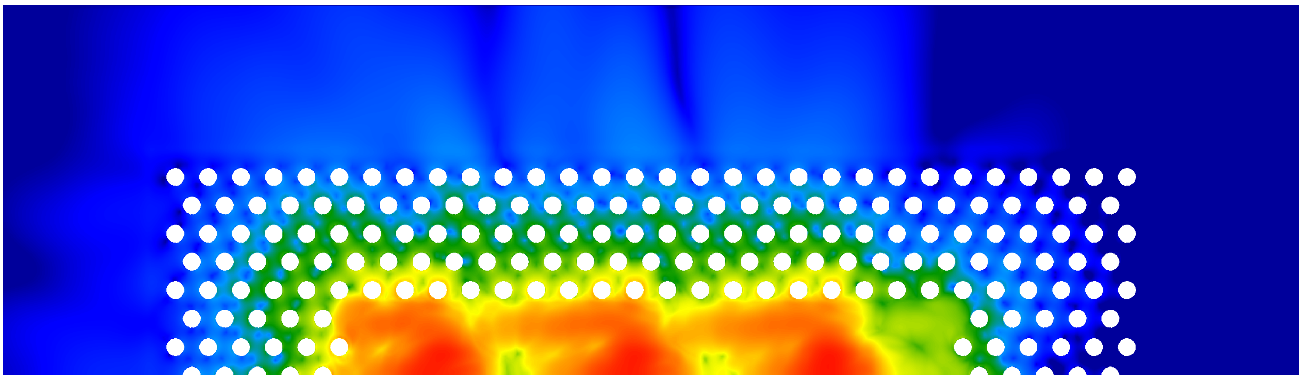
The applicator is equipped with a three waveguide nozzles and a hexagonal lattice of cylindrical metallic chokes preventing microwave leakage. The design is performed with the aid of electromagnetic simulations, based on a finite-difference time domain method implemented in commercial QuickWave software for electromagnetic design and simulations. The device is equipped with a set of radiation sensors cooperating with a remote control system that will turn off the microwave sources in case the safety limits for non-ionizing EM radiation are not satisfied.



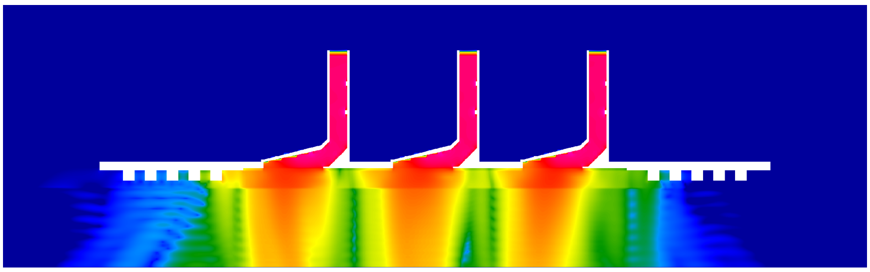
Top view of the computational scenario of the applicator, view in QW-Modeller.



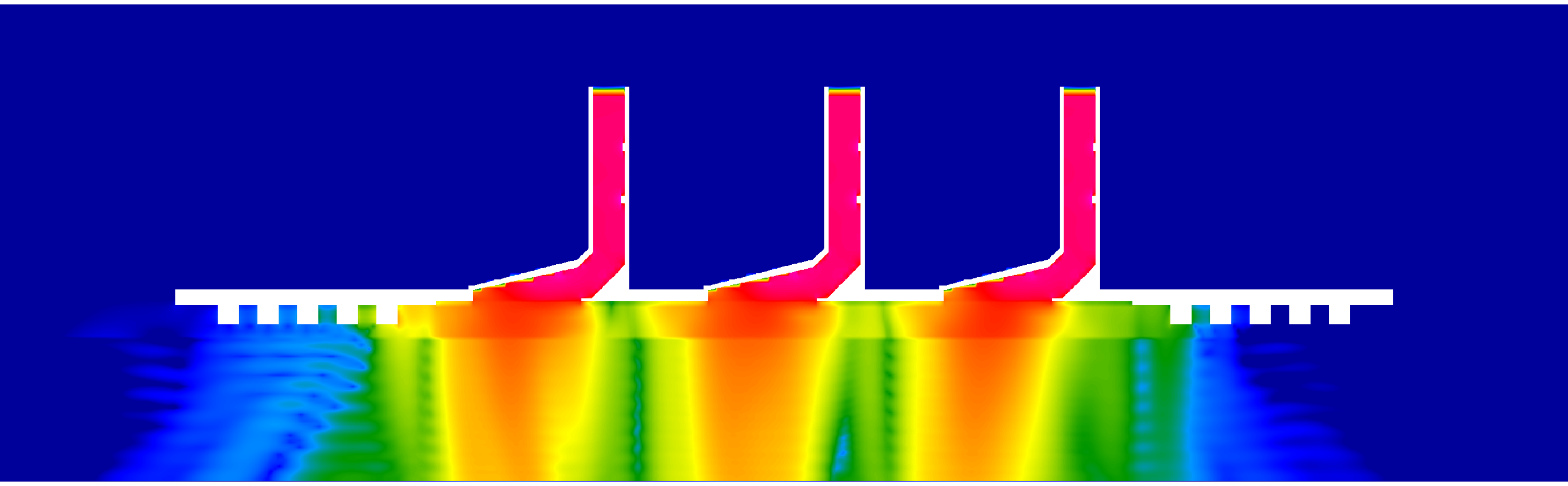
Bottom view of the computational scenario of the applicator, view in QW-Modeller.



Averaged power density (W/mm2) distribution of the half of applicator at the cylindrical chokes plane.



Averaged power density (W/mm2) distribution at the cross-section of the applicator with cylindrical chokes.



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Narodowe Centrum Badań i Rozwoju

In cooperation with:

Instytut Badawczy Dróg i Mostów

QWED Sp. z o.o.

ul. Krzywickiego 12 lok.1, 02-078 Warsaw
tel. +48 22 625 73 19, fax +48 22 621 62 99
www.qwed.eu, info@qwed.eu