Study 'The black gold' in the laboratory

Supervision UT: André Dorée, Frank Bijleveld, Henny ter Huerne (a.g.doree@utwente.nl)

Languages: Dutch, English

Possible companies / contractors: Ooms (Scharwoude), Dura Vermeer (Eemnes), Ballast Nedam (Nieuwegein)

Ooms Nederland Holding bv DURA VERMEER Ballast Nedam

Problem domain and importance

The problem domain can be summarized through the following statements:

- Asphalt plays a vital role in global transportation infrastructure and drives economic growth and social well-being in developed as well as developing countries. In 2007, the estimated world production of asphalt was about 1.6 trillion metric tonnes of asphalt and Europe produces about 435 million metric tonnes per year. In Europe public investment in highway, street, and bridge construction totals about 80 billion euro per year and in the USA the public investment is around 55 billion euro per year. Also, in the USA and Europe the asphalt paving industry collectively employs about 400.000 workers.
- Traditional practice of asphalt paving companies leans heavily on the experience and craftsmanship (tacit knowledge) of the asphalt paving teams on site. This results in individual implicit learning. Therefore, it is difficult to understand the quality of operations during this asphalt paving process.
- Contractors seek for deeper insights into the relationships between the paving and compaction operations and the corresponding project conditions as well as the circumstances at the final functional and mechanical properties of the asphalt pavement. Contrary, knowledge, design rules and models, for these relationships are absent.
- Although the impact and importance of the paving and compaction process to the final quality of the asphalt pavement are recognised – in scientific community and journals – the knowledge about the effects on the quality of the pavement still is in academic infancy. So it is generally unknown how operations impact asphalt pavement quality. The major part of the literature and the research deals with the characteristics of asphalt from a material-perspective.

The challenge

The overall aim of this Msc/Bsc-research is to develop deeper insights into the relationship between operational strategies, the project conditions and circumstances, and the final quality of the asphalt layer. From these insights new paving and compaction strategies can be developed: A set of design rules and models for the paving and compaction process that better fits current policies of the asphalt paving industry (clients and contractors) towards improved and consistent asphalt pavement quality.

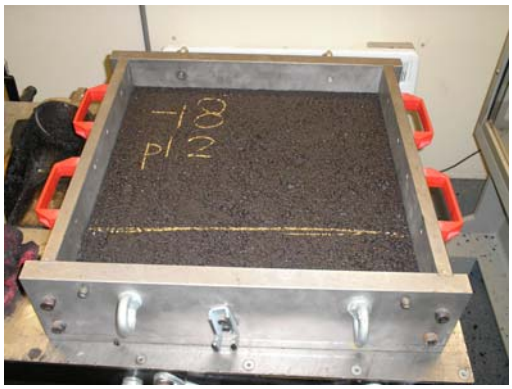
So, for contractors it is necessary to understand the (causal) relationships between operational strategies and the resulting quality of the asphalt pavement. An initial study (Bijleveld, 2010) about the effect of compaction at certain temperatures at the final quality of the pavement show that these relationships can be vital and also gives an impression about the research that should be done (http://essay.utwente.nl/59418/).

But still questions arise - what are for example the effects of the total number of roller passes of the quality of the pavement? The different types of rollers they use? The sequence of the roller passes and the time and temperature windows they compact in?

Research methodology and expected results

To study and evaluate the effects of these different operational strategies, it is difficult and complex to make use of real construction projects. In these projects it is really difficult to distinguish causal relationships because of the number of variables and the inflexibility to control these variables. Because of the large number of variables and the difficulty to control these in practice, the effects of different strategies on the quality of the asphalt layer will be evaluated in a laboratory setting, where variables can be controlled and certain variables can be isolated.

For the lab-experiments a Roller Sector Compaction (RSC) will be used to simulate the compaction process in the laboratory – see the compaction equipment in the figure below. Several studies showed that this rolling compactor has the potential to closely simulate field compaction. With this laboratory compaction equipment, different strategies will be simulated under varying conditions to determine the effects of different strategies and which strategies are best under which conditions.



Making asphalt…. *…and break it again ☺*

With the results of these lab-experiments, it is possible to determine the effects of different operational compaction strategies on the quality of the asphalt layer and design an ideal compaction process to understand why one process is better than the other, and based on which variables the on-site process can be steered. The results from the lab-experiments lead to a deeper insight into the paving and compaction process, the operational behaviour and the effects on the quality of the pavement.