Assessment of asphalt production for reliability-based design optimization

Prof. Matthias Faes[1], Dr. Nicolás Carreño[2]

[1]Supervisor, matthias.faes@tu-dortmund.de

[2]Co-supervisor, nicolas.carreno@vinci-construction.com

Context

In Germany, around 40 million tons of asphalt are produced and paved each year. This material is a highly heterogeneous, as it is a mixture of bitumen, filler, sand, and aggregates from different sources and different shapes and diameters. However, it is usually regarded as a homogenous material for design purposes. Its mechanical properties depend greatly on the parameters of each component, as well as on their mixture. Parameters such as bitumen source, aggregate type, mixture composition, along with the mixing plant configuration, production temperature, aggregate storage and moisture content, among many others, dictate the mechanical performance that the asphalt mixture will exhibit during its service life. This poses the need for a good material characterization to choose the best materials considering the existing variability for a long-lasting road infrastructure. This aspect has gained additional relevance in recent years, due to the impact that the construction sector has on the global green-house gas (GHG) emission. The pressure to reduce the environmental impact that the construction sector has on a European and global scale is leading to scrutinize and reassess the entire production process.

Objectives

The purpose of this project is to evaluate the entire production chain of asphalt mixtures, with the objective to identify and assess where processes should be adapted to mitigate uncertainties during production to build high quality roads. Specific goals associated with this overarching objective are:

- Analyse and characterise material selection processes.
- Study the impact of mixing plant processes.

The processes involved with these two goals have a great impact not only on the mechanical performance of the mixture, but on its environmental impact as well.

Required Skills

To develop this project, the following skills are considered a plus.

- Strong mathematical background.
- Knowledge of software for numerical analysis (e.g. Matlab) and simulation (e.g. Abaqus).
- Reading and writing skills in English.

Application

In case that you are interested in this project, please follow these steps.

1. Read the associated bibliography (see below).
2. Prepare a short motivation letter addressing the following issues:
   a. Your interest in developing this project.
   b. The reasons that make you a good candidate for developing this project.
   c. Intended dates for working in the project.
3. Send the motivation letter to the supervisors via E-mail and ask for an exploratory meeting.

Bibliography

1. Forschungsgesellschaft für Straßen- und Verkehrswesen. (2007/2013). Technische Lieferbedingungen für Asphaltmischgut für den Bau von Verkehrsflächenbefestigungen: TL Asphalt-StB (FGSV R1 - Regelwerke FGSV-797). Köln.
2. Forschungsgesellschaft für Straßen- und Verkehrswesen. (2007/2013). Technische Lieferbedingungen für Straßenbaubitumen und gebrauchsfertige Polymermodifizierte Bitumen: TL Bitumen-StB (FGSV R1 - Regelwerke FGSV-794). Köln.
3. Forschungsgesellschaft für Straßen- und Verkehrswesen. (2013). Zusätzliche technische Vertragsbedingungen und Richtlinien für den Bau von Verkehrsflächenbefestigungen aus Asphalt: ZTV Asphalt-StB 07/13 (FGSV R1 - Regelwerke FGSV-799). Köln.
4. Forschungsgesellschaft für Straßen- und Verkehrswesen. (2012). Richtlinien für die Standardisierung des Oberbaus von Verkehrsflächen: RStO (FGSV R1 - Regelwerke FGSV-499). Köln.
5. Forschungsgesellschaft für Straßen- und Verkehrswesen. (2009/2013). Merkblatt für die Wiederverwendung von Asphalt: M WA (FGSV R1 - Regelwerke FGSV-754). Köln.