

blokPAVE

Status at this stage

7 May 2012

Expectations of blokPAVE

- A design program similar to cncPAVE to predict the structural performance of block pavements
- Predict performance in terms of deformation, loose blocks, cracked blocks and riding quality
- Translate performance into cost implications over the long term in order to compare different pavement types.

Phases to develop blokPAVE

- Finite element analyses to quantify effect of block characteristics, joint and bedding sand and subbase stiffness on stress & strain in top layers
- Include the effect of the subbase, selected layers and subgrade on stress & strain in the pavement
- Predict performance in terms of rutting, loose & cracked blocks and riding quality (IRI)
- Calibrate blokPAVE

Finite element analyses

To determine the effect of the following parameters on stress and strain in the top layers:

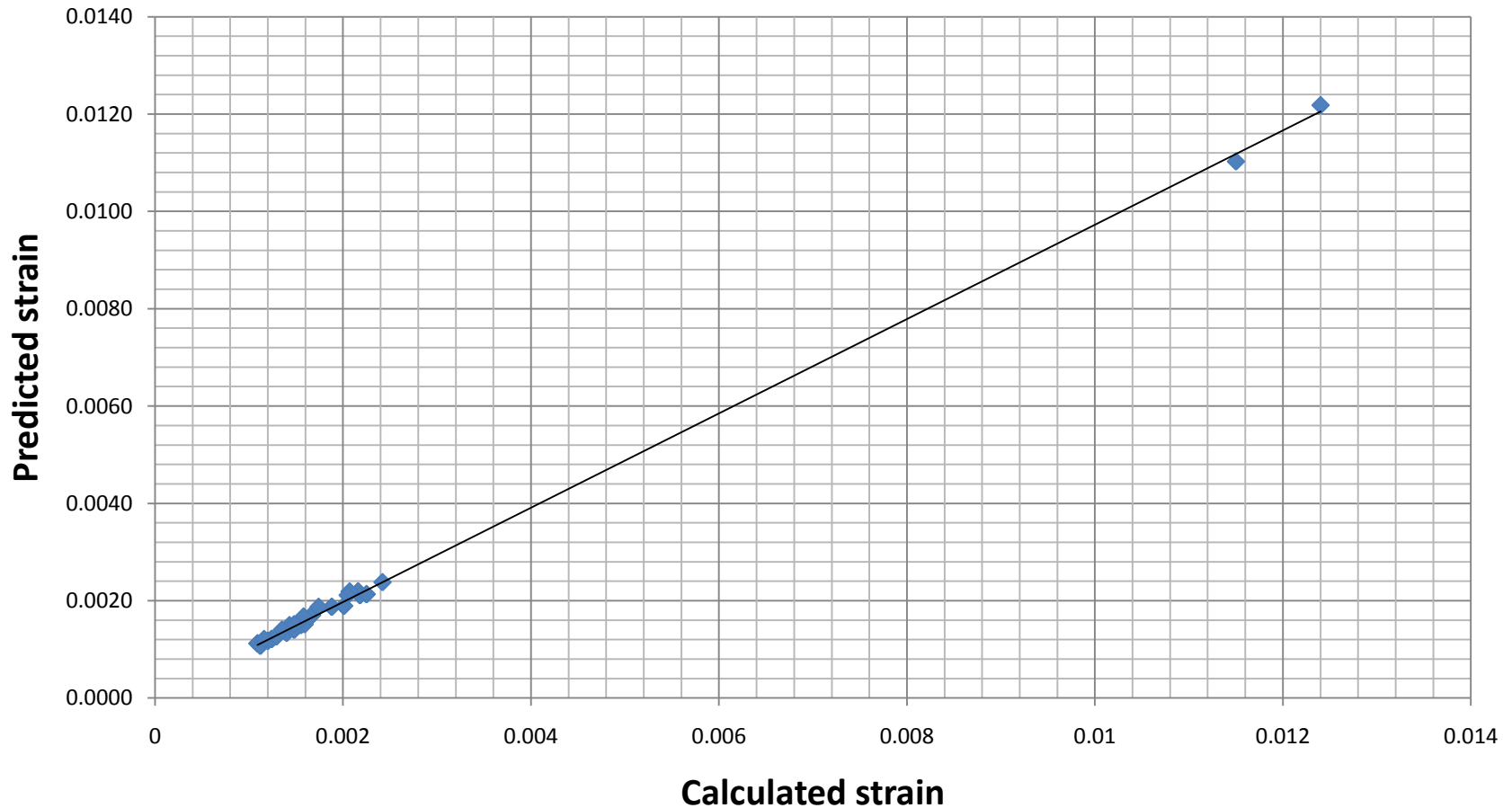
- Dynamic loading
- Paver thicknesses & shapes and paving pattern
- Width and stiffness of the joint between blocks
- Thickness and stiffness of the bedding sand between the blocks and the subbase
- Subbase stiffness

Analysis of total pavement

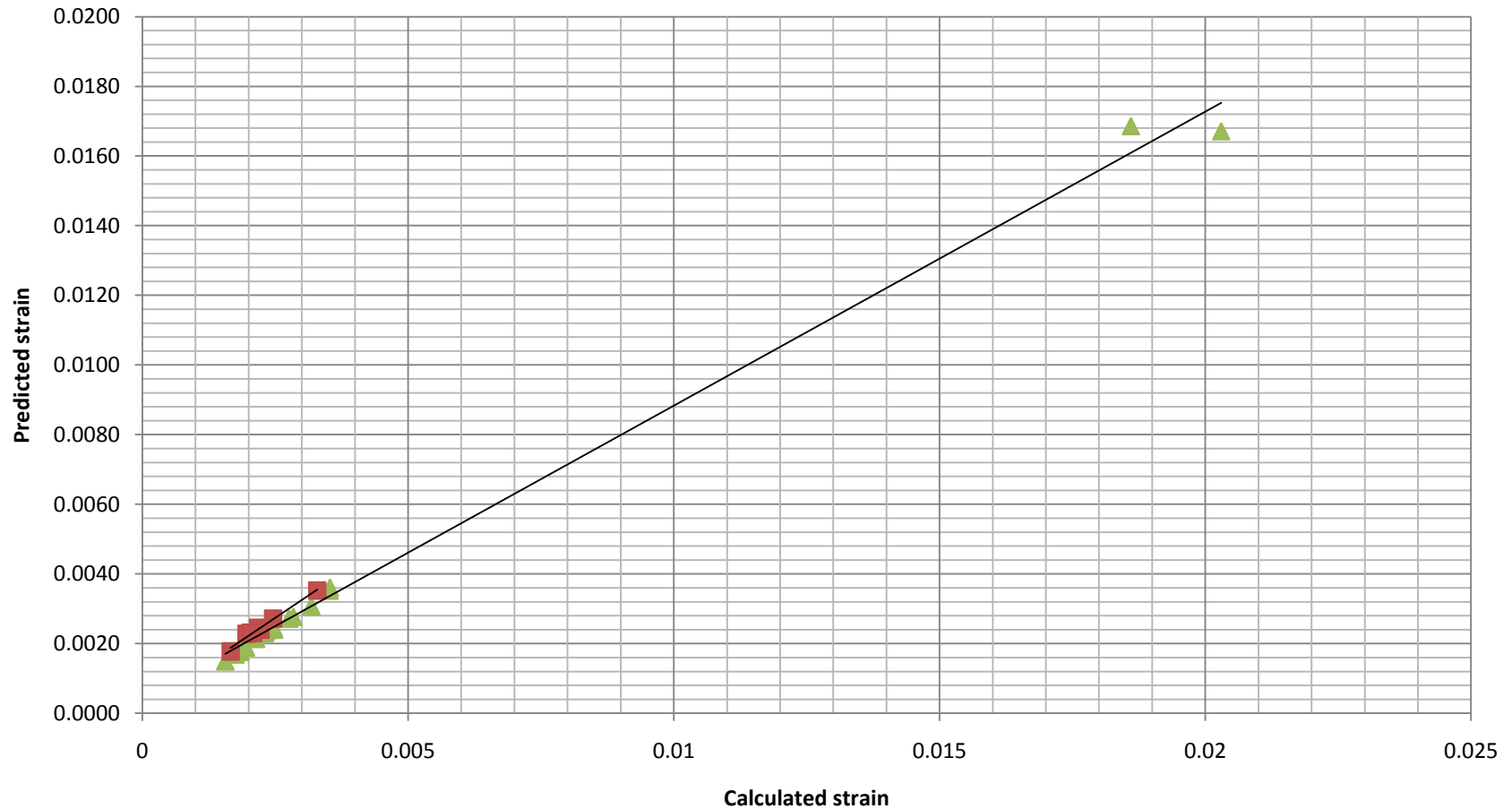
For different loads, block configurations and different combinations of layer thickness and stiffness determine the following using linear elastic analysis:

- Stress and strain at different positions in the pavement
- Deflection on the surface of the pavement

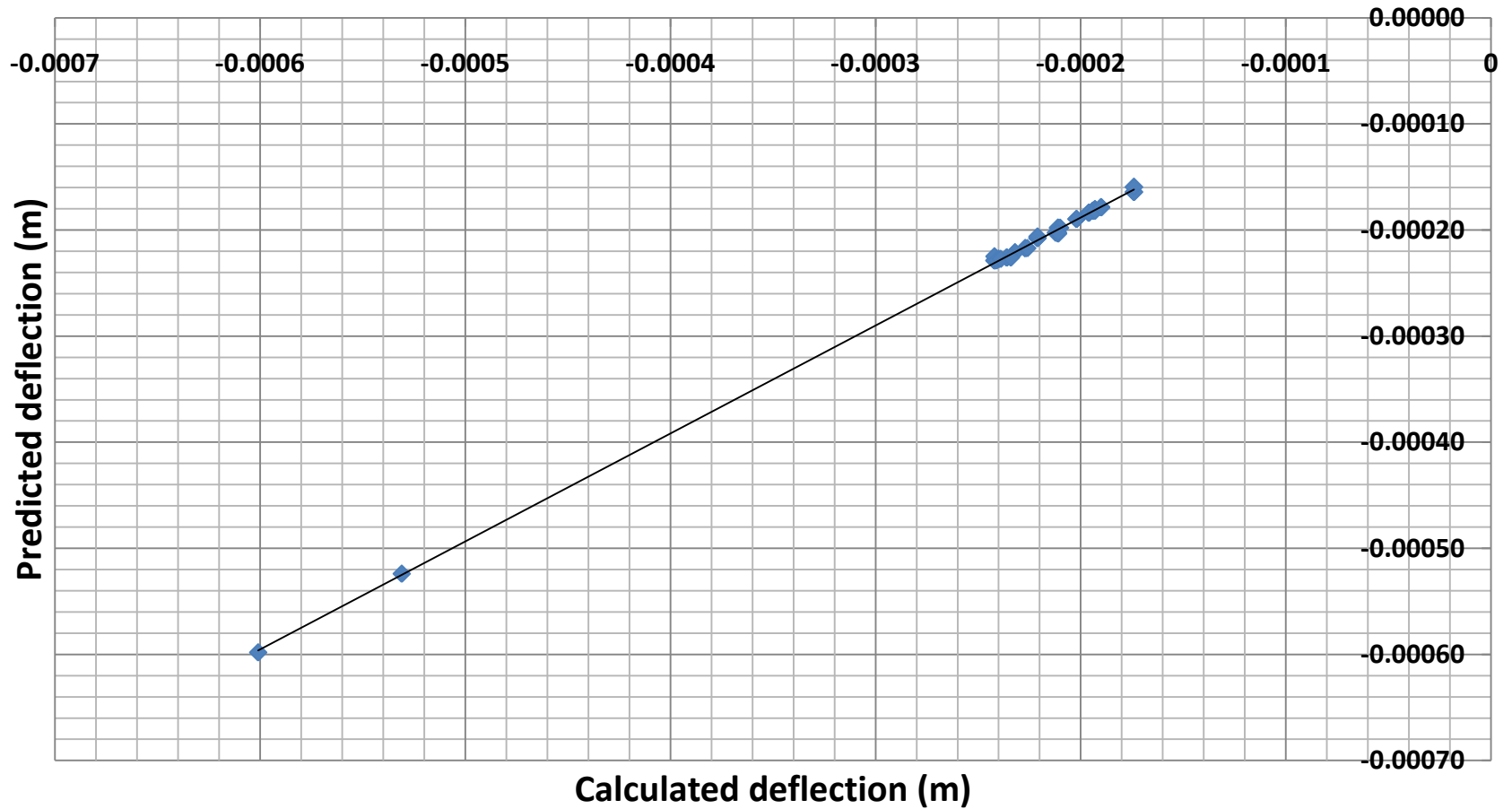
Predicted versus FE calculated strain in the top of the bedding sand at a joint



Predicted versus FE calculated strain in the bottom of the jointing sand



Predicted versus FE calculated deflection due to variation in top layer properties



Steps in developing blokPAVE

- Develop equations to predict strain, stress and deflection of a block pavement
- Equations to predict the changes in joint width, movement of bedding sand and block cracking under increased loading with time
- Calculate changes in strain, stress and deflection with time
- Strain, stress and deflection used as input to predict performance from performance curves

Distress and performance of block pavements

- Deformation (rutting)
- Widening of joints and loose blocks
- Cracked blocks

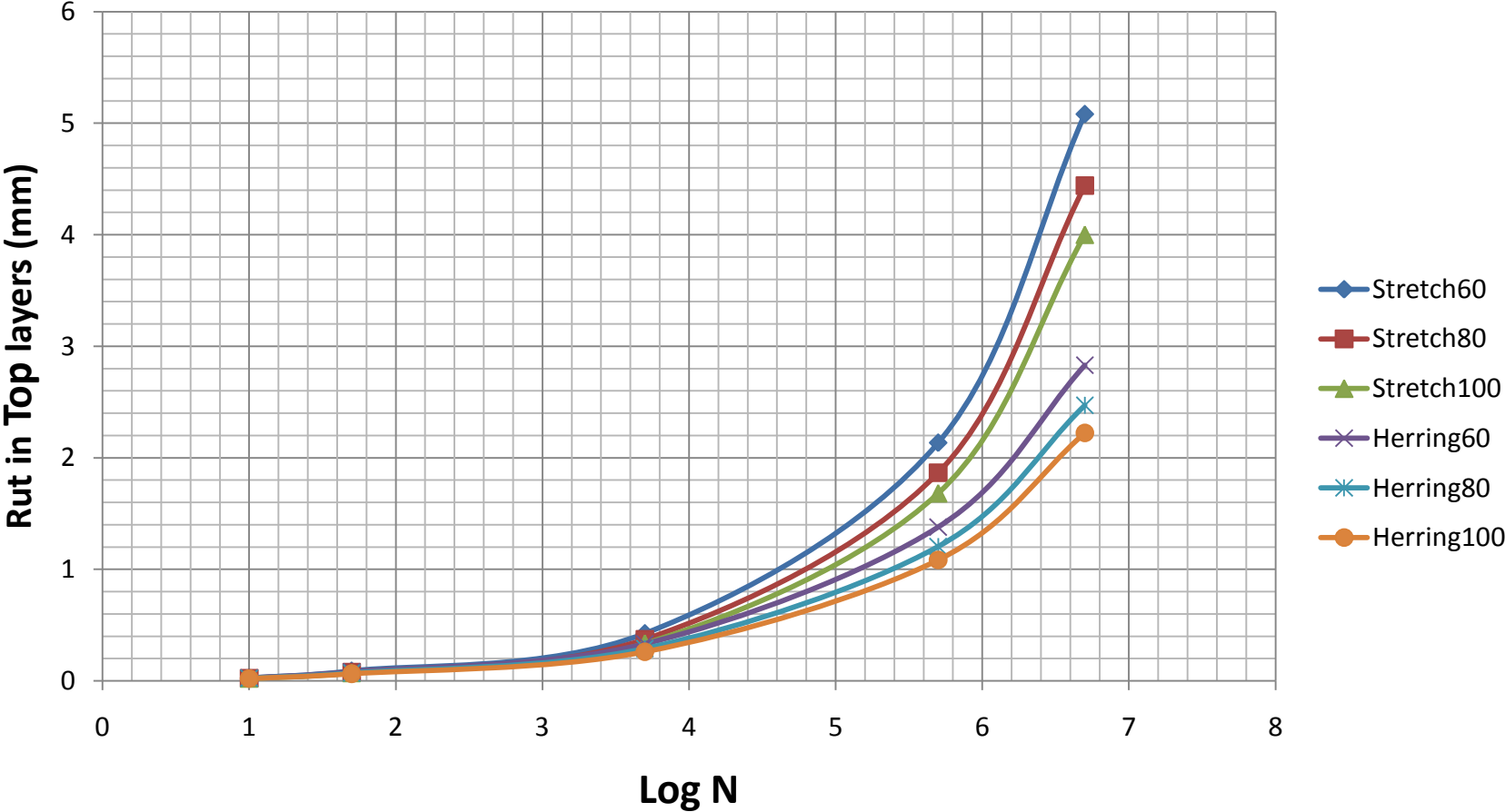




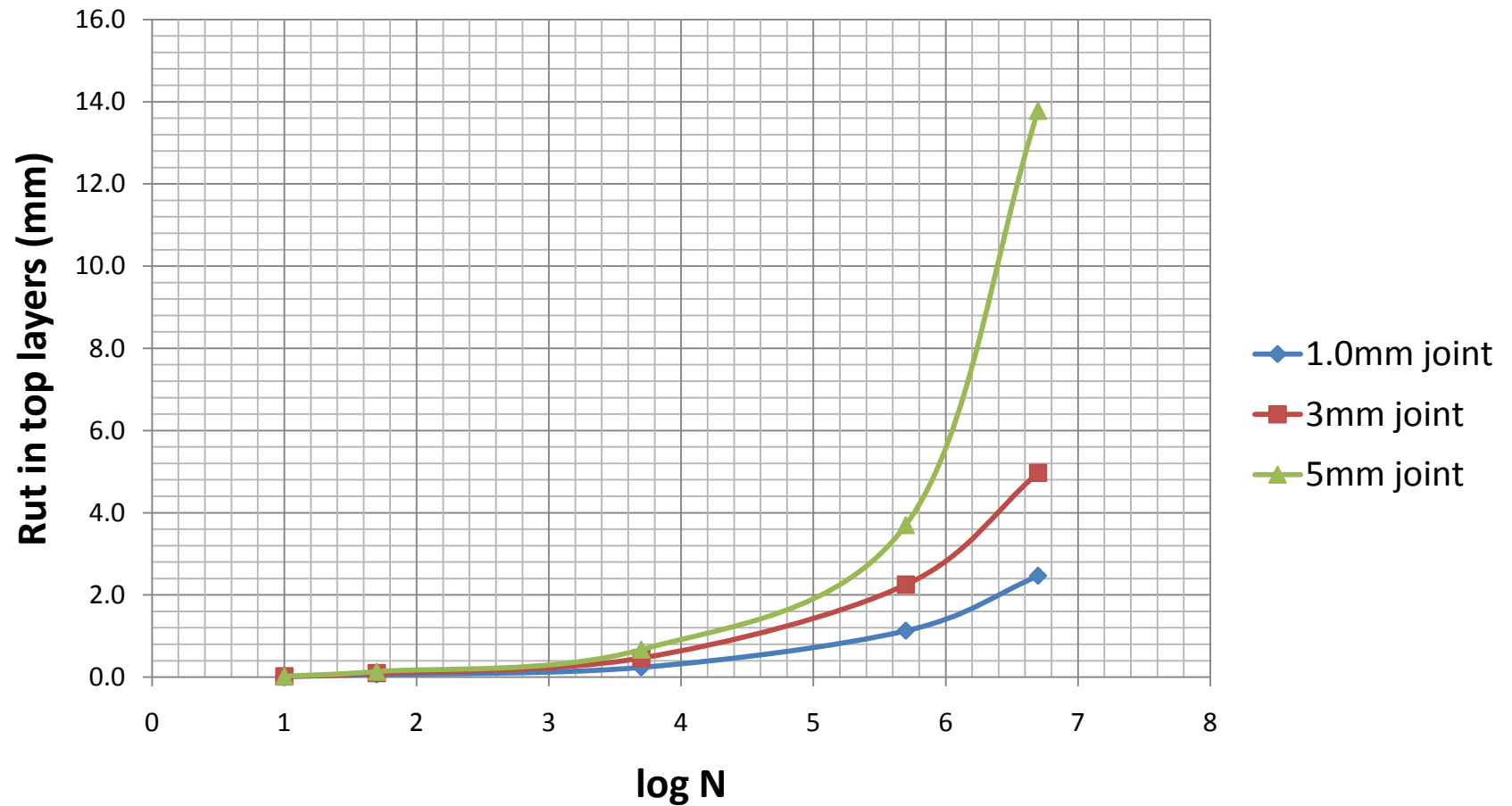




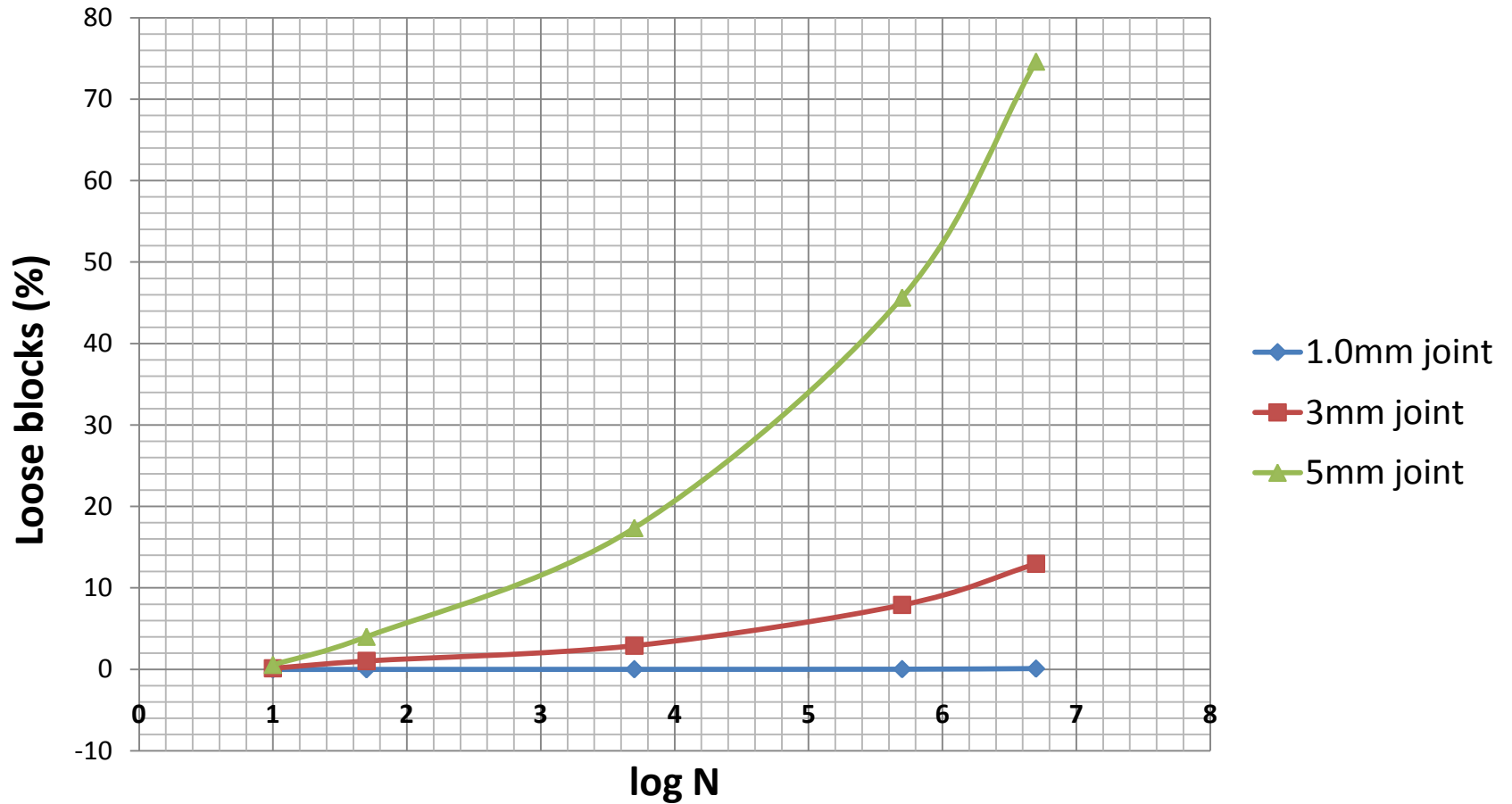
Block thickness & paving vs rut in top



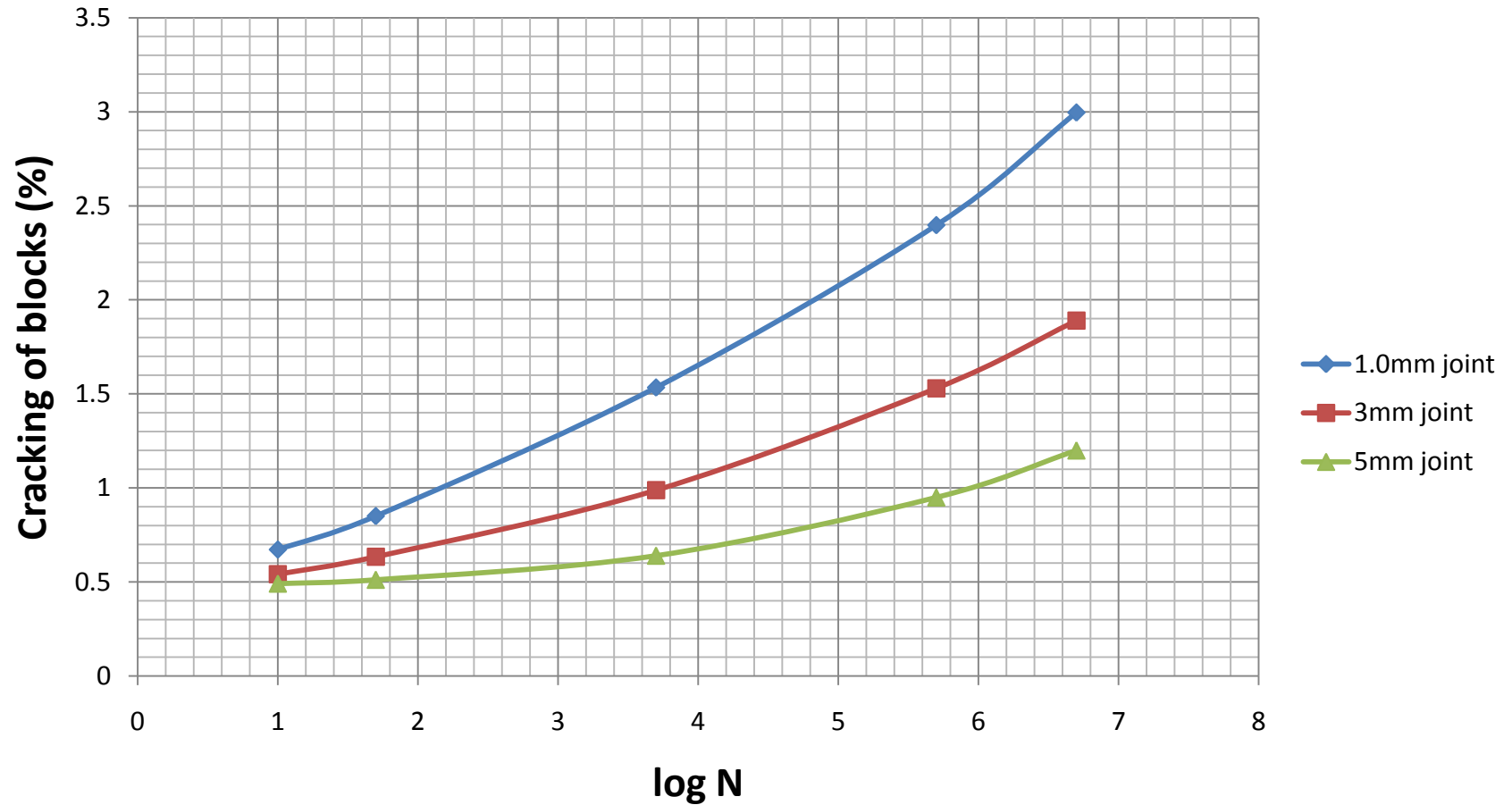
Deformation (mm): a function of joint width



% Loose blocks: a function of joint width



% Blocks cracked: a function of joint width



Assistance from industry

- Using limited data performance curves have been developed
- Quantify the effect of climate, traffic characteristics and variation due to construction on performance curves
- Implication is that full set of pavement characteristics and properties is needed for sites that are being used for calibration purposes

Colleagues involved in the design,
construction or maintenance of block
pavements, please contact:

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I will send a draft of blokPAVE to play with
and then you send back data to adjust the
program to increase its reliability

cncPAVE

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Planned additions and alterations

- The change in riding quality with loading/time
- Consider the effect of fibre characteristics on load transfer at cracks
- Quantifying erosion of the subbase

PLUS

Adjust cncPAVE to accommodate the above

Riding quality

IRI depends on

- initial IRI (effect of construction)
- Faulting at the joints
- Structural failures (shattered slabs)

$$\text{IRI} = 0,025 \cdot \% \text{shattered} + 0,06 \cdot \text{Faulting (mm)}$$

Fibre characteristics

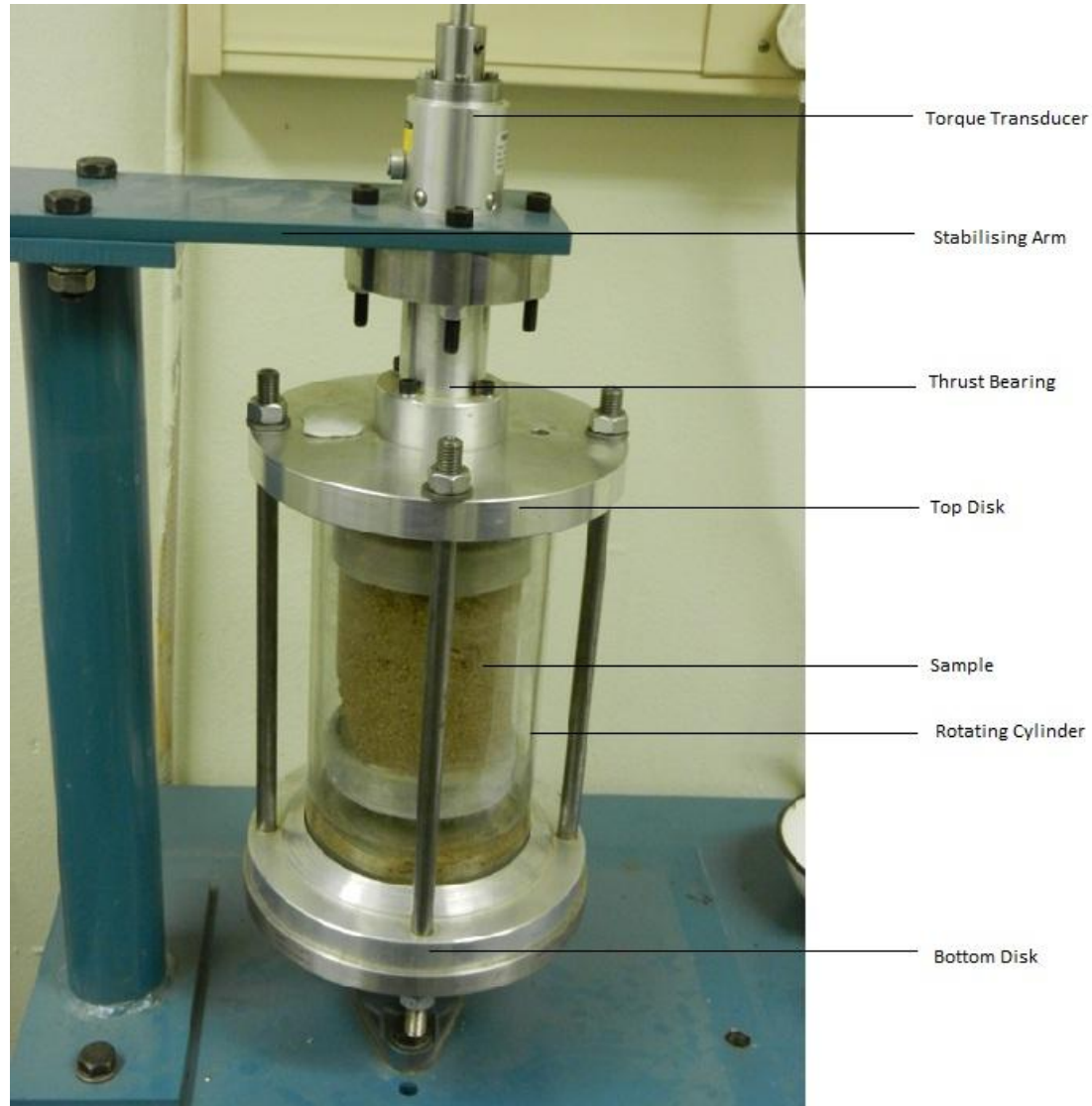
- Higher fibre content improves flexural strength. This can be quantified through measurements
- It also affects fatigue performance positively
- Shorter fibres improves load transfer at cracks

$$\text{Load transfer} = f(\text{Agg. cnt}^{1.45} / \text{dx}^{1.5} / \text{Ingth}^{0.04})$$

Agg= aggregate size, dx=crack width,

cnt= fibre content, Ingth= fibre length

Test to quantifying erosion of subbase material



Quantifying erosion of subbase material

- Equipment is in use
- First results promising
- Calibration and establishing a data base
- Factor in cncPAVE, presently 0 to 10, to depict erosion will be replaced by actual loss of material determined in the lab for the particular material to be used as subbase.

Changes in cncPAVE

- Effect of fibre content & length incorporated and can now be used in all pavement types
- The change in IRI with loading now predicted
- Quantifying of erosion to be included
- The equations in cncPAVE now similar for all different pavement options
- Objective comparison of different pavement types.

Demonstrate cncPAVE