

AAPA's 14th International Flexible Pavements Conference

Sydney

25–28 September 2011

Topic:

**Asphalt Pavement Solutions – For Life
Implementation project update**

PRESENTER: Ian Rickards

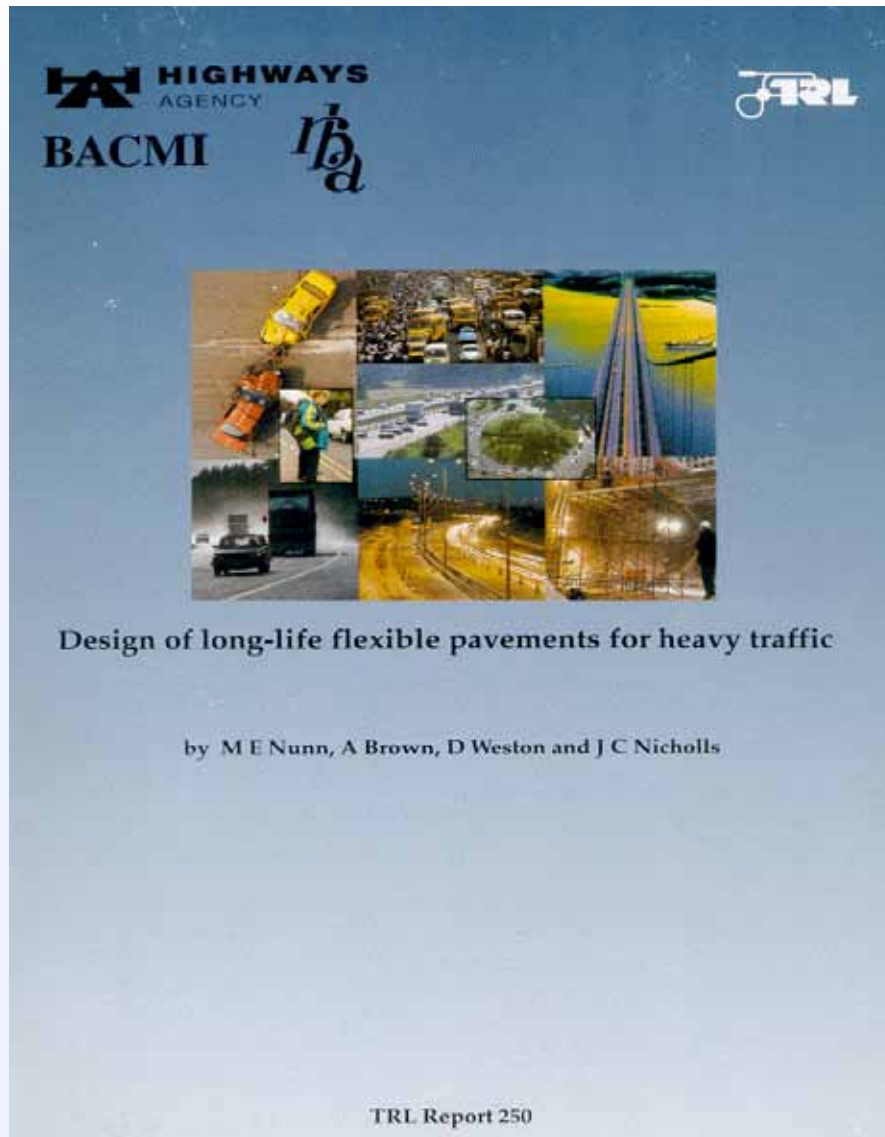
Position: Consultant

Organisation: AAPA

ASPHALT PAVEMENT SOLUTIONS – FOR LIFE (APS-FL) PRESENTATION

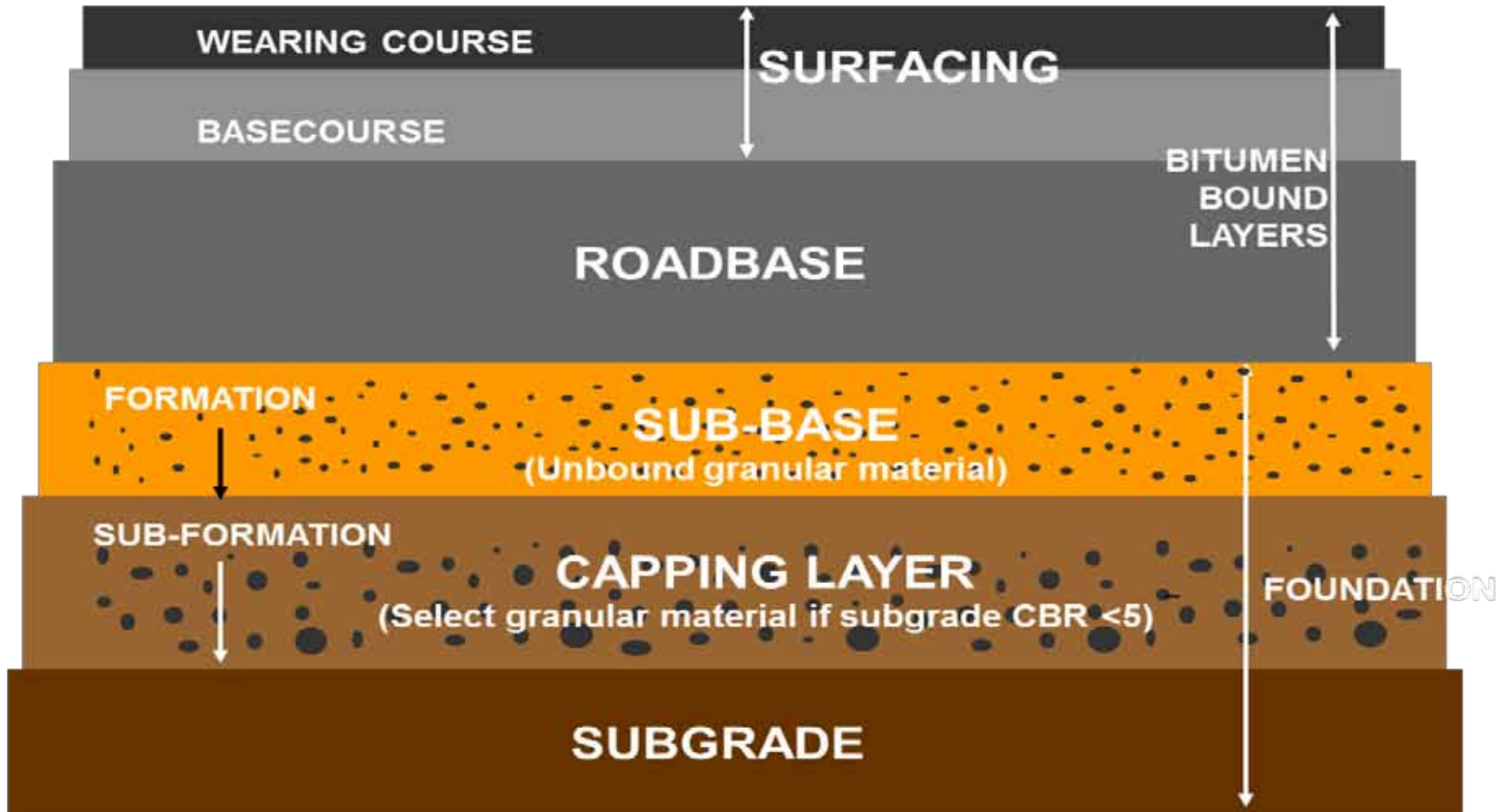
- LLAP background and motivation
- Project methodology and deliverables
- Project current status

APS-FL Project background and motivation

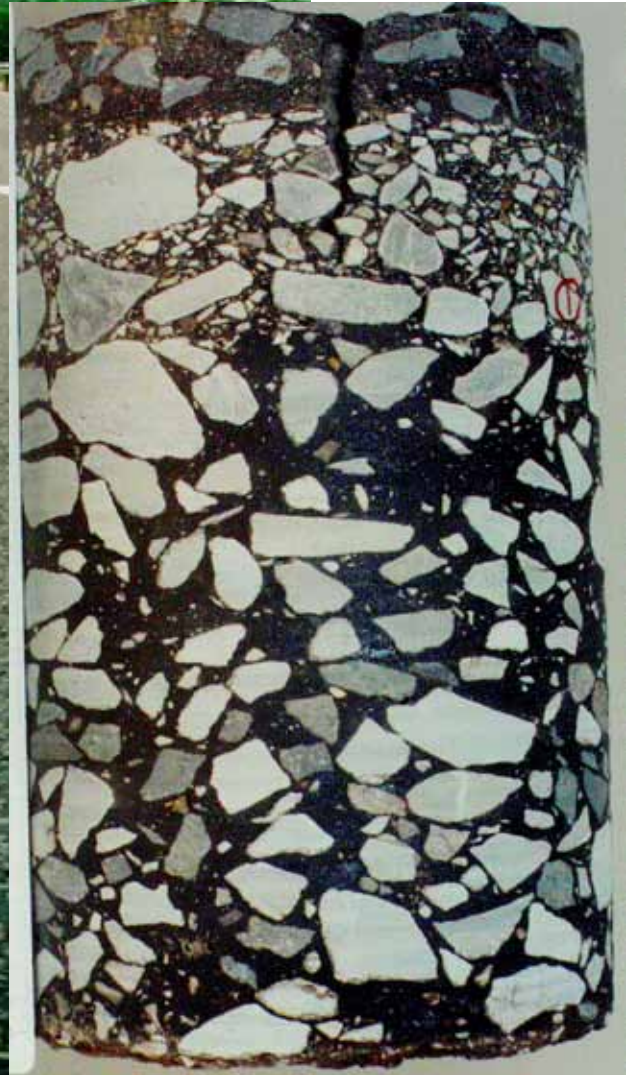


APS-FL Project background and motivation

UK FULLY FLEXIBLE PAVEMENT CONSTRUCTION

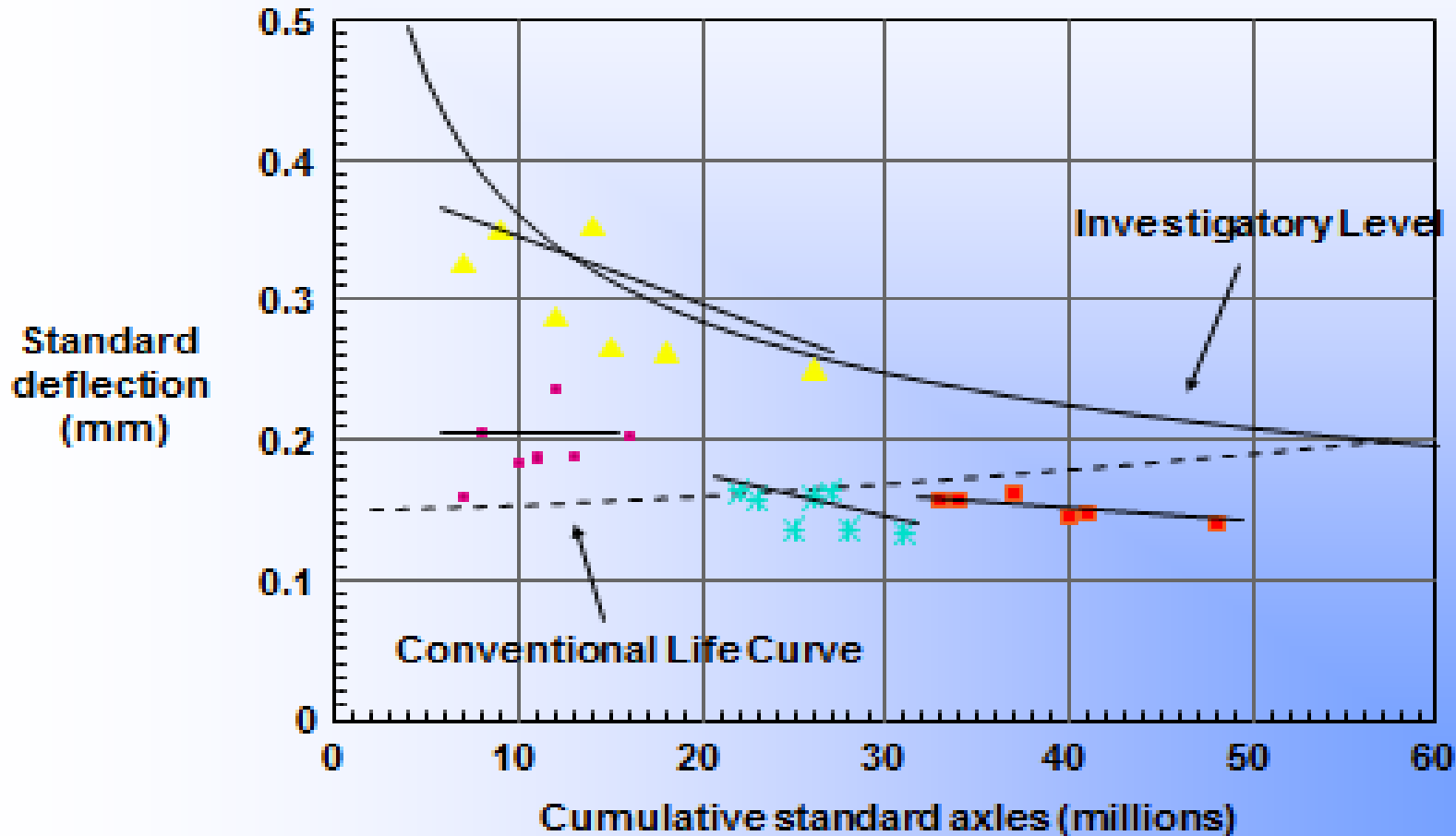


APS-FL Project background and motivation

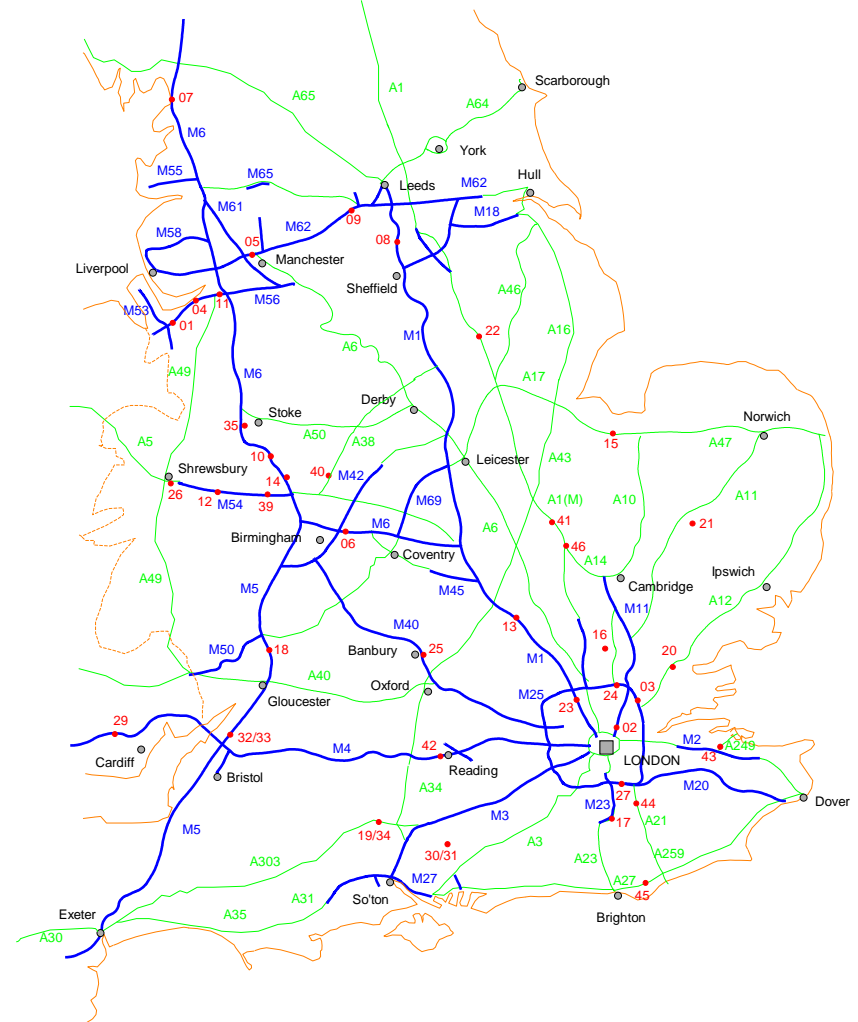
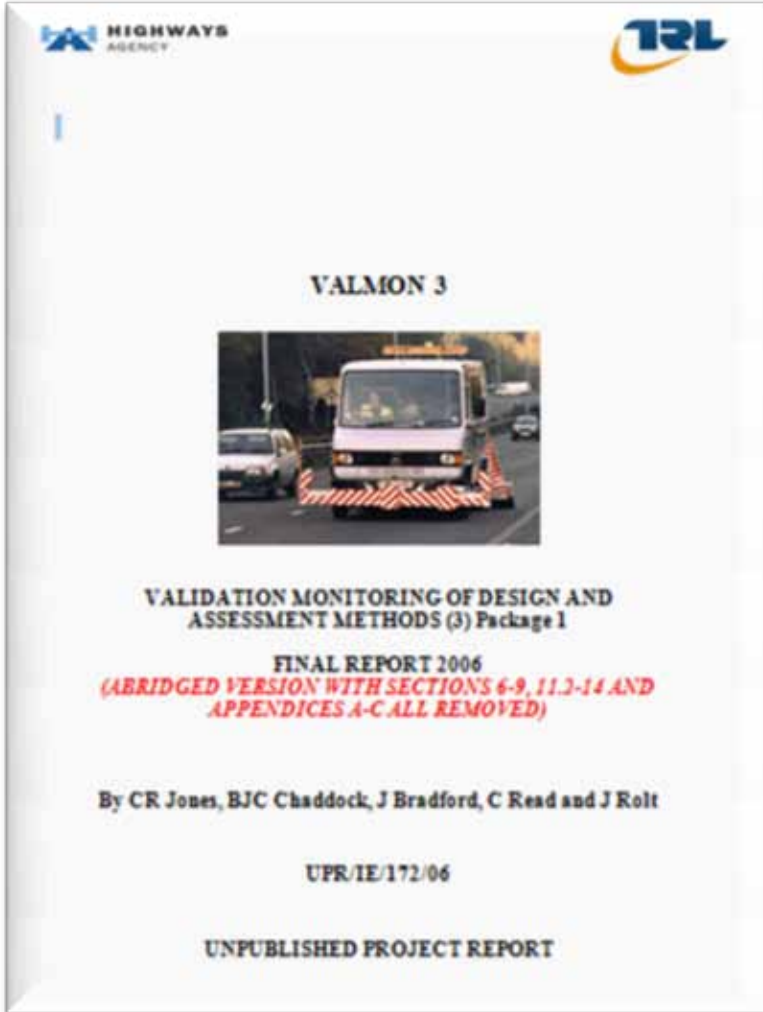


APS-FL Project background and motivation

DEFLECTION HISTORIES OF IN-SERVICE MOTORWAYS (DEFLECTOGRAPH)

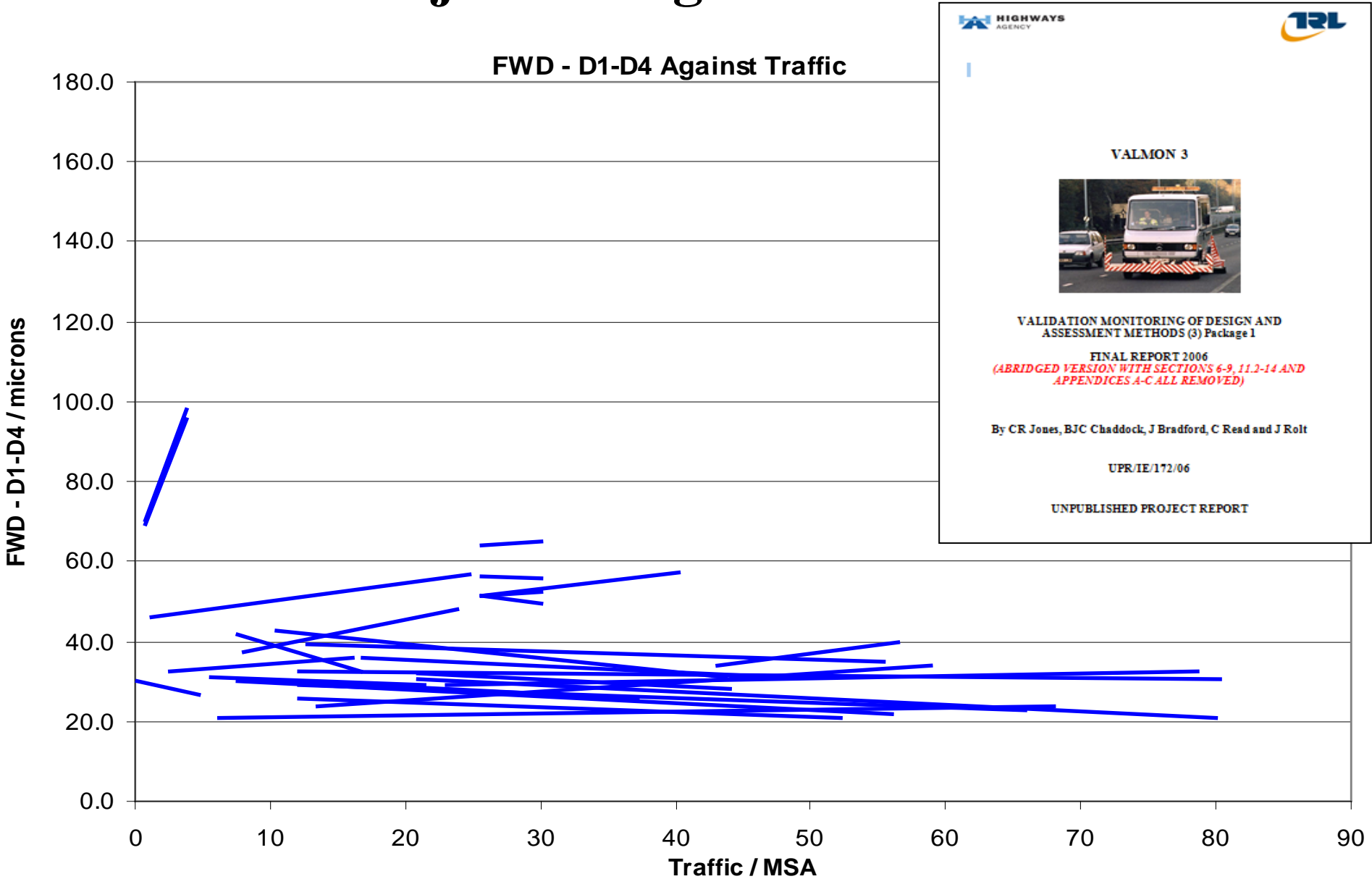


APS-FL Project background and motivation




28 Fully flexible sites monitored

APS-FL Project background and motivation



HIGHWAYS AGENCY **TRL**

VALMON 3



VALIDATION MONITORING OF DESIGN AND ASSESSMENT METHODS (3) Package 1

FINAL REPORT 2006
(ABRIDGED VERSION WITH SECTIONS 6-9, 11.2-14 AND APPENDICES A-C ALL REMOVED)

By CR Jones, BJC Chaddock, J Bradford, C Read and J Rolt

UPR/IE/172/06

UNPUBLISHED PROJECT REPORT

APS-FL Project background and motivation

FEHRL

ellpag
European Long-Life Pavement Group

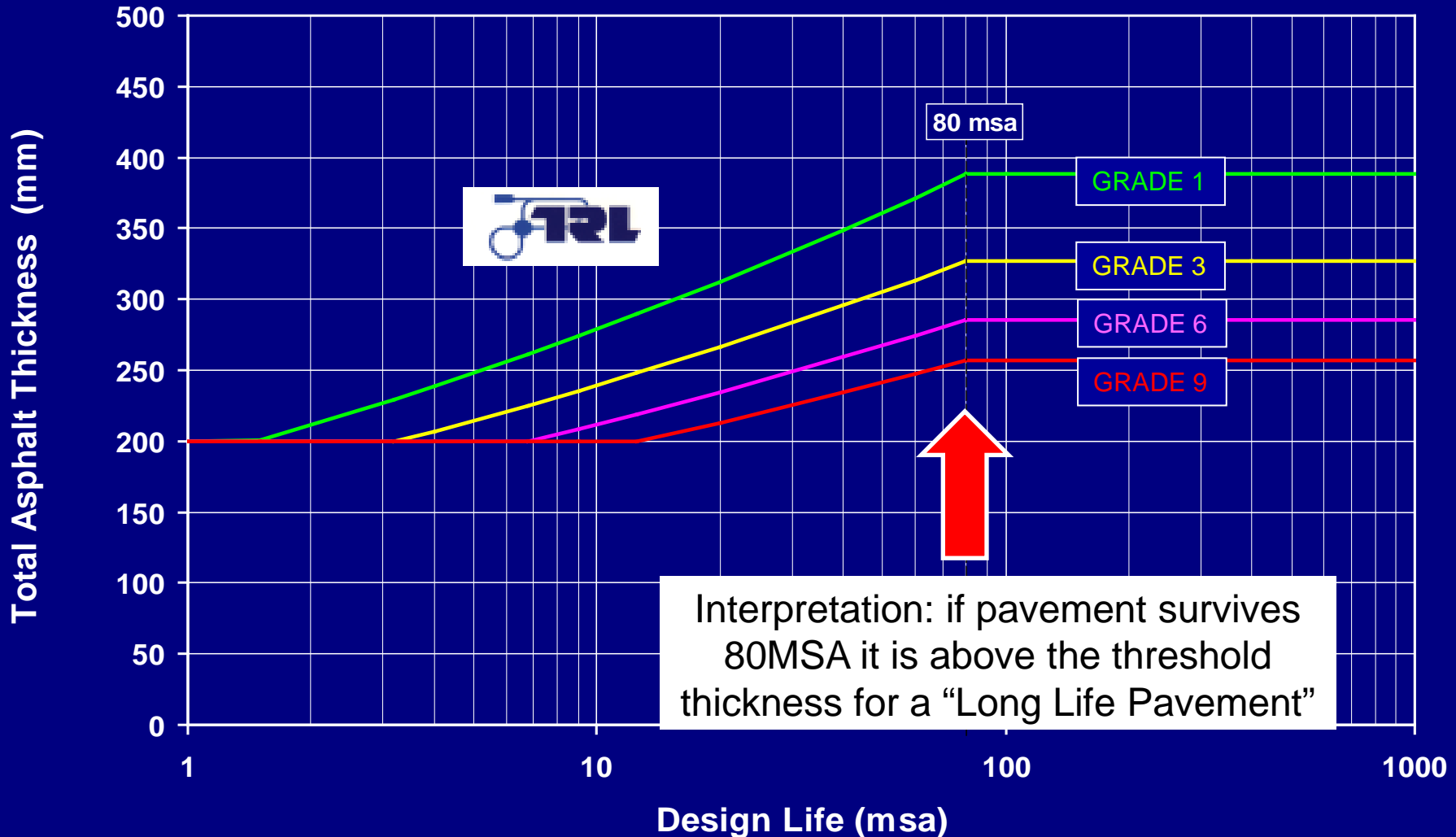
FEHRL REPORT 2004/01
ELLPAG PHASE 1
 A Guide to the Use of Long-Life Fully-Flexible Pavements

The cover features a blue background with a diagonal orange line. Along this line are four circular images showing different stages of pavement construction and testing: a road surface, a road with a vehicle, a close-up of a tire on pavement, and a person working on a road surface.

Avenal Research, Austria www.avenal.ac.at	ANAS, Italy www.ans.it
BRRC, Belgium www.brcc.be	INRR, Luxembourg
CRBL, Bulgaria	DWW, Netherlands www.dmwv.wv.nl/res/dmw
IGH, Croatia www.igh.hr	NPR, Norway www.vegvesen.no
CDV, Czech Republic www.cdv.cz	IBDIM, Poland www.ibdim.edu.pl
DRI, Denmark www.vdi.dk	LNEC, Portugal www-ec.lnec.pt
TECEER, Estonia http://www.teceer.ee	CESTRIN, Romania www.cestrin.ro
LPCO, France www.lpc.fr	IP, Serbia-Montenegro www.highway.co.yu
BAST, Germany www.bast.de	ZAG, Slovenia www.zag.si
KEDE, Greece	CEDEX, Spain www.cedex.es
KTI, Hungary www.kti.hu	VTI, Sweden www.vti.se
PRA, Iceland www.vegagerdin.is	LAVOC-EPFL, Switzerland lavoc.epfl.ch
NRA, Ireland www.nra.ie	TRL, United Kingdom www.trl.co.uk
TKTI, Lithuania www.tkti.lt	FEHRL www.fehrl.org

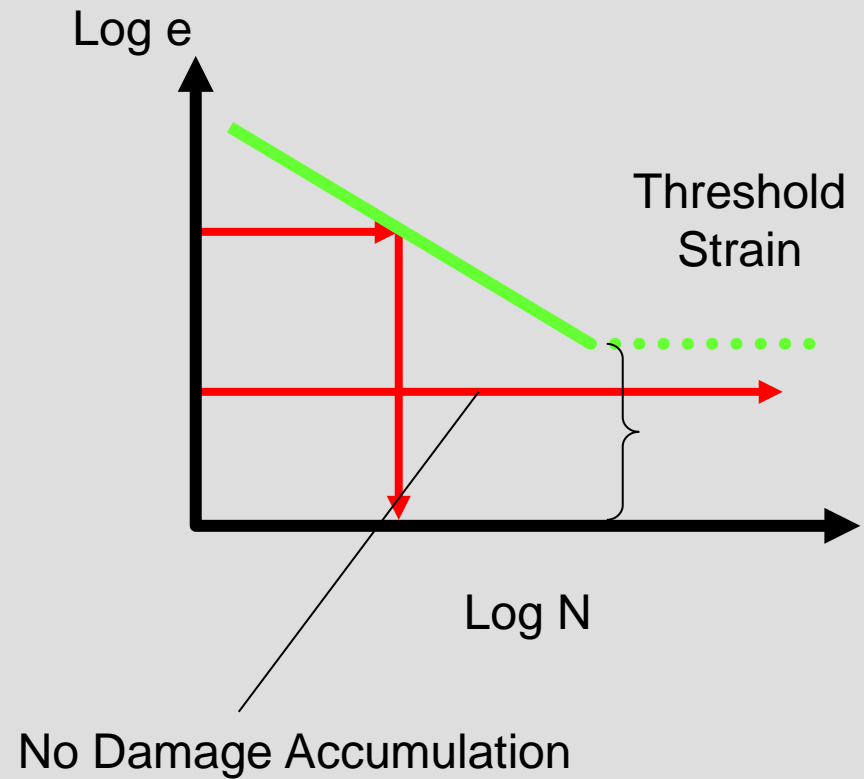
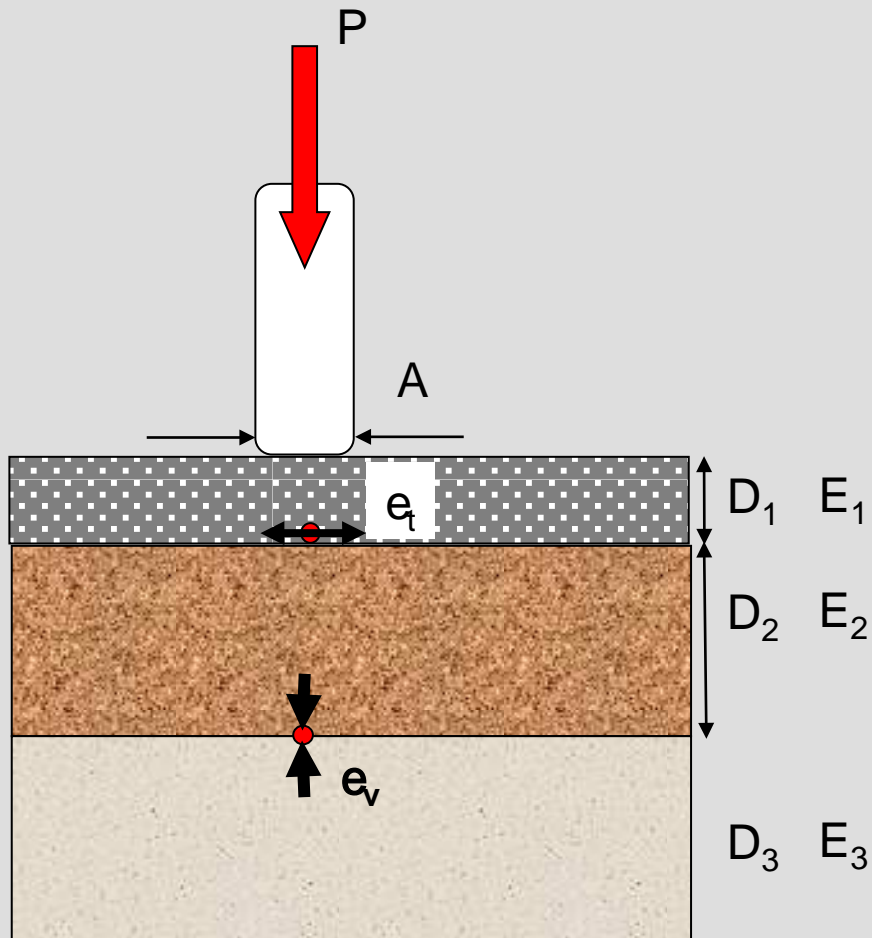
APS-FL Project background and motivation

UK Highways Agency design chart

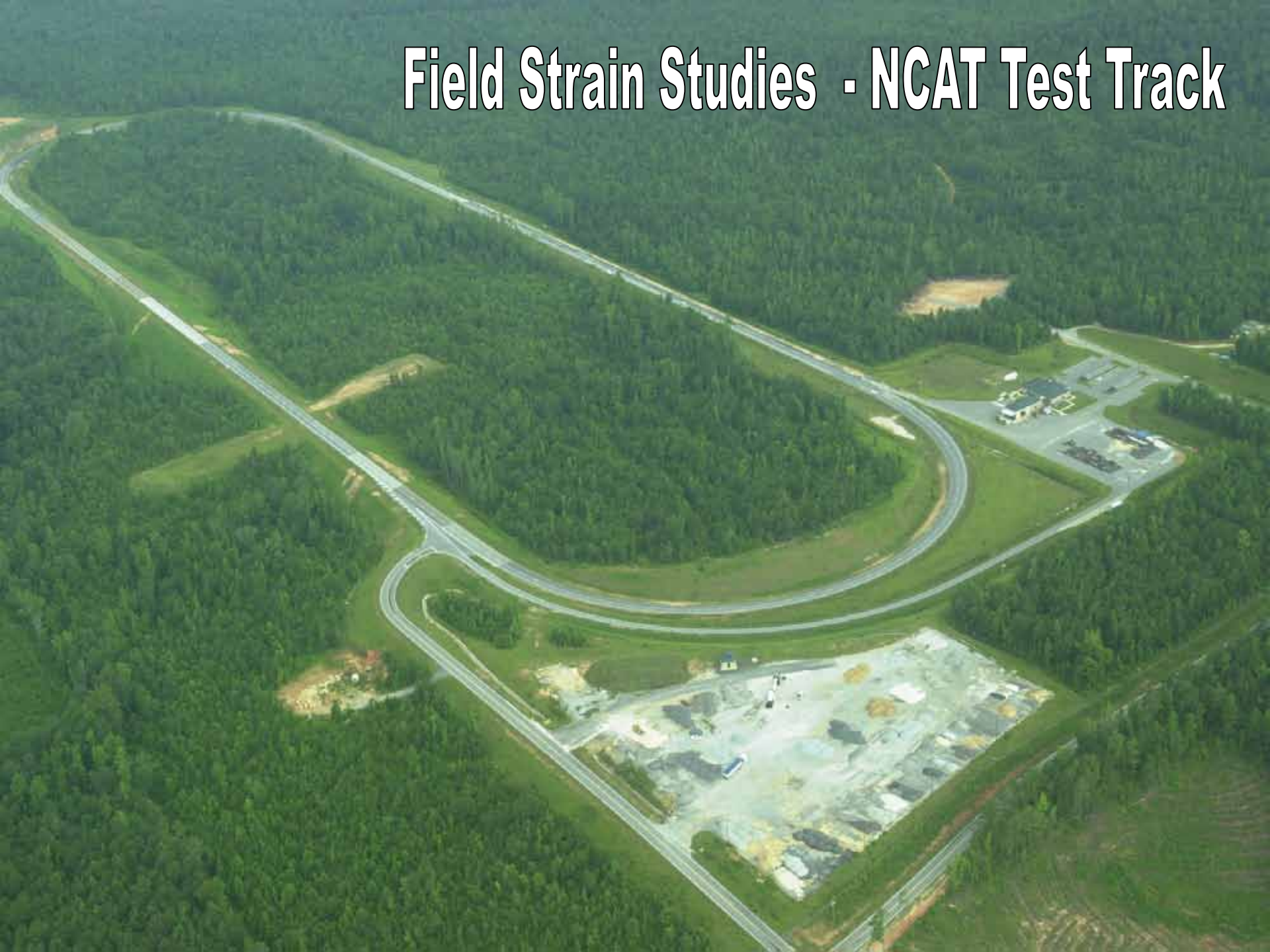


APS-FL Project background and motivation

ASPHALT FATIGUE ENDURANCE LIMIT CONCEPT

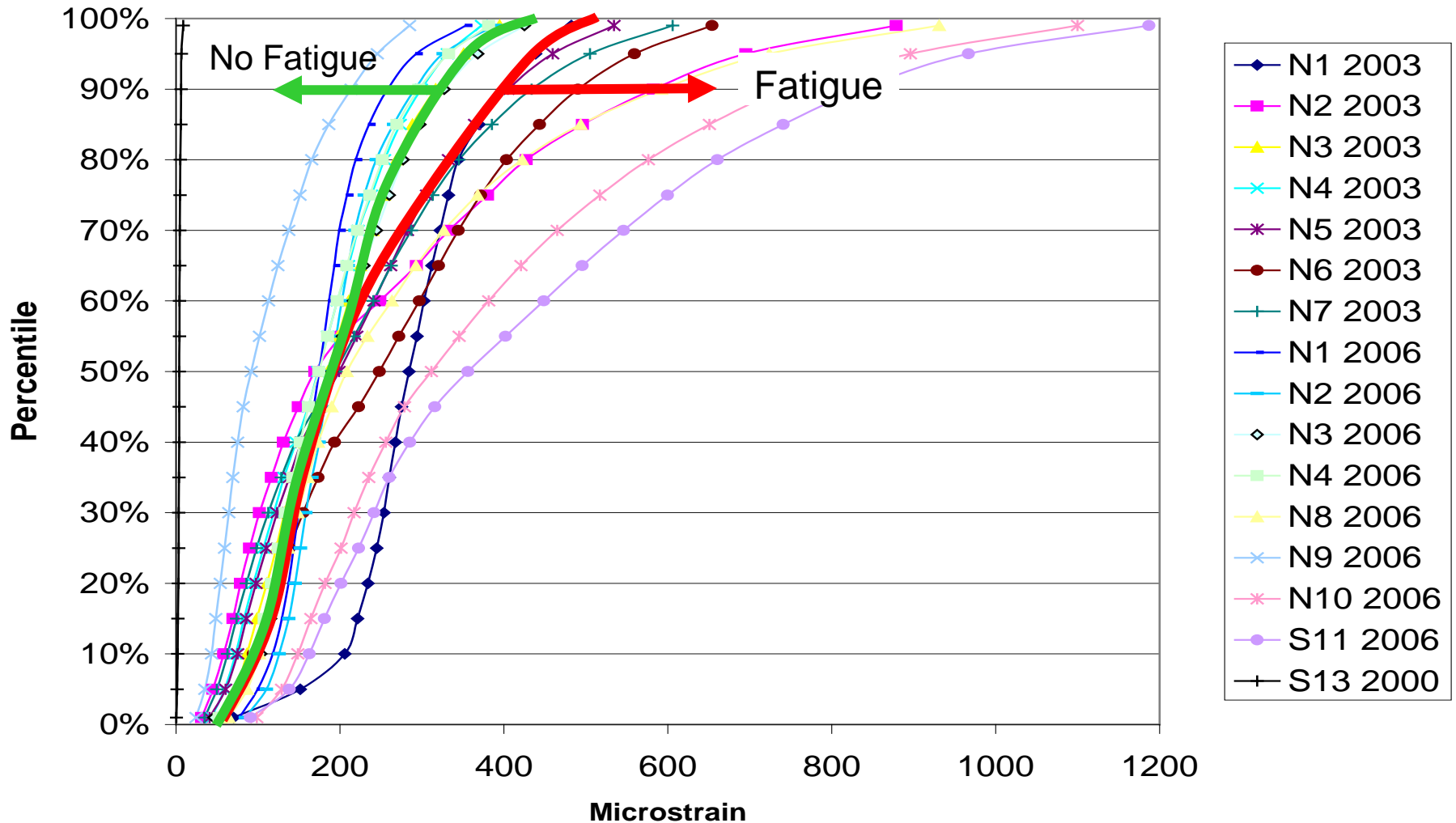


Field Strain Studies - NCAT Test Track



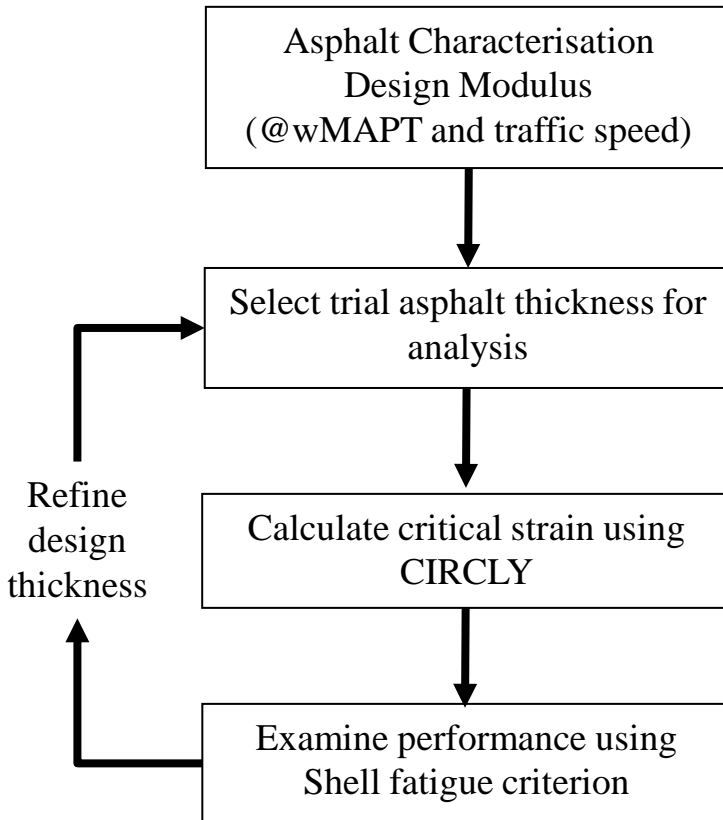
APS-FL Project background and motivation

CORRELATION OF STRAIN DISTRIBUTION AND PERFORMACNE

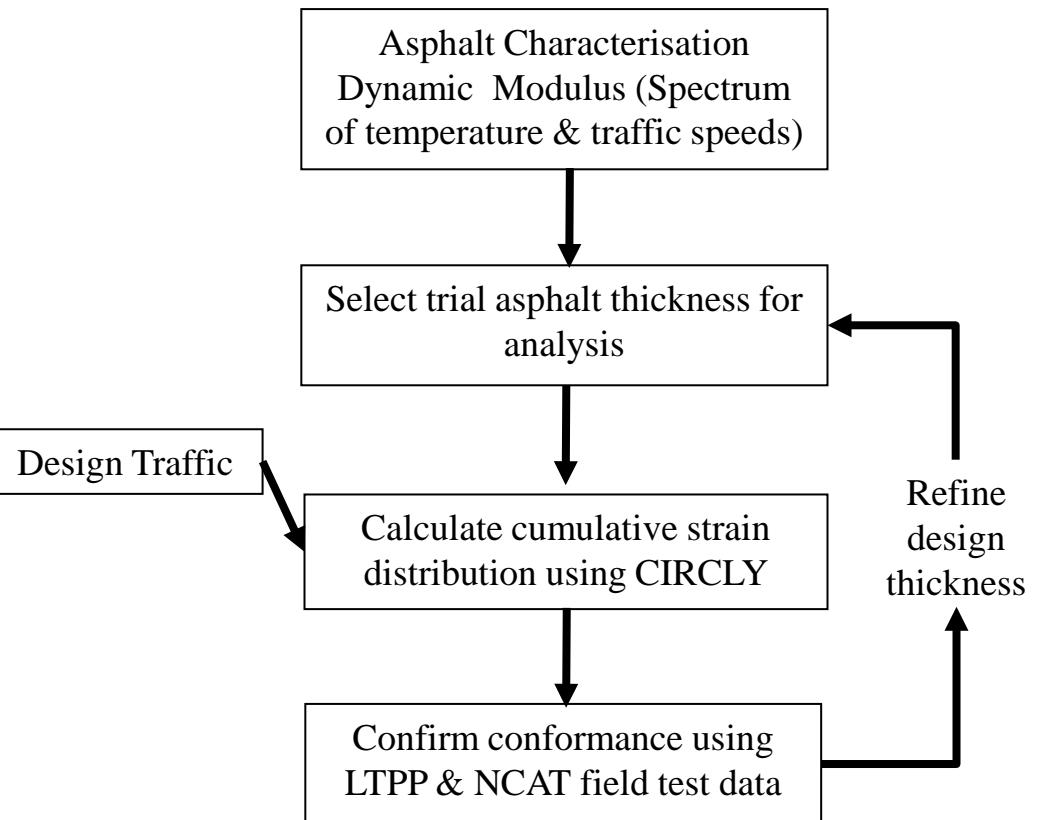


APS-FL Project background and motivation

CURRENT AUSTRROADS DESIGN METHOD



PROPOSED ASP-FL DESIGN METHOD



APS-FL Project background and motivation



Bottom-Up Fatigue Cracking

- “Myth or Reality?”, Prof. Molenaar (2004)
 - “...does bottom-up fatigue cracking we predict...exist or is it a myth which means that our design models are wrong?”
 - Bottom damage
 - more likely develops a “zone of degradation”
 - seriously doubts that it appears as a visible crack
 - Longitudinal cracks can develop at the pavement surface because of complex tire contact stresses and develop as sharp, clearly visible cracks because of localized stresses

APS-FL Project background and motivation

TRL observations on classical fatigue

No evidence of bottom-up fatigue cracking:

- **From long-term monitoring of full-scale experimental pavements.**
- **In material extracted from UK motorways that had exceeded their design life.**
- **From condition assessment reports and specific investigations**

APS-FL Project background and motivation

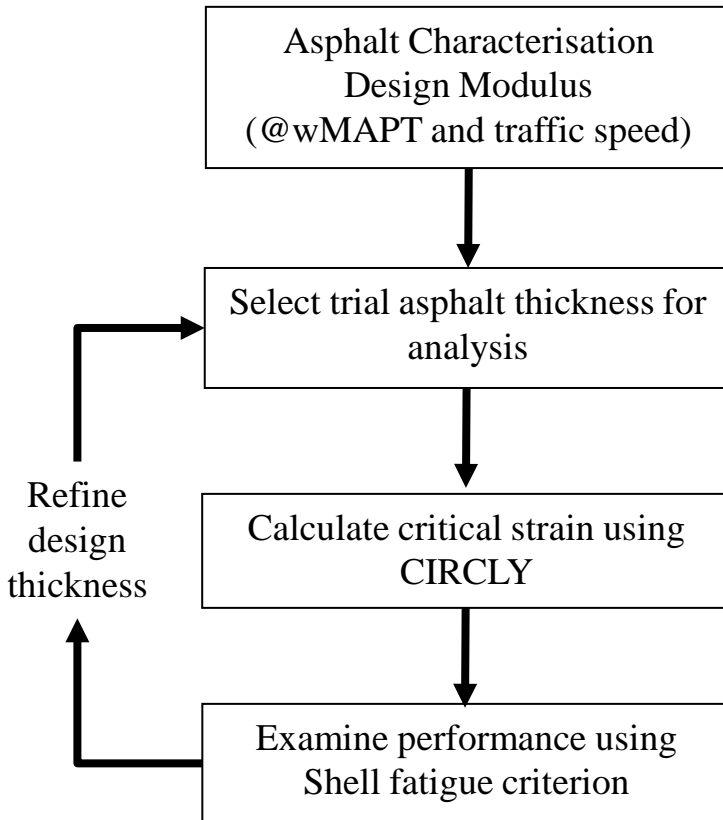
Supporting evidence from elsewhere

The German Road Research Laboratory (BASt) monitored in excess of 170 pavements for over 23 years and they concluded (Werner, 1995) that:

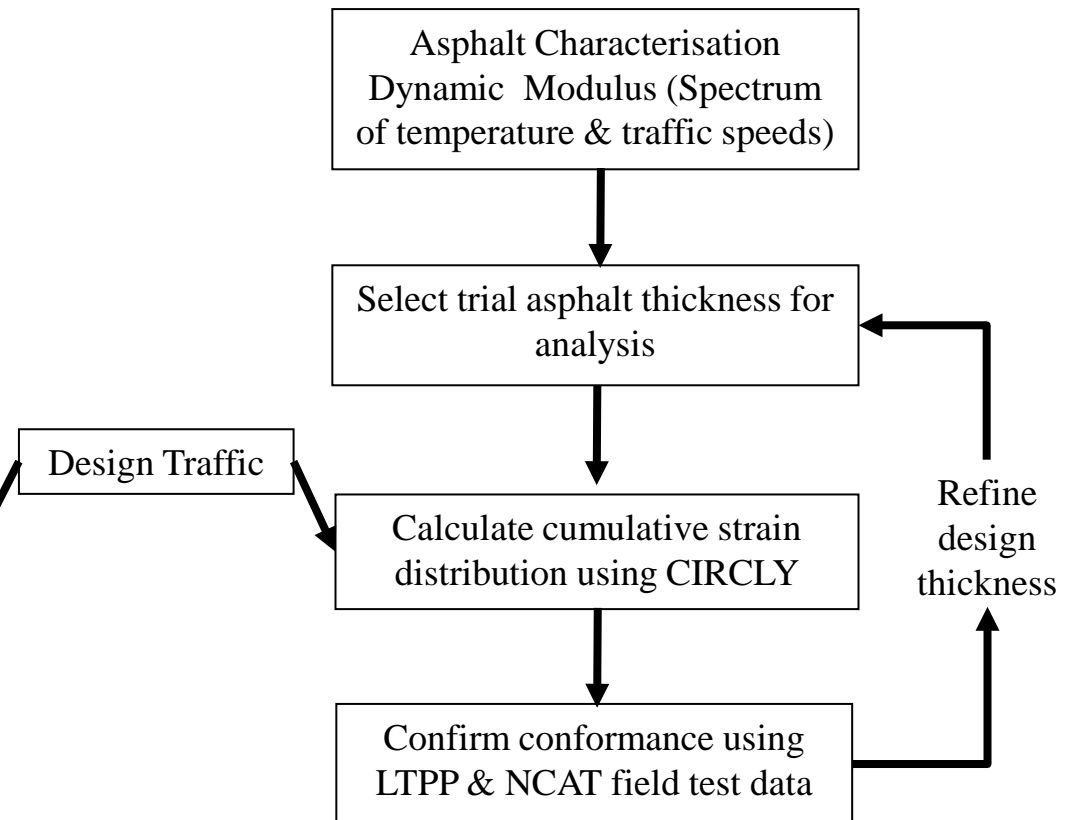
“In Germany fatigue theories are only applicable under certain conditions, if at all for the relatively thick pavements found in Germany. As a result fatigue theories should be checked regarding their universal validity”.

APS-FL Project background and motivation

CURRENT AUSTRROADS DESIGN METHOD



PROPOSED ASP-FL DESIGN METHOD



APS-FL Project background and motivation

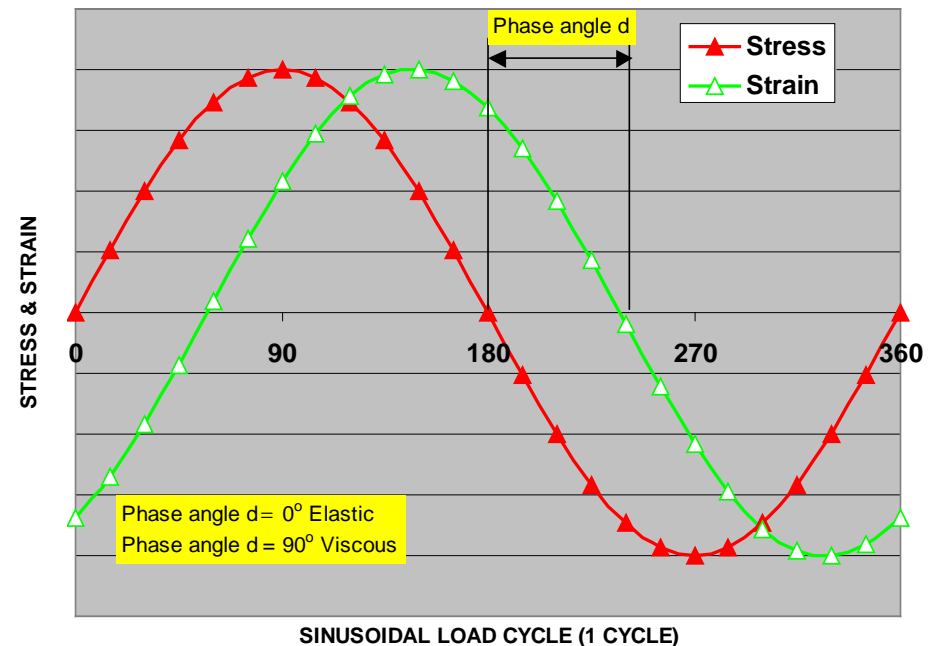
- Recap: NCAT findings
 - Measured the fluctuation in asphalt stiffness and strain as a function of temperature spectrum
 - Concluded the limiting of the cumulative distribution of asphalt strain is a rational design criterion
- Thus we need to model asphalt stiffness over the temperature spectrum in design analyses
- This process will enable us to calibrate the LLAP design limits by analysis of LTPP sites

APS-FL Project background and motivation

ASPHALT MATERIALS PERFORMANCE TESTER (AMPT)

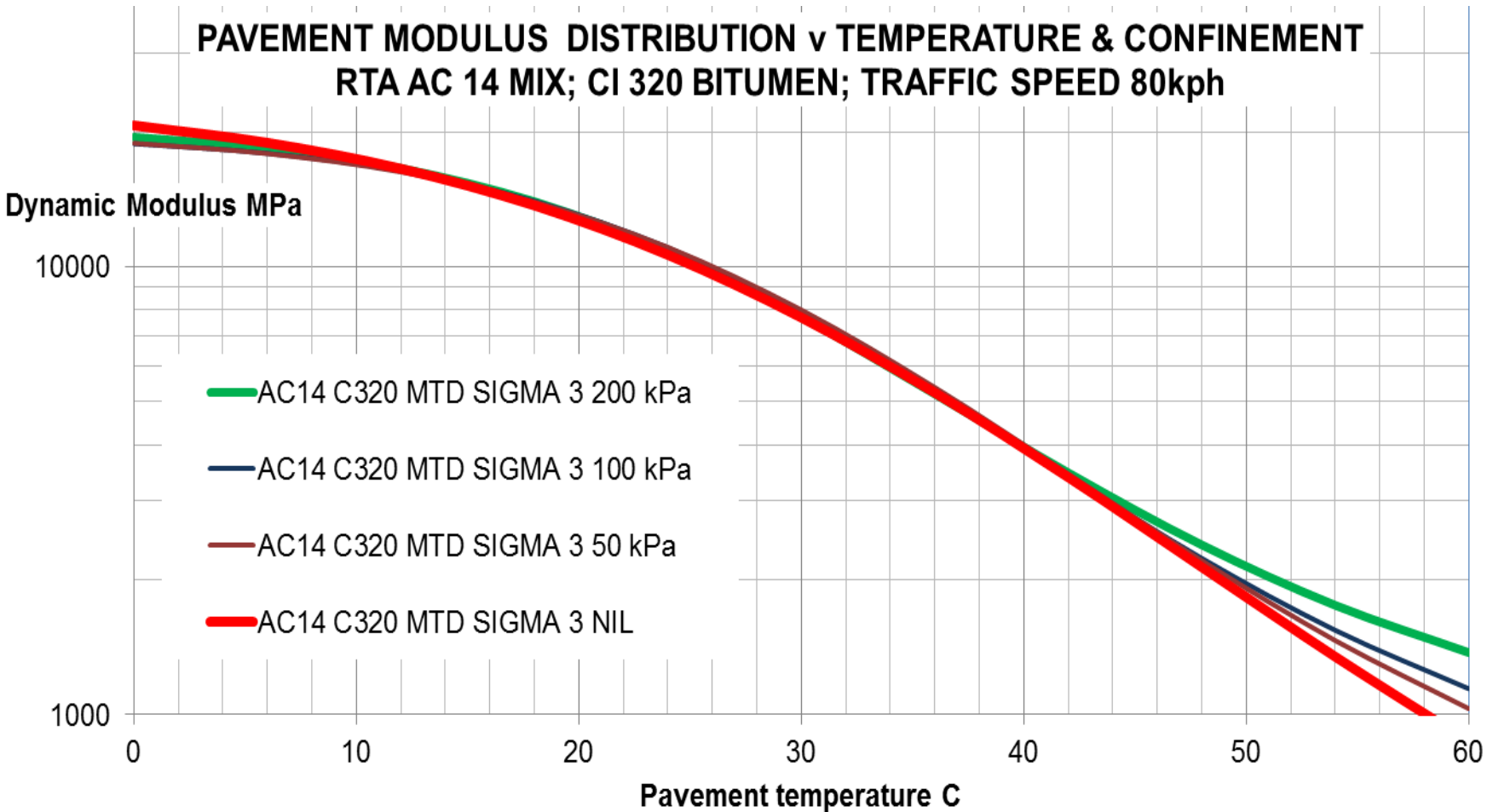


SPT TEST - OUTPUT DATA DYNAMIC MODULUS E^*



APS-FL Project background and motivation

Dynamic modulus master curve



APS-FL national asphalt characterisation study

Objectives

- Determine typical E^* v temperature and load duration of typical Australian mixes
- Determine typical G^* v temperature and load frequency of typical Australian bitumen
- Calibrate predictive models e.g. Hirsch
- Once calibrated can be used in the absence of laboratory data

APS-FL national asphalt characterisation study

- Replicate testing in overseas laboratory for calibration purposes
- Establishes basis for comparison with overseas mix to facilitate access to LTPP data i.e. similar laboratory performance will imply similar field performance

APS-FL national asphalt characterisation study

- Analysis of laboratory test data; development of material models for thickness design
- Report summarising relationship local and overseas mixes; implications for technology transfer
- Peer review of APS-FL project and research plan; workshops with overseas experts

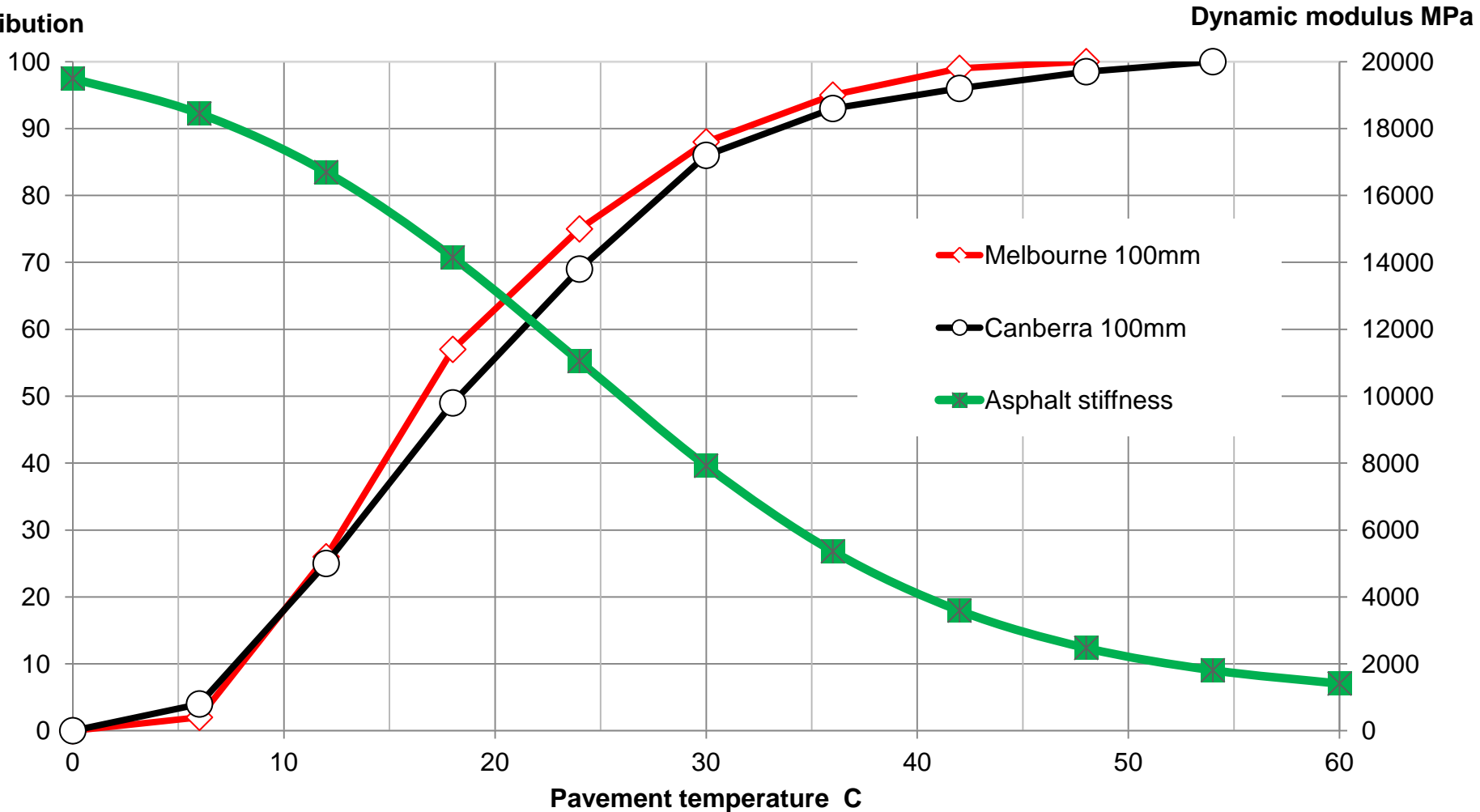
Long life pavement design software and manual

- Define software methodology; prepare project brief and obtain cost estimates
- Beta version; temperature spectrum single layer; outputs cumulative distribution of strain
- Refinement; modeling multi layer structure; output strain distribution cumulative damage
- Final version; includes iterative loop to yield required thickness to satisfy design criterion

Long life pavement design software and manual

TRAFFIC, PAVEMENT TEMPERATURE & ASPHALT STIFFNESS DISTRIBUTION

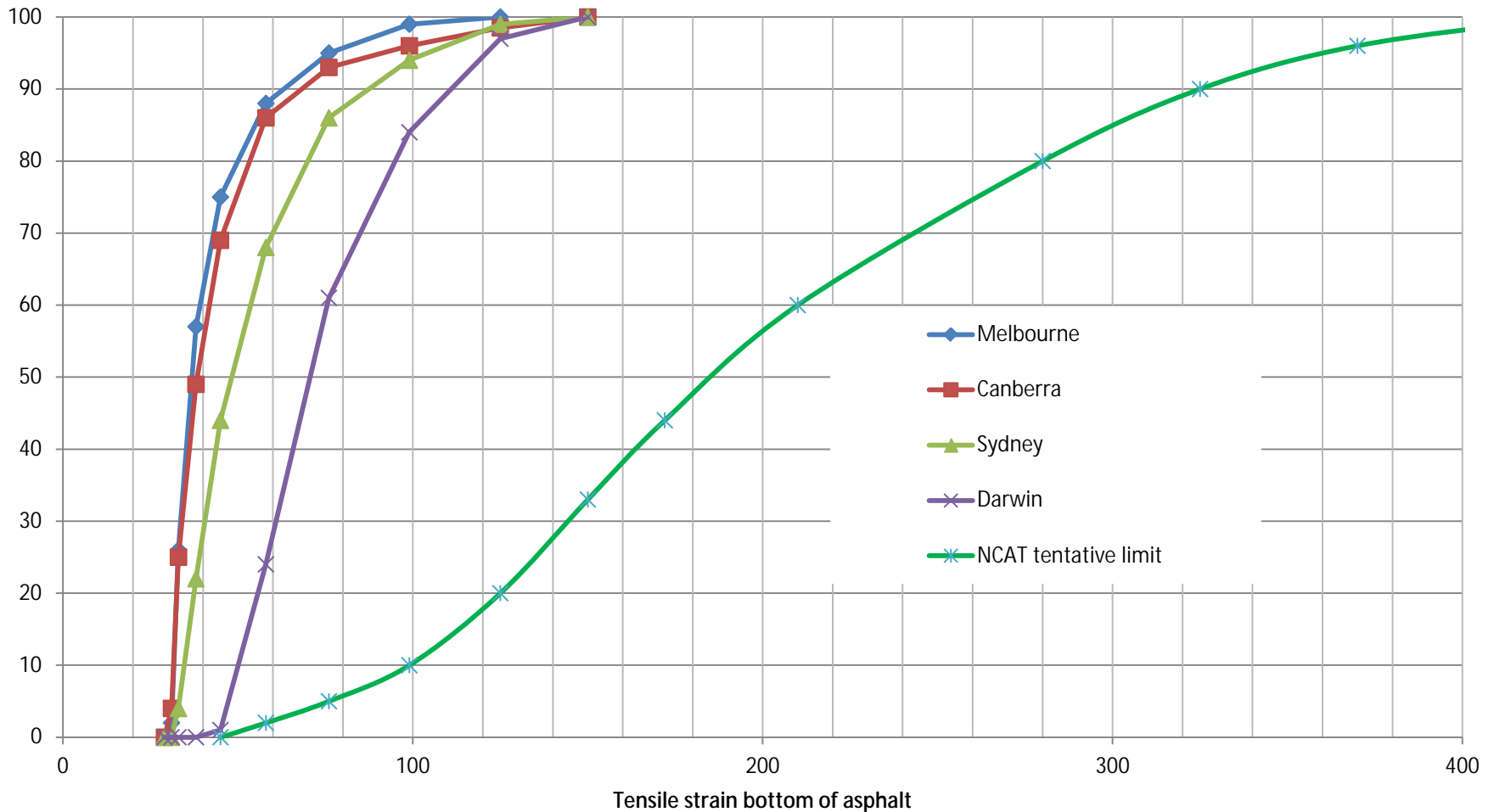
Distribution



Long life pavement design software and manual

CUMULATIVE ASPHALT STRAIN DISTRIBUTION RELATIVE TO CLIMATE
300mm ASPHALT ON STANDARD FOUNDATION

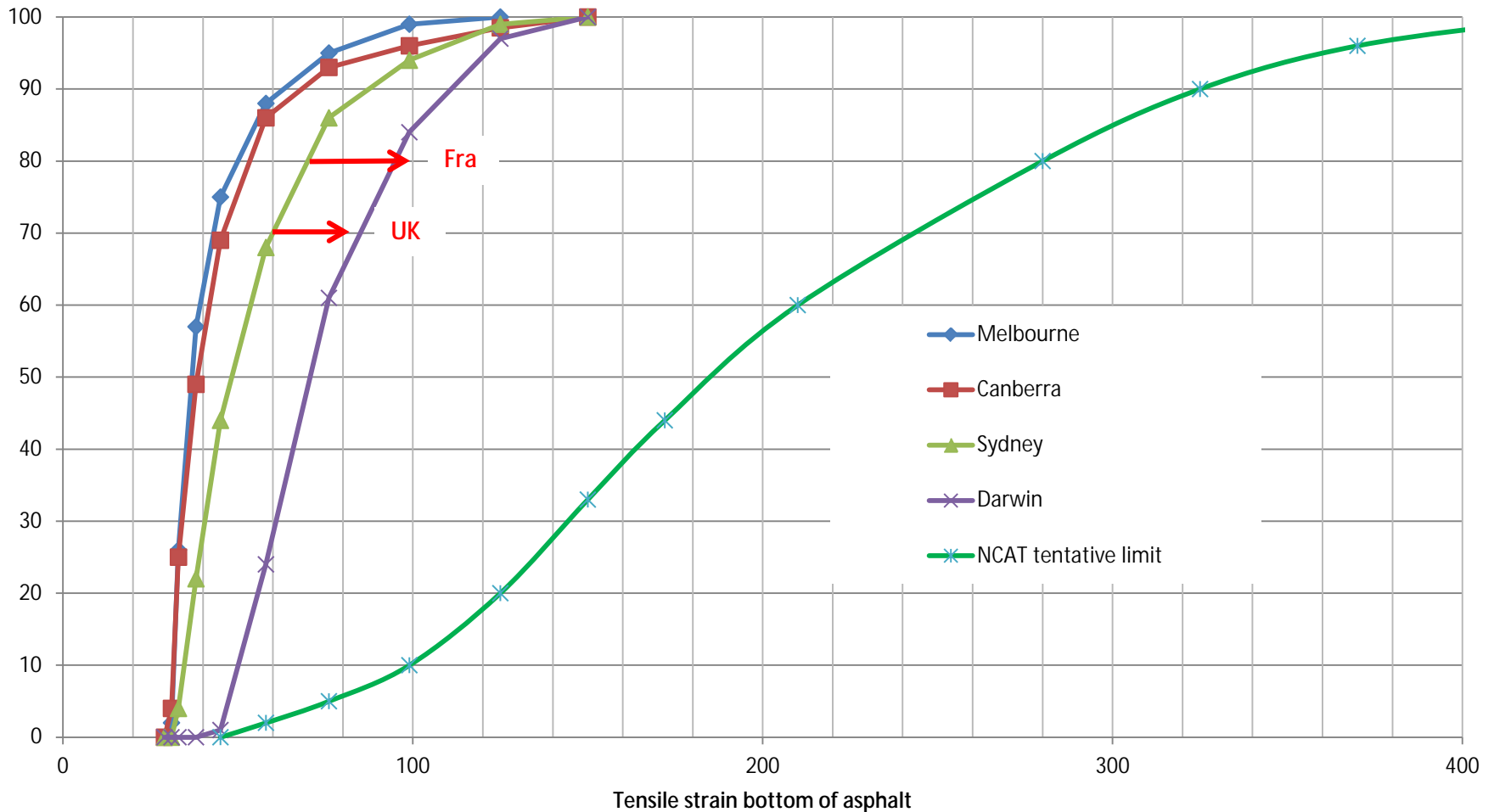
Cummulative distribution %



Long life pavement design software and manual

CUMULATIVE ASPHALT STRAIN DISTRIBUTION RELATIVE TO CLIMATE
300mm ASPHALT ON STANDARD FOUNDATION

Cummulative distribution %



Long life pavement design software and manual

Proposed procedure to validate cumulative strain distribution limits

- Identify and select LLAP sites i.e. deflections reducing over the long term
- Obtain pavement composition, temperature / traffic distribution data from long life LTPP sites
- Obtain component asphalt materials master curve data (if possible)
- Run back-analyses to determine the cumulative distribution of asphalt strain using preceding data

Long life pavement design software and manual

Proposed procedure to validate cumulative strain distribution limits

- Postulate: the validation analyses will use the same assumptions and relationships to be used in the design process, thus the validated design limits i.e. cumulative distributions of strain, will accrue the effects of variability
- Examine durability control by specification e.g. binder 'richness modulus' and benchmark fatigue 10^6 cycles at 100 $\mu\epsilon$

Long life pavement design software and manual

- US proposal to incorporate healing into design process beyond our resources – time and money
- The APS-FL manual will focus industry on the essential delivery of construction quality; this will more than compensate for any minor inaccuracy in modelling

APS-FL CURRENT STATUS

- The project team is in place and guidelines framed with input from key stakeholders
- The national asphalt characterisation project has been scoped, approved and samples sought
- The long life pavement design software has been scoped and costed
- Information dissemination is ongoing and peer review is programmed

AAPA's 14th International Flexible Pavements Conference

Sydney

25–28 September 2011

Topic:

**Asphalt Pavement Solutions – For Life
Implementation project update**

PRESENTER: Ian Rickards

Position: Consultant

Organisation: AAPA