

DRaT
Development of the Ravelling Test

Deliverable 6: Interim Report July, 2016

1) Project Facts

Duration: 01/09/2015 – 31/08/2017

Budget: EUR 531.956

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2) Project Description

Ravelling is a common mode of early failure for many types of asphalt pavement. The potential causes for this loss of aggregate particles include lack of sufficient binder; inappropriate aggregate grading; poor adhesion between the binder and the aggregate; errors during compacting; aggressive scuffing by the traffic; ageing; and effect of climatic conditions. The number of different causes and their interdependence makes it difficult to assess the theoretical potential to ravel of an asphalt mixture in the design stage. This is contrary to the general progression towards the design of asphalt mixtures to be resistant to the other principal modes of failure.

Highway authorities need to specify against all the modes of failure that can foreseeably occur. Currently, ravelling is generally attempted to be curtailed by specifying minimum binder content, aggregate grading envelopes and aggregate/binder affinity, but these are indirect assessments that have also been used to counter other aspects of asphalt performance. Recently several simulative laboratory tests have been developed that claim to give an indication of that potential. These tests use scuffing machines that repeatedly apply a scuffing action to slab or core samples to replicate in service loading. The test methods for four such scuffing machines have been written up as a draft technical specification by Comité Européen de Normalisation (CEN) as prCEN/TS 12697-50: Resistance to scuffing. However, these methods need to be culled or combined so that there is only one test method for this one property before the technical specification can be converted into a test standard.

There is a need for a direct scuffing test to assess the resistance to ravelling of asphalt mixtures, but this method needs to be a single measure that is validated against site performance and has good precision.

3) Expected Results

This project will look at the methods of test and the results produced for the four scuffing machines in order to identify:

- The extent to which sample preparation needs to be standardised, such as compaction level, evenness, storage conditions and age when tested.
- The most effective method of measurement in terms of extent of differentiation, validity as a measure of ravelling and practicality.
- Whether the results from one or more scuffing machines can be validated from experience on site.
- Whether the results from different scuffing machines can be converted to a common measure.
- Estimates of the precision of the results with each scuffing machine or, if the results can be converted to a common measure, of the common measure.
- Whether the results from either pair of similar machines are comparable and their results are reproducible.
- A procedure to identify if other scuffing machines can be used for the standard test.

The overall objective is to provide advice on how to refine prCEN/TS 12697-50 to be an acceptable standard with a draft incorporating that advice.

4) Progress

WP1: Information review and site data

A review was conducted by TRL into the parameters that affect the propensity of surface course asphalt to ravel. This culminated in the second deliverable of the project (D2) and informed the choice of variants to investigate in the test programme. The reference mixtures selected to investigate were Porous Asphalt, BBTM and SMA; variants on these mixtures will reflect low binder content and compaction at a lower than optimal temperature.

Milestone 2 made recommendations for sample preparation in WP2.

Mixture type	Binder	Aggregate	Reference	Variant 1	Variant 2
Porous asphalt	70/100 pen	0/16 mm	Compaction at 150°C; 5.2 % binder	4.2 % binder	Compaction at 110°C
BBTM	50/70 pen	0/6 mm	Compaction at 160°C; 5.6 % binder; 12-19 % air voids	4.6 % binder	Compaction at 110°C
SMA	PMB with 3 % SBS polymer	0/11 mm	Compaction at 160°C; 6.8 % binder; 3 % voids; cellulose fibres	5.5 % binder	Compaction at 110°C

D3 *Compendium of sites and the extent of ravelling* received an extension and is still in preparation (due 04/2016) and will provide a review of ravelling experience in the field, providing further context for the project. The premise of the extension was to include any research on ravelling that was reported at this year's Eurasphalt and Eurobitume Congress held in Prague in early June. Actual reported evidence of ravelling experienced in the field seems quite difficult to obtain and any experience of ravelling observed by the PEB would be most welcome to include in this deliverable.

WP2: Sample preparation

The finer points of sample preparation and distribution were discussed at meetings on 20th November 2015 and 29th January 2016. The dimensions of slabs, parameters to be measured directly after production, rejection and acceptance criteria, and method of transit were all agreed.

The first set of porous asphalt slabs were produced and distributed to testing laboratories by BAM during the week commencing 7th March 2016.

The second set of BBTM slabs have been manufactured and were delivered to testing laboratories week commencing 4th April.

The third set of SMA slabs have also been manufactured and were delivered to testing laboratories week commencing 6th June. This is slightly later than planned but has no consequences for the overall schedule. The additional time was required to adjust the mixture compositions, since the original mixtures had resulted in slabs with a greasy surface

appearance. Discussions took place between BAM, TU Darmstadt and Franz Bommert to resolve the issues.

WP3: Test programme

Instructions for testing were prepared by BRRC and agreed by all partners (Milestone 2), with particular attention paid the requirements of the draft standard (12697-50), storage conditions and the age of slabs at the point of testing (10 weeks with a tolerance of 1 week).

Results recording templates for all three sets of slabs have also been distributed by BRRC (D4).

IFSTTAR reported that they had observed very low mass loss whilst testing the initial porous asphalt samples, probably due to the softness of the penetration grade (70/100 is not used in France).

Heijmans had to make some running repairs on their device whilst testing the first set of PA samples.

WP4: Analysis

The meetings and subsequent discussions led by TNO have placed particular emphasis on achieving statistical robustness in the results.

To this end, it was agreed to modify the number of samples prepared and distributed to laboratories utilising quarter slabs in their machines, allowing further degrees of freedom and a greater chance of statistical significance to be observed in the results. Nine additional slabs will be prepared (one of each type of variant of each mixture) making the total number of slabs 144 for the main testing schedule (135 were anticipated in the proposal).

In addition to this, two laboratories have requested additional slabs to investigate (a) the influence of temperature during testing (BRRC) and (b) the method of loading the slab in testing (IFSTTAR). This constitutes work additional to the original scope detailed in Part A of the proposal, but it is anticipated that the findings will be reported in D7 and/or D8.

The additional slabs will be prepared and distributed within the existing cost schedule.

The table below outlines the status of testing results received by TNO, as of 12/07/16.

	Porous Asphalt	BBTM	SMA
Distributed (w/c)	07/03/16	04/04/16	06/06/16
ISAC(Aachen)-ARTE	Received		
BAM-Arte	Received	Received	
Heijmans-RSAT	Received		
BRRC-DSD	Received	Received	
TU Darmstadt-DSD	Received	Received	
IFSTTAR-Triboroute	Received	Received	
STATUS	COMPLETE		

WP5: Dissemination and Project Management

The CEN committee for TG2 were due to be re-engaged about the project at a meeting on 10th-11th March 2016 by committee members represented on the project team. Any outcomes will be discussed at the next project meeting.

The Contract for R&D Services was signed by all partners and submitted to FFG on 9th October 2015.

The Consortium Agreement was signed by all partners and submitted to FFG on 18th February 2016.

All eight ZS-QU2 forms have also been submitted to FFG.

The first invoice was submitted to FFG on 7th June 2016. The payment has yet to be received.

A website will be deployed at: www.trl.co.uk/solutions/road-rail-infrastructure/laboratory-testing/asphalt-testing/drat when the first deliverables have been approved by the PEB and can be uploaded.

A flyer has been prepared for use at conferences / events (D1).

5) List of Meetings

Nr.	Meeting	Location	Date
1	PEB inception	Brussels, Belgium	14 th October 2015
2	Kick-off and initial progress meeting	BRRC, Sterrebeek, Belgium	20 th November 2015
3	Progress meeting	WebEx	29 th January 2016

A further meeting is anticipated in Autumn 2016 when all results have been received and analysed by TNO, unless problems arise that need to be resolved in the meantime.

6) List of Deliverables

Nr.	Deliverable Name / Report Name	Due date (agreed at inception with revised start date)	Actual Submission Date	Approved by PEB
D.1	Webpage and flyer for project	10/2015	Completed but not submitted	
D.2	Review of parameters influencing propensity to ravel	12/2015	22/12/2015	
D.3	Compendium of sites and the extent of ravelling	04/2016		
D.4	Result reporting template	02/2016	30/03/2015	
D.5	Report detailing properties of manufactured slabs	06/2016		
D.6	Interim report	09/2016		
D.7	Factual report on test results	03/2017		
D.8	Report on analysis of results	06/2017		
D.9	Final report giving recommendations for the standard	07/2017		