PAVING THE WAY FORWARD

The Asphalt Process Newsletter Vol 2 - November 2018

Beste collega's en vrienden,

Het jaar is bijna tot een einde gekomen. Er is veel gebeurd in de ASPARi groep op de universiteit. Op het lokale vlak is Denis Makarov verder gegaan aan zijn onderzoek, Keoma Ong-A-Fat is hard aan het werk met het ontwikkelen van ASPARiCool en Priya Darshini is bezig met het afronden van haar PDEng project over het ontwikkelen van 'Guided Compaction Strategies'. Naast deze lopende projecten zijn er een aantal Masterprojecten afgerond. Marjolein Galesloot, Peter-Jan Runnenboom en Robert Perton hebben namelijk hun projecten allemaal succesvol afgerond en zijn nu aan het werk in de 'echte' wereld. Verder heeft Robbert Bosch zijn bachelorproject bij ons afgerond en gaat hij nu verder met het Masterprogramma.

Op het internationale vlak is Mauricio Pradena op de University of Conception in Chili nog een 'PQI monitoring exercise' aan het uitvoeren. Hij schrijft hierover in deze nieuwsbrief. We zullen hem opnieuw ondersteunen met het plotten van de visualisaties en het analyseren van de data. De visie van ASPARi wordt verspreid in Chili en we wensen Mauricio veel succes met zijn toekomstige werkzaamheden.

Er is ook goed nieuws op het vlak van onze inspanningen in het onderwijs. Babs Ernst heeft zich bij de ASPARi familie gevoegd en gaat innovatieve onderwijsmaterialen voor de hbo-sector wegenbouw maken. In deze editie stelt ze zich voor. Janine Profijt zal terug zijn in januari 2019 om haar nu al succesvolle project af te ronden waarbij ze onderwijsmaterialen heeft gemaakt voor de Mbo-sector. We zijn erg blij om te zien dat haar onderwijsmaterialen al gebruikt worden op het ROC van Twente en de SOMA colleges.

Vergeet verder niet, het jaarlijkse ASPARi symposium en de 'Founders Meeting' vinden plaats op 5 december op het SOMA college in Harderwijk. We hopen jullie daar allemaal te zien.

Met vriendelijke groet,

Seirgei

In deze editie …

- Babs Ernst introductie
- Monik Pena introductie
- Denis Makarov werken op temperatuur metingen
- Mauricio Pradena geeft een update vanuit Chile

Hallo iedereen in het ASPARi Netwerk!


Babs Ernst

Mijn naam is Babs Ernst en ik ben net begonnen met een PDEng project in het ASPARi netwerk. Op dit moment ben ik 23 jaar oud en woon ik in het mooie Twente in de stad Almelo. In mijn vrije tijd houd ik me bezig met (digitaal) tekenen, wandelen en bakken. Al vanaf een jonge leeftijd heeft educatie mijn interesse gehad. Daarom ben ik in 2014 begonnen met een bachelor psychologie hier aan de universiteit Twente met een nadruk op de psychologie achter het leren van mensen. Hierop volgend heb ik de master Educational Science and Technology gedaan, welke ik afgerond heb medio september. Tijdens mijn bachelor en master heb ik mezelf verder ook nog beziggehouden met het geven van bijlessen in wiskunde en Nederlands en het werken als een student assistent.

Voor mijn PDEng project ga ik aan de gang met het ontwerpen van innovatieve onderwijsmaterialen voor wegenbouw op het Hbo-niveau. Toen ik bezig was met mijn masterthese kwam ik de vacature voor deze PDEng tegen en was ik meteen enthousiast voor de positie. Het leek me erg gaaf om de kennis die ik opgedaan had tijdens mijn master toe te passen in een daadwerkelijk ontwerpproject terwijl ik ondertussen mijn kennis nog kan verbreden en verdiepen.

Urban heat island effect

by Monik Pena


Monik Pena

This summer we experienced one of the hottest and driest summers since 1976 on record, with temperatures above 35°C. This prolonged wave of high temperature brought the possibility to enjoy outdoor activities for a longer period of time, but also brought to our attention the importance of climate change and how its effects are impacting our everyday life. We understand climate change as a consequence of the increase of atmospheric greenhouse gases (GHGs) emissions over the last 150 years mainly due to human activity. As the world's population continues to grow, the amount of GHGs emissions is likely to continue to rise. Furthermore, the world's urban population has grown from 751 million in 1950 to 4.2 billion in 2018 and by 2050, 68% of the world's population is expected to live in urban areas. Cities consume 78% of the world's energy and produce about 60% of all carbon dioxide and other GHGs emissions (UN, 2014). Consequently, human activity has also an undeniable impact on the climates of an urban area.

Those climates are known in the literature as urban microclimates, and are determined by a set of local and unique climate features such as urban geometry, construction materials, albedos, sky view factors, wind flow, and urban heat island (UHI) effects. UHI is an interesting phenomenon (figure 1) characterized by an urban-rural air temperature difference of 1-2°C. To overcome the drawbacks of a rapid urbanization and to successfully face the sustainable urban development challenges of this century, a global momentum has been built to reduce urban emissions and therefore mitigate the negative effects of climate change.

My interest in urban microclimates and UHI phenomenon and how they affect each other became more evident just after having realized how hot the asphalt stones were on my balcony, during an ordinary summer day. As a Colombian civil engineer, educated in South Korea, I'm quite used to questioning everything; to be very critical but also very passionate about all the infrastructures around me. I started to question myself the degree to which the road infrastructure is directly related to urban microclimates, how it can be used to mitigate the UHI effects, and to what extent it represents an opportunity to harvest energy, thereby moving a step forward towards resilient and sustainable cities.

I delved into the literature and found that significant research has been carried out to assess the impact of UHI effects on urban microclimates for different urban configurations, and climate conditions. However, the focus has been primarily on buildings and how they contribute to the UHI formation. While very important, the current body of research work largely ignores the potentially significant impact and role played by infrastructures, particularly roads, on the UHI formation. Given the fact that road infrastructure can account for up to 35% of the total urban area (Gwilliam, 2002), this can be a major oversight in the study of UHI and urban microclimates.

My Ph.D. research, therefore, focusses on developing a decision support system (DSS) that captures the interplay between road infrastructure and urban micro-climates to help decision-makers to develop strategies for (1) mitigating UHI effects, and (2) harvesting energy. By integrating and combining several computational data analysis techniques enabling the analysis of urban data streams provided by technologies which are already implemented (i.e., road weather sensors) and tools, such as BIM and GIS.

The road ahead is long. However, I'm very excited about this project and I hope you find it as interesting as I do.

In-asphalt temperature measurements

by Denis Makarov

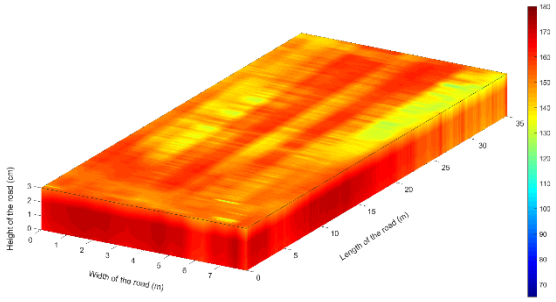

Figure 1. 3D asphalt temperature profile

This year aiming at more accurate analysis of data that have been collected through the years of PQi monitoring, the AS-PARi research unit has developed 3D visualizations for the asphalt layer temperature profiles. As a result, more clear representation of the asphalt layer temperature profile has been obtained (Figure 1).

Visually comprehensible 3D plots inspired the team to develop a better way/protocol of in-asphalt temperatures collection. Following this idea and given the lessons learnt during our previous tests using RFID chips and fiber optic sensors for in-layer temperature measurements, the tried and trusted thermocouples were chosen as a more robust and easier solution to use and install during construction. The focus then was shifted to developing a more accurate and stable thermocouple placement inside the asphalt layers. Brainstorms sessions of the team revealed the possibility to build a 3D model of a stand for fixing the thermocouple sensors on specific heights above the ground and placing them onto predefined spots on the construction site. The stands (Figure 2) can easily be printed with help of 3D printing technology, taking into account the depth of the asphalt layer, a predefined amount of thermocouples and their placement positions inside the layer.

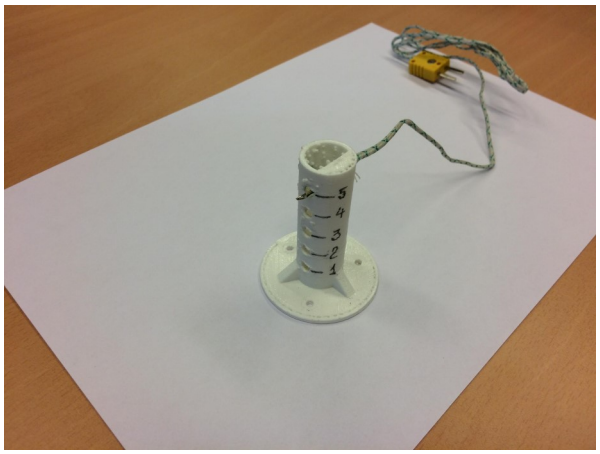

Figure 2. First testing version of the thermocouple

During June and July 2018, first tests using the 3D thermocouple stands were conducted. One of the projects took place along Ulftsestraat, Etten, in collaboration with TWW. The stands were set up for two cooling curve stations with 50 meters between the stations (Figure 3). The thickness of the paved asphalt layer was 4 centimeters.

Figure 3. TWW, cooling curve measurements (June 2018)

The other project was conducted in collaboration with Boskalis on A58, Etten-Leur. For this project the thermocouple stands were improved to create better resistance to toppling over movements during paving. PQi work on the A58 project included monitoring two different asphalt layers with thicknesses of 4,5cm and 2,5cm respectively. Thus, purpose-made stands were used to monitor the temperature in the various layers. Using these purpose-made stands resulted in more accurate temperature data being collected. Based on the gathered temperature data, further research can be conducted regarding the thermal behavior of the asphalt layers during compaction and the influence of a cold or warm base on the temperature profile of the laid asphalt and therefore, on compaction. Furthermore, better asphalt cooling rate prediction algorithms for actual construction projects can be developed and implemented in a new version of pavement operation support systems.

News from Chile!

by Mauricio Pradena

Figure 1. Presentation of the results to the aslphalt pavement team

Dear ASPARi contractors and friends, here Mauricio Pradena sending news from Chile. I introduced myself at the ASPARi newsletter Vol 2 - February 2018 (Page 7). There I shared with you about my special connections with the Netherlands and the work I am developing with Seirgei Miller on the reduction of variability of asphalt pavement construction. Since then not only we have been progressing in that variability reduction in Chile but also, we have already our first scientific article accepted for publication. The paper is based on the pilot project developed in Chile at 2017 (ASPARi newsletter Vol 2 - August 2017) and it deals with making explicit the asphalt pavement process as a fundamental step for quality improvement, the importance of considering the specific context where the PQi methodology is being applied and the “human factor” of that context. The paper, to be published in the Journal of the Croatian Association of Civil Engineers, includes the results of the measurements performed at the pilot project.

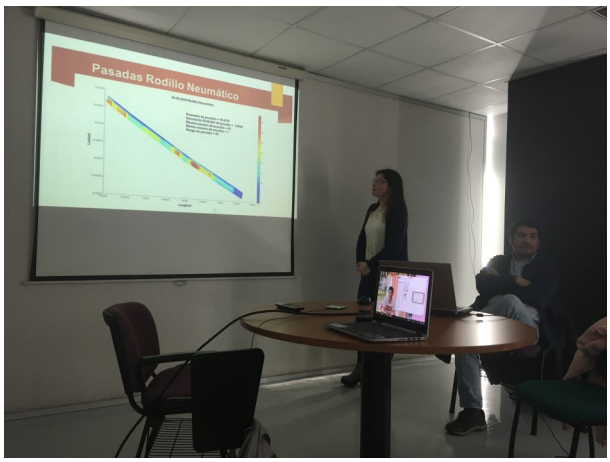

Figure 2. Fernanda, one of the students under my guidance, presenting one of the CCP

Besides that, at the beginning of 2018 I made the first research visit to the University of Twente as part of the Postdoctoral investigation I am developing with Seirgei. My Postdoc project includes most of the work in Chile (in direct collaboration with the Chilean Highway Agency) and research visits to the UT. At May 2018 we performed the first field campaign of the Postdoc investigation with the necessary measurements to make explicit the construction process of the asphalt pavement team we are working with. After the data process and preparation of graphs, visualizations and animations (made at Chile and the Netherlands) we presented the results to the asphalt team in a way that can be understandable and significant to them. The meeting was very interesting with active participation of the engineers, technicians and operators (Figures 1 and 2). In effect, they analysed the results and together we searched for strategies of improvement, due to the importance of the commitment of the asphalt team with those strategies. n that basis and understanding that the improvement should be focussed in the compaction and logistic processes, we had a second meeting only with the operators of the paver, compactors and the field supervisors. There we refined the strategies of improvements to apply in the field. Finally, at the second week of September 2018, we performed a new field campaign (Figures 3 and 4), and although we still need to process all the data, we could assure reduction of the variability of the pavement construction process in comparison with the campaign of May 2018. It was also noticeable the enthusiasm of engineers, technicians, operators and, off course, the research team, with the obtained results.

Well dear ASPARi contractors and friends, I just wanted to share with you the important progress we are making in Chile ….. and this is just the beginning because the highway agency has realized the effectiveness of this applied research. Furthermore, we have a very interesting research team. In addition to what I shared with you in previous ASPARi newsletters, recently a Doctor in Geodesy (a former student assistance of mine) has been added to the research team.