Introduction

In 2018, the USC Airport Pavement Research Program (APRP) has focused on completion of set-up activities and commencing the research priorities agreed in late 2017, as well as student and staff recruitment. As of September 2018, the program is being supported by:

- Australian Airports Association (AAA) in conjunction with the Department of Defence.
- Perth Airport.
- Sunshine Coast Regional Council/Sunshine Coast Airport.

Positive discussions continue with other airports.

Staffing

Dr. Ali Jamshidi will commence at USC as a post-doctoral research fellow in October 2018.

Ali joins the APRP from the pavement construction industry and a post-doctoral position at Hokkaido University, Japan. All's areas of expertise are pavement material testing and the incorporation of sustainable solutions into pavement design and construction.

In 2019 Ahmed Naguib will also join the USC APRP on a full-time PhD scholarship to research ravelling resistance of airport asphalt. Ahmed comes from a laboratory testing background in the USA and the Middle East.

2018 Research Projects

The following student and staff projects are being undertaken during 2018, either directly or in association with the APRP. Some of the outcomes are expected to be presented at the May 2019 AAA Pavement and Lighting Forum in Melbourne.

Ungrooved Stone Mastic Asphalt for Runway Surfacing

Undertaken by Sean Jamieson (Master of Science in Civil Engineering) under the supervision of Dr. Greg White and Dr. Adrian McCallum.

This project is adapting the composition of Stone Mastic Asphalt (SMA) used on Australian roads, as well as overseas airports, and will develop an Australian airport SMA specification within a performance-based framework. A number of ‘typical’ mixtures have been designed, produced and tested with the support of the asphalt industry (AAPA members) to validate the mixture design requirements. An airport asphalt resurfacing project has been identified to include a small field trial for future evaluation. Sean is full-time at USC in 2018 and the findings of this project are expected to be presented in 2019.

Reflection Cracking of Concrete Pavement Joints through Asphalt Overlays

Undertaken by Sahar Deilami (part-time PhD student) under the supervision of Dr. Greg White and Associate Professor Christophe Gerber.

This project aims to develop a laboratory test machine and protocol for measuring the propagation rate of reflection cracks from concrete joints through asphalt overlays. Once developed, the test machine will enable the efficacy and cost-effectiveness to be determined for different asphalt mixtures, strain alleviating membranes and geofabric interlayers. Initial results are expected in 2020 and completion is expected in 2022.

The University of the Sunshine Coast gratefully appreciates the support provided by:
Comparing Layered Elastic and Finite Element Airport Pavement Responses

Undertaken by Lincoln Johnson (undergraduate Civil Engineering student) under the supervision of Dr. Greg White and in collaboration with researchers from the University of Illinois, Chicago, USA.

This project extends the work undertaken by Warren Smith in 2016, with the aim of determining when layered elastic tools are adequate for airport pavement structural analysis and when the additional benefit of finite element tools is warranted. The research includes comparison of finite element model (ABAQUS) calculated pavement response to aircraft loads with equivalent layered elastic model calculated responses, using the Australian design tool (APSDS).

Repeatability of FWD results for airport pavements

Undertaken by Joshua Beehag (undergraduate Civil Engineering student) under the supervision of Dr. Greg White and building on the work by Andrew Barbeler in 2017.

Using a database of results from different FWD machines repeatedly operated over a FAA test pavement, constructed to be as uniform as possible, the repeatability and reliability of key FWD responses will be evaluated. The typical and extreme outliers will be used to calculate layer modulus values and resulting PCNs using the ELMOD software. This will allow the effect of the test variability on pavement strength rating to be determined, as an indicator of the efficacy of relying solely on FWD test results for PCN calculation.

Efficacy of non-destructive testing in lieu of coring for airport asphalt density

Undertaken by Dr. Greg White.

This project explores the use of a non-nuclear density gauge used throughout an asphalt overlay project. The aim is to determine whether the gauge, after calibration and validation, can be used to either reduce or completely replace the need for destructive coring for airport asphalt construction density testing and acceptance. The limitations of the gauge for reliable density evaluation are also considered.

Future research initiatives

Other research projects available in the future, as undergraduate projects, Masters by Research or PhD thesis include:

- Developing instrumentation standards for intelligent airport pavement structures.
- Potential for reusing moisture damaged asphalt in new pavement construction.
- Recycling in rigid and flexible airport pavement materials.
- Non-bituminous asphalt rejuvenation products for asphalt preservation.
- Understanding the impact of laboratory reheating of asphalt samples prior to testing.
- Characterising an airport asphalt mixture by dynamic modulus for better pavement analysis and design.
- Alternates to flexural beams for airport concrete acceptance testing.

Recycled plastic modified and extended bituminous binders for asphalt production

Undertaken by Connor Magee (undergraduate Civil Engineering student) under the supervision of Dr. Greg White and with the support of Brisbane City Council, Fulton Hogan, Boral Asphalt and MacRebur.

This project aims to evaluate asphalt manufactured with different waste plastic for the extension and modification of bituminous binder. The work combines laboratory bitumen testing, laboratory asphalt testing, asphalt production consistency and a field trial in the northern suburbs of Brisbane.

Comparing rigid and flexible airport pavement thicknesses calculated with different design tools from Australia and the USA

Undertaken by Reeve Balestra (undergraduate Civil Engineering student) under the supervision of Dr. Greg White.

This project aims to quantify the differences in pavement thickness required by the USA’s COMFAA, FAARFIELD 1.3, FAARFIELD 1.4 and the Australian APSDS, for both rigid and flexible pavements on a range of subgrades and for a range of commercial aircraft. This will better inform airports regarding the cost implications associated with selecting one software over another.

Comparing Australian-style flexible airport pavement thicknesses to full-depth asphalt and other pavement compositions

Undertaken by Georgia Kelly (undergraduate Civil Engineering student) under the supervision of Dr. Greg White.

This project aims to analyse the financial cost and environmental impact of Australia’s traditional thin asphalt over thick crushed rock style flexible airport pavements, compared to USA FAA style pavements, full-depth asphalt and full-depth asphalt including EME (high modulus asphalt). The results will better inform designers regarding the implications associated with the traditional and alternate pavement compositions of equivalent structural capacity.
Quantifying the impact of reclaimed asphalt pavement on airport asphalt

Undertaken by Dr. Greg White.

This project aims to quantify the impact of RAP on airport asphalt performance by comparing otherwise identical asphalt mixtures, with RAP and without RAP, in the laboratory and in the field. Different RAP sources, including the low risk ramps from the same job and existing surface millings, are both being considered.

Planned 2019 Research Projects

The following student and staff projects will commence in 2019, either directly under, or associated with, the APRP.

Comparing foamed bitumen base properties for different production methods

Undertaken by Tom Weir (Master of Science in Civil Engineering) under the supervision of Dr. Greg White and Dr. Adrian McCallum.

The project will compare foamed bitumen-based products produced in the field and in the laboratory, as well as both field and laboratory curing of samples. The results will provide a better understanding regarding the selection of material modulus values for pavement design, based on laboratory mixture design results.

Tom is full-time at USC in 2019 and the findings of this project are expected to be available towards the end of 2019 and early in 2020.

Evaluation of marginal materials for foamed bitumen base course

Undertaken by Roberto Espinosa (Master of Science in Civil Engineering) under the supervision of Dr. Greg White and Dr. Adrian McCallum.

The project will consider the efficacy and efficiency of foamed bitumen stabilisation of marginal gravel materials. Outcomes will improve the understanding of this useful technology for regional and remote airports, with outcomes expected in 2020 and 2021.

Re-setting construction tolerances for airport asphalt production and construction

Undertaken by Dr. Greg White.

Following completion of three airport overlay projects under the Performance Based Airport Asphalt Specification published by AAPA in 2018, the production and construction quality testing results will be statistically analysed to determine the realistic production and construction compliance tolerances. Statistically reasonable limits will then be incorporated into a revision of the specification. In parallel, guidance material will be prepared for the acceptance or rejection of non-compliant materials and construction, based on fitness for purposes evaluations where they are available.

Predicting the ravelling resistance of airport asphalt mixtures

Undertaken by Ahmed Naguib (PhD student) on scholarship under the supervision of Dr. Greg White and Dr. Adrian McCallum.

This project will investigate theoretical modelling and laboratory testing of asphalt ravelling, the primary distress triggering runway resurfacing when major distresses (such as severe cracking and groove closure) are avoided. The outcome is expected to provide an objective basis for comparing different asphalt mixtures on the basis of relative erosion and ravelling resistance.

Ahmed is full-time in 2019 and the findings of this project are expected to become available from 2020 to 2022.

Industry support and representation

In additional to APRP research and projects, USC APRP staff and students also supported and represented the Australian airport industry through a range of initiatives during 2018, including:

• Pavement engineering inputs to CASA’s MOS 139 review throughout 2018.
• Member and Secretary of the AAA PWG throughout 2018, including telecons and meetings.
• Attended the ICAO Airport Pavement Expert Group meeting (including ACN-PCN changes discussion) in Montreal, Canada, April 2018.
• AAA Webinar Sprayed Sealing for Airports, March, 2018.
• Coordination and chair of the AAA Pavement Technology Workshop, Brisbane, May 2018.
• AAA Webinar Thickness and ACN-PCN, July, 2018.
• Development of a standardised specification for Airport Sprayed Sealing, supported by AAPA and AAA.
Research publications

The following papers and articles have been publications in 2018. All publications and associated student theses are available from the USC APRP output repository, access here, or access via the webpage.

Journal articles


Website and Research Output Repository

Don't forget that the APRP webpage was launched in late 2017, within the USC website, and can be viewed here.

A repository of research outputs has also been developed, accessed via the webpage, or directly accessed here.

Conference papers


White, G 2018, 'Foamed bitumen base for airport pavements', 28th *ARRB International Conference*, Brisbane, Queensland, Australia, 30 April to 2 May.

White, G & Deilami, S 2018, 'Review of reflective cracking mechanisms and mitigations for airport pavements', 28th *ARRB International Conference*, Brisbane, Queensland, Australia, 30 April to 2 May.

White, G & Reid, G 2018, 'Recycled waste plastic for extending and modifying asphalt binders', 8th *Symposium on Pavement Surface Characteristics (SURF 2018)*, Brisbane, Queensland, Australia, 2-4 April.

More information

The next USC APRP update will cover the full year of 2018 and will be available in March 2019. For more information regarding the Airport Pavement Research Program, or to enquire about completing a post-graduate research degree, please contact:

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