



Roads Pavement forum 13-14 May 2009

Progress Report: Ultra Thin Reinforced Concrete Pavements: Field evaluation through accelerated pavement testing

Louw du Plessis

Contents

- HVS evaluation of the UTRCP sections
- Construction
- Test site & sections
- Preliminary results

HVS Evaluation

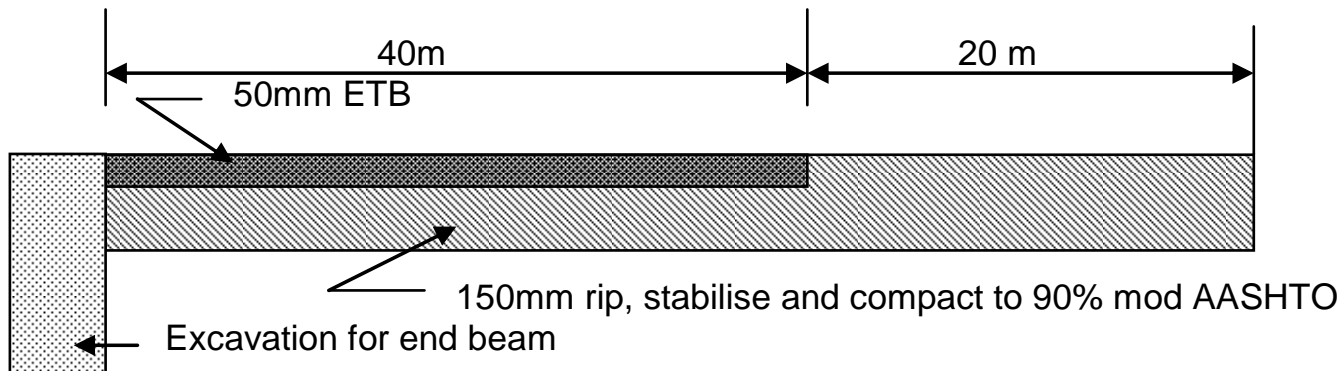


Base construction



1. WEAK PAVEMENT

- Cut top 100mm to spoil
- Cut to line and level
- Rip insitu material 150mm deep, stabilise with 3% lime and compact to 90% Mod AASHTO at OMC
- Mill out 50mm of first 40 metres of lime stabilised base and construct 50mm ETB by labour and light plant as per Soshanguve specification
- Treat top of base with a 1:8 diluted emulsion broomed onto the surface.



1. STRONG PAVEMENT

- Cut top 100mm to spoil
- Cut to line and level
- Cut 150mm to stockpile
- Rip insitu material 150mm deep, stabilise with 1½% lime and compact to 90% Mod AASHTO at OMC
- Place material from stockpile, stabilise with 3% lime and compact to 95% Mod AASHTO at OMC
- Mill out 50mm of last 40m of lime stabilised base and construct 50mm ETB by labour and light plant as per Soshanguve specification
- Treat top of base with a 1:8 diluted emulsion broomed onto the surface.



ROAD SURVEY

JCJ009 GP

TJP 621 GP

ZA

NON-DESTRUCTIVE INGRESS

Concrete Mix

- Aggregate: 2 stone size matrix: 13 & 9mm quartzite
- CEM 1 (42.5) cement
- Reinforced steel mesh 5.6mm diameter placed on neutral axis
- Grid size: 200 x 200mm
- PCC thickness: 50mm
- Cured for 7 days under plastic sheets
- HVS testing started after 28 days
- Ave Compressive cube strength was 37.5 MPa (28days)

UTRCP Construction









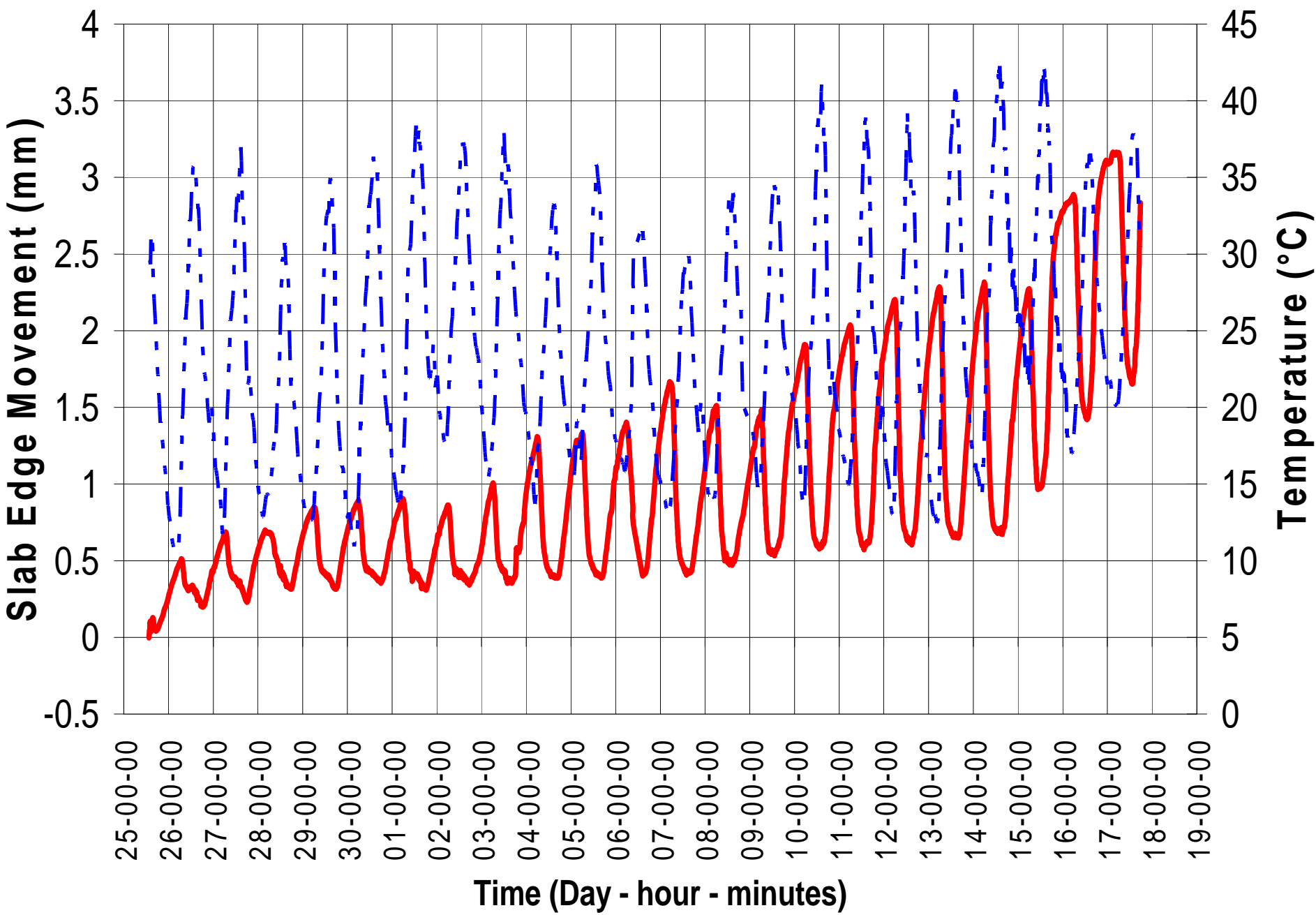






Environmental effects on slab curling and warping

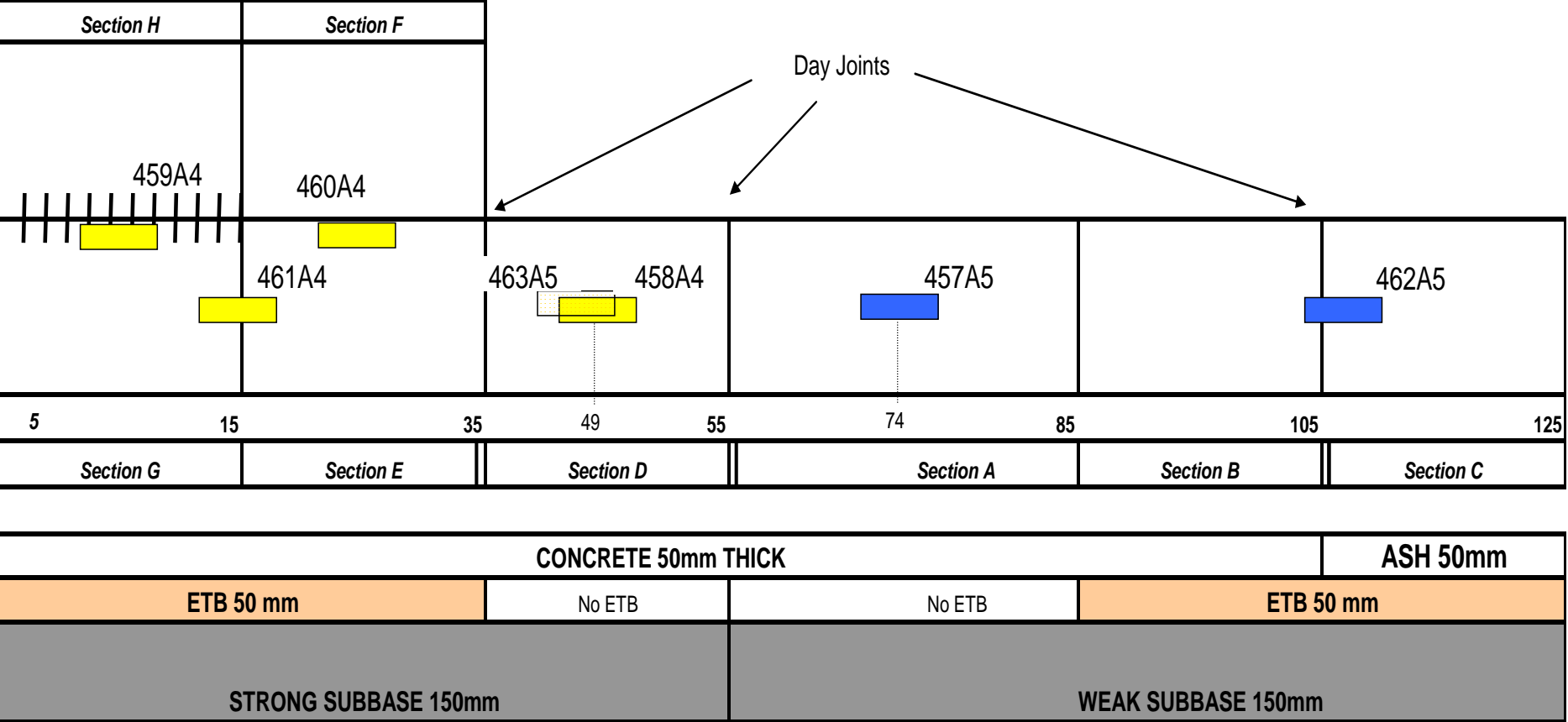




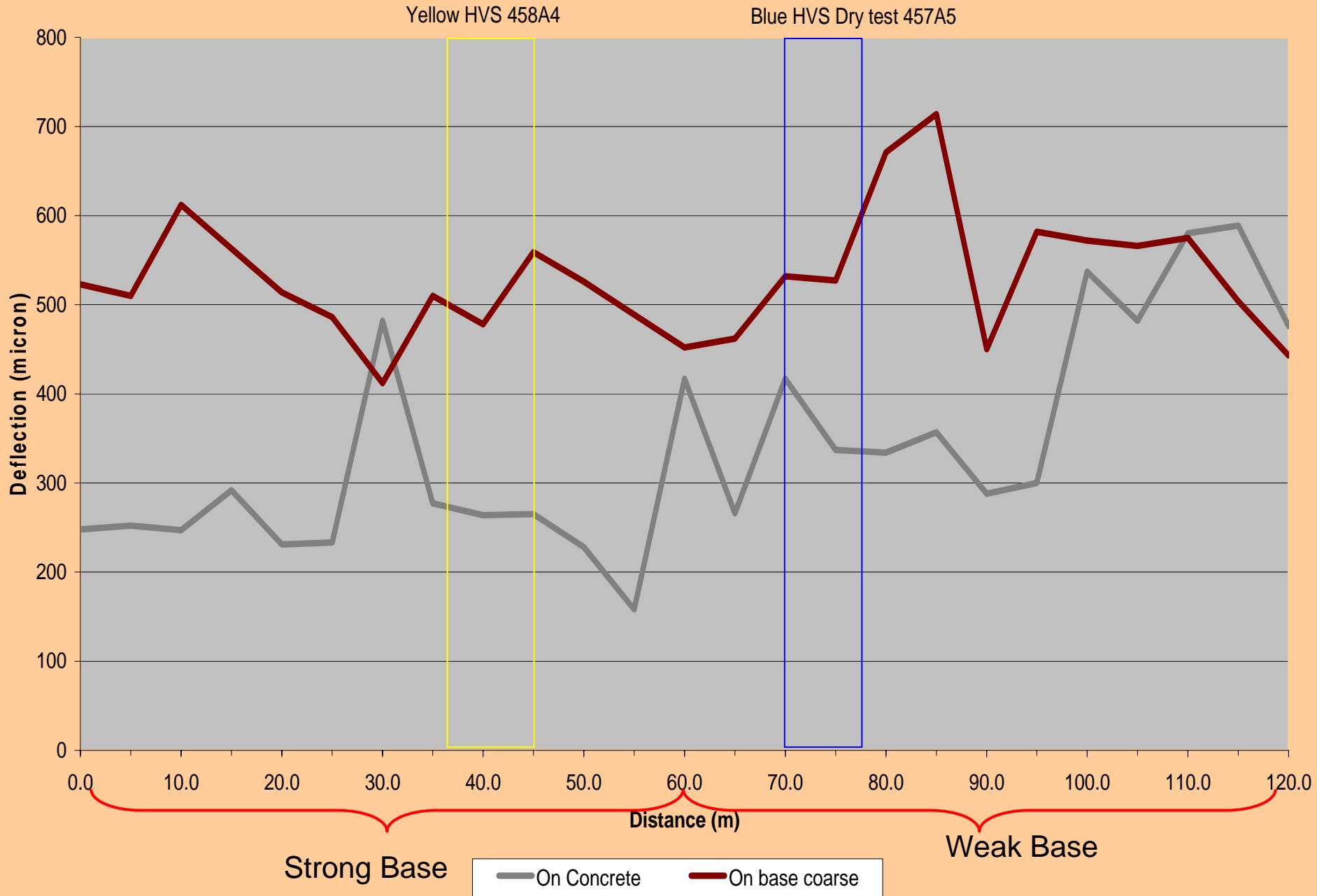
Summary of slab edge movements due to environmental influences

Instrument	Permanent Warp (upward)	Daily Curl		Total daily elastic curling movement
	(mm)	up (mm)	down (mm)	(mm)
JDMD 10	2.30	0.80	0.70	1.50
Maximum surface temperature (Deg C)				42.40
Minimum surface temperature (Deg C)				10.50
Maximum positive temperature differential (top - bottom) (Deg C)				3.60
Maximum negative temperature differential (top - bottom) (Deg C)				-3.40
<p>The diagram illustrates the slab edge movements. It shows a cross-section of a slab with a vertical line on the left representing the edge. Three curves are plotted: a blue curve (top surface), a black curve (bottom surface), and a red curve (neutral axis). The blue curve shows a maximum upward movement of 2.30 mm at the edge, which decreases to zero at a distance of 3.1 m. The black curve shows a maximum downward movement of 1.60 mm at the edge, which also decreases to zero at 3.1 m. The red curve shows a maximum downward movement of 0.80 mm at the edge, which decreases to zero at 3.1 m. The total daily elastic curling movement is 1.50 mm. The diagram also shows the maximum positive temperature differential of 3.60 Deg C and the maximum negative temperature differential of -3.40 Deg C.</p>				

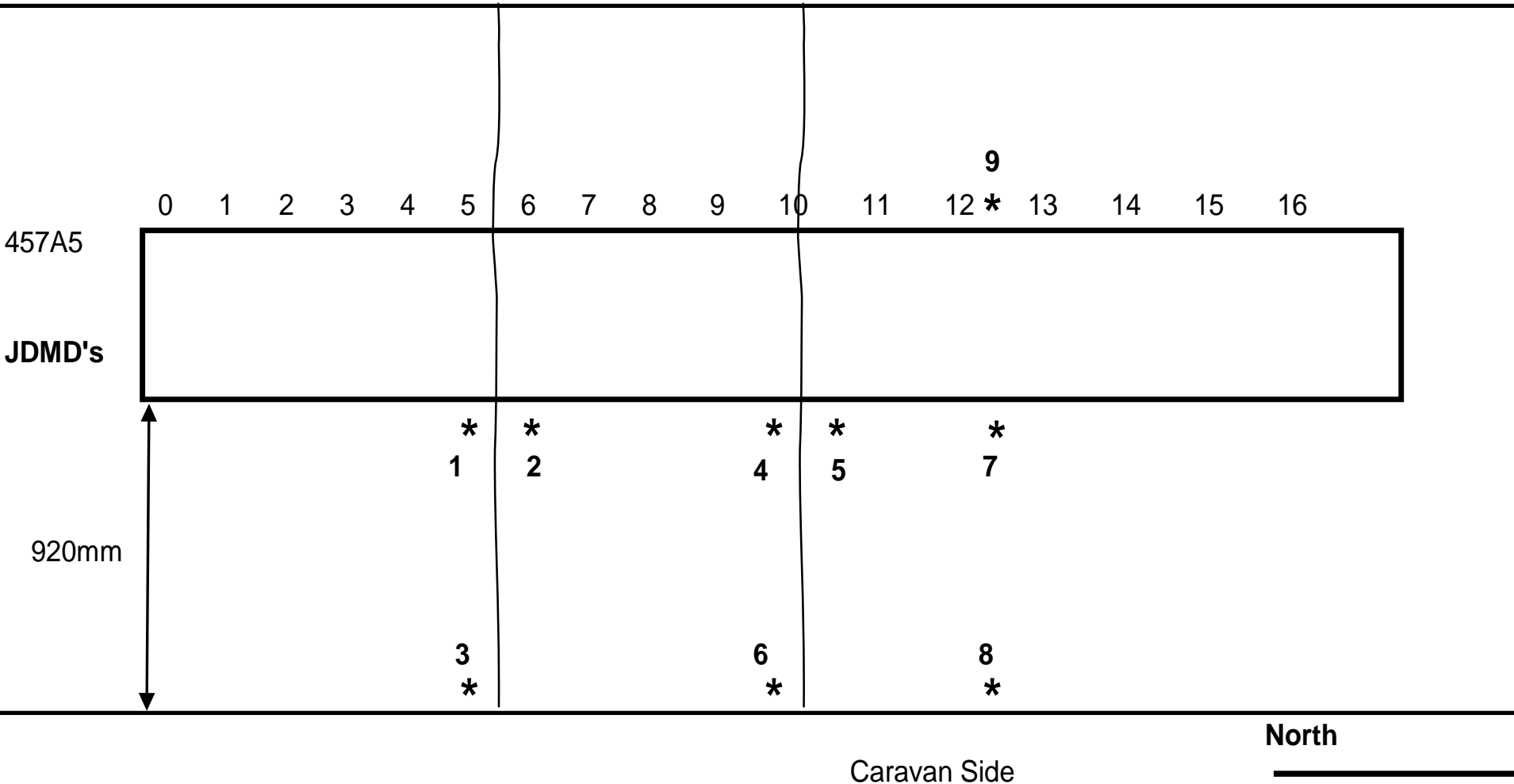
Testing Areas



FWD Peak Deflection on UTRCP section



457A5: Test on weak base (no ETB): Dry test, centre slab loading, 40kN



457A5: Centre slab loading Weak base (no ETB)

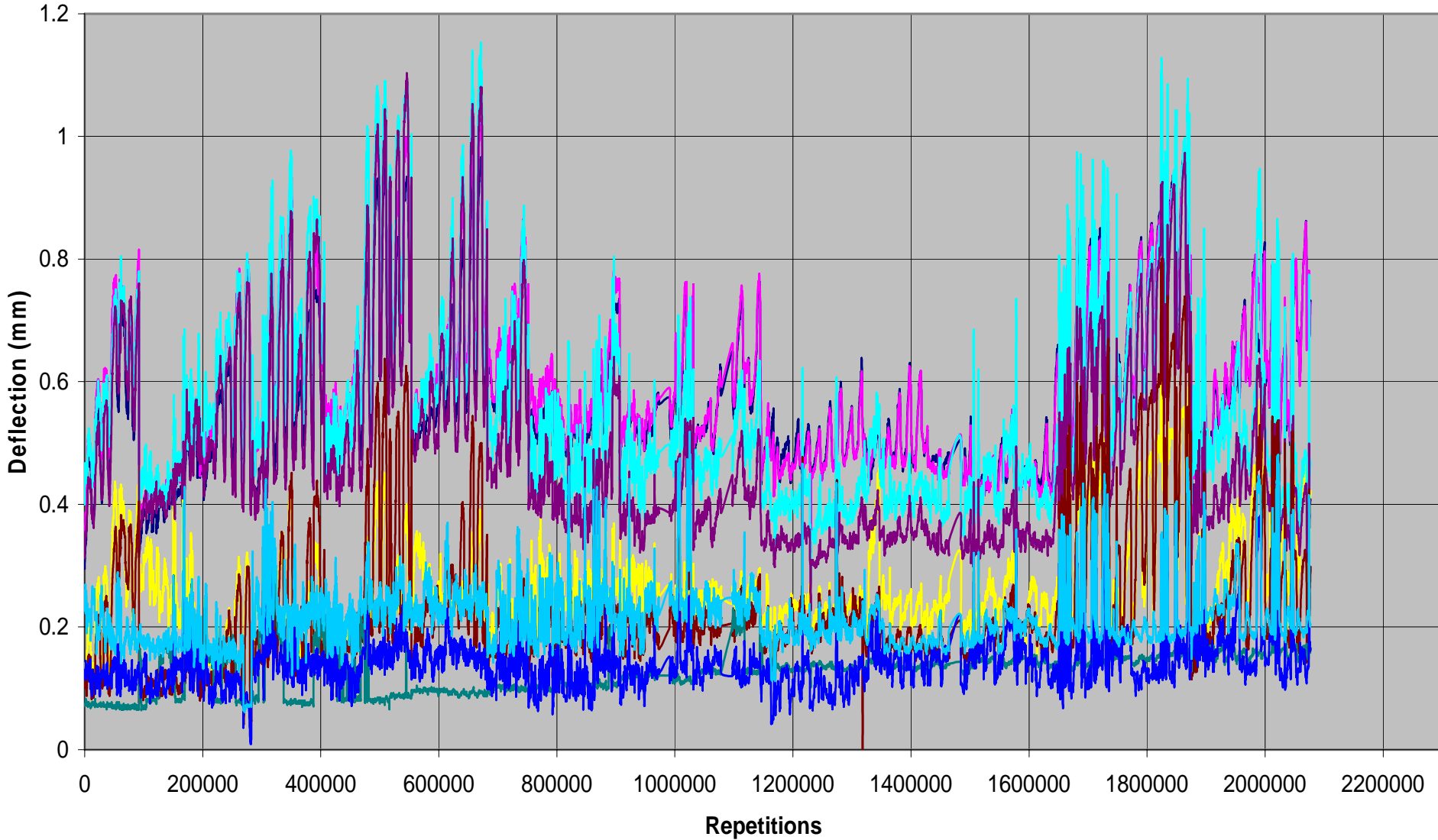
- Section failed after 2 346 920 reps
- 2m dry, 40k wet, 120k dry etc.
- Section failed in its 3rd watering cycle
- Starting date: 31 Oct 08, end 15 April 09 (166 days)
- Ave slab thickness: 55mm

SEC : 437A4
REPS : 1301220
DATE : 09-02-2009
TIME : 08:00
LOAD : 40kN
PAINT : GREEN
CRACKS : NEW CRACKS AT
Point Point 8-13

09.02.2009

DEFLECTIONS OF JDMD'S SECTION 457A5 (cracked)

Weak Concrete Section



— JDMD 1

— JDMD 2

— JDMD 3

— JDMD 4

— JDMD 5

— JDMD 6

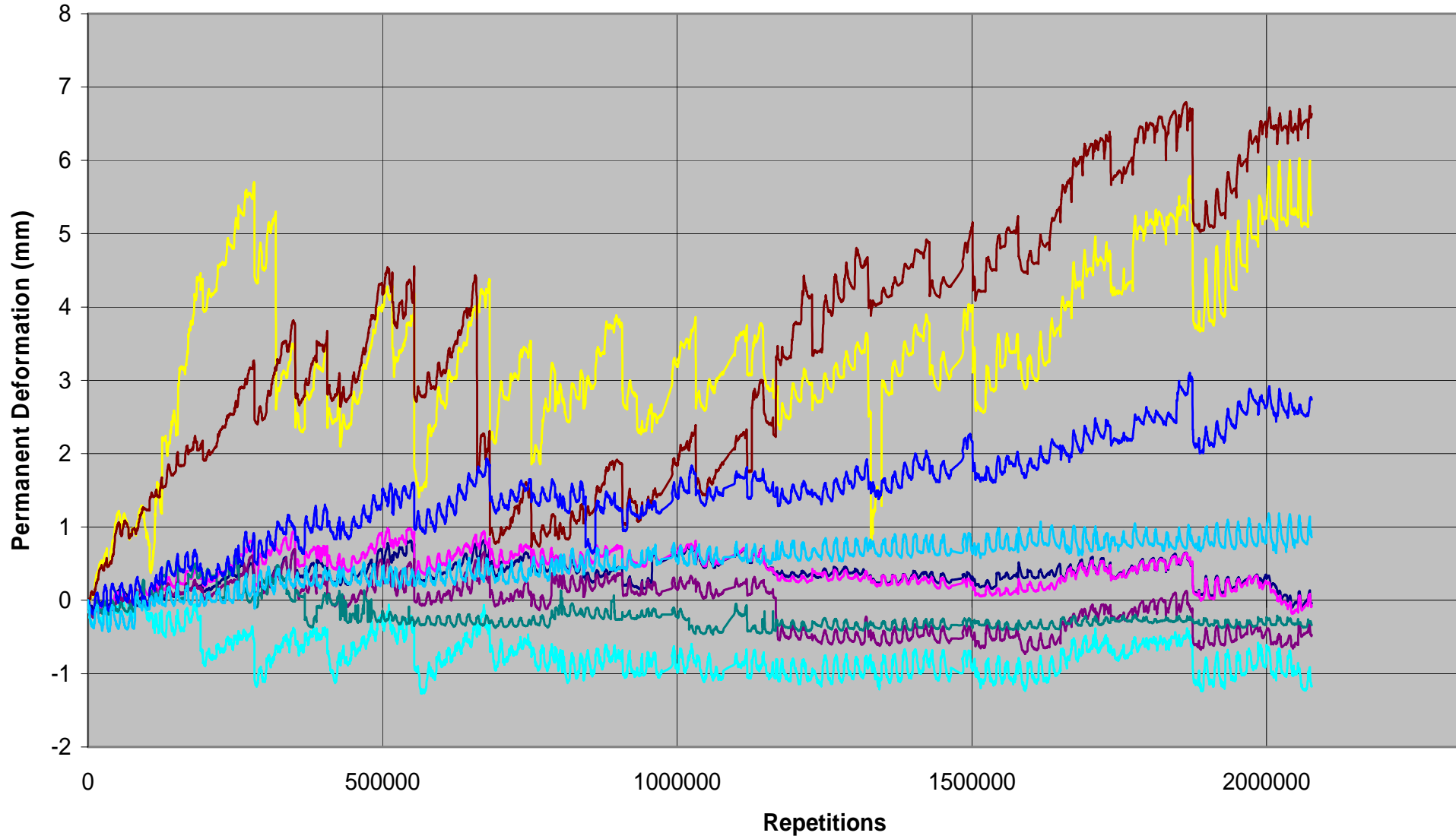
— JDMD 7

— JDMD 8

— JDMD 9

PERMANENT DEFORMATION OF JDMD'S SECTION 457A5 (crack)

Weak Concrete Section



JDMD 1

JDMD 2

JDMD 3

JDMD 4

JDMD 5

JDMD 6

JDMD 7

JDMD 8

Failure: 2 346 920 Reps (3rd water Cycle)

SEC : 407A5
REPS : 2346920
DATE : 16-04-2009
TIME : 10:00
LOAD : 40KN
POINT : End of 3rd cycle
STATUS : Failed (Fract)

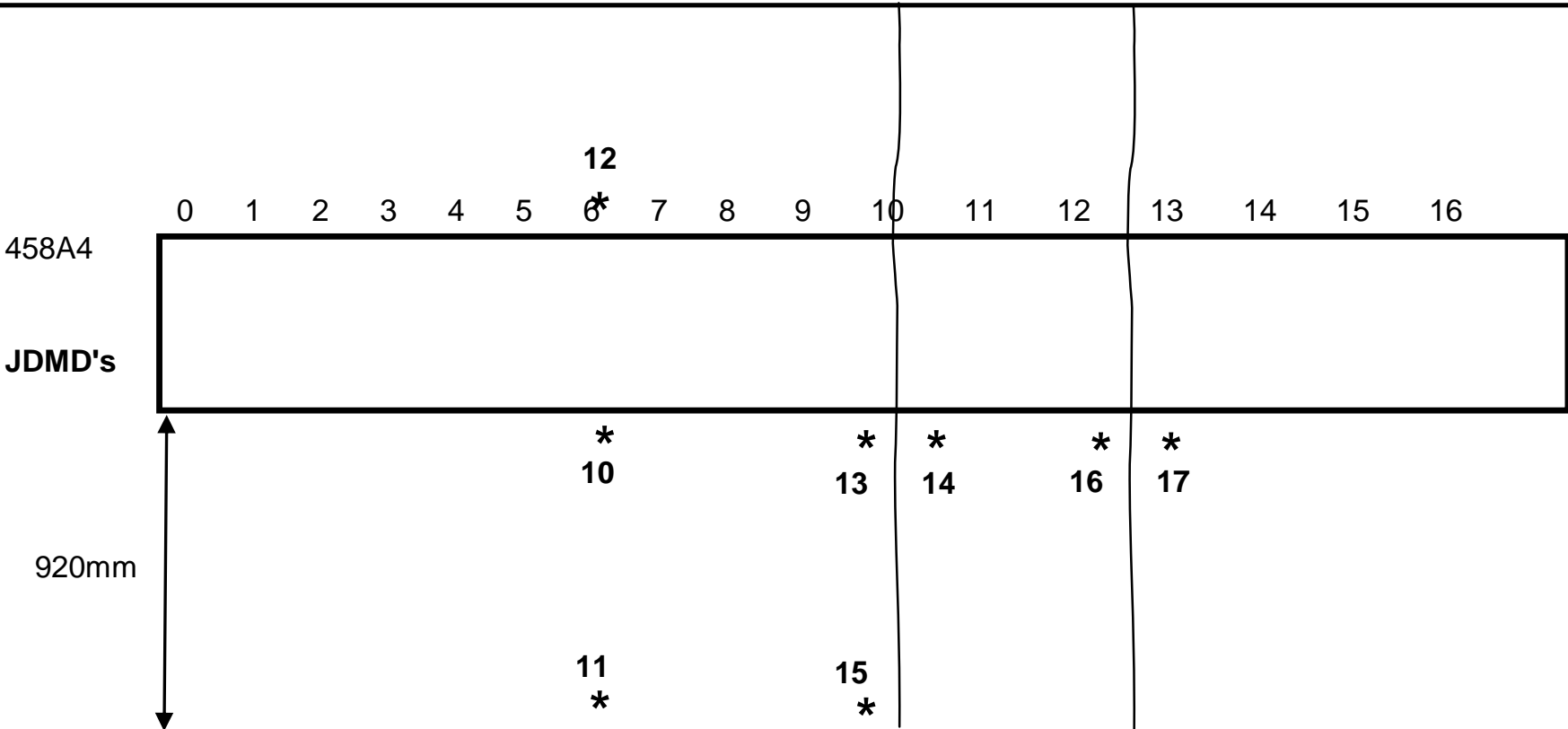


16.04.2009

458A4: Centre slab loading Strong base (no ETB), water from 1.150m reps

- Section failed after 1 243 100 reps
- 1 149 700 dry, 93 400 reps wet
- Starting date: 31 Oct 08, end 13 Feb 09 (104 days)
- Ave slab thickness: 59mm

458A4



Caravan Side

North



Watering cycle started after 1 149 700 reps

5 Feb 2009









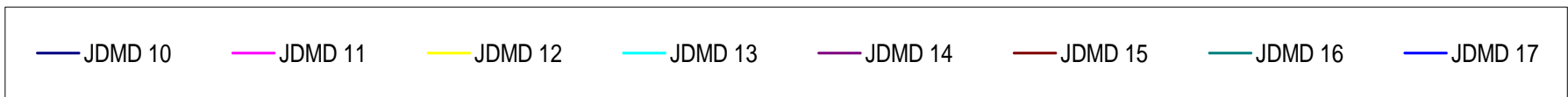
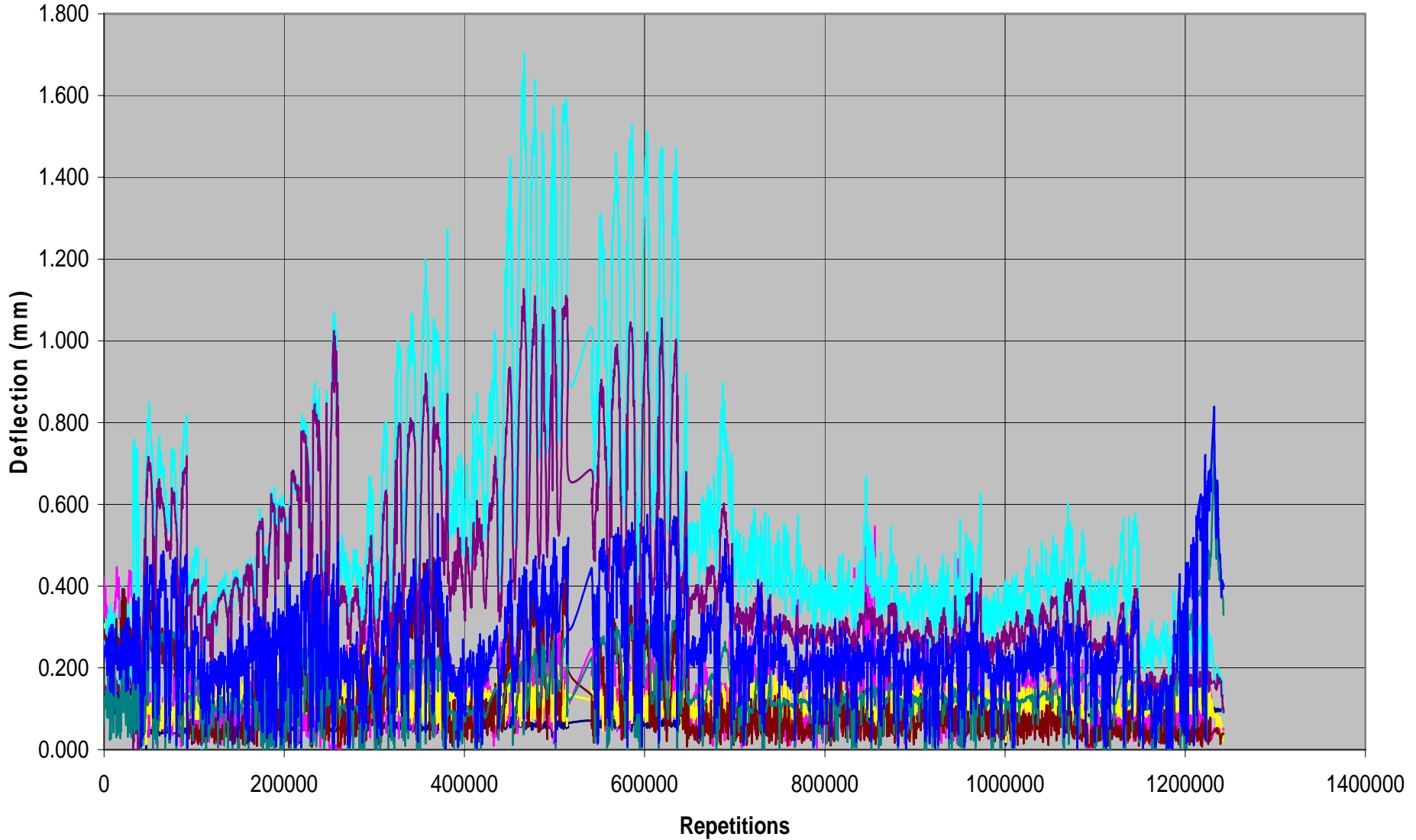


Section failed after 1 242 700 Reps

13 Feb 2009

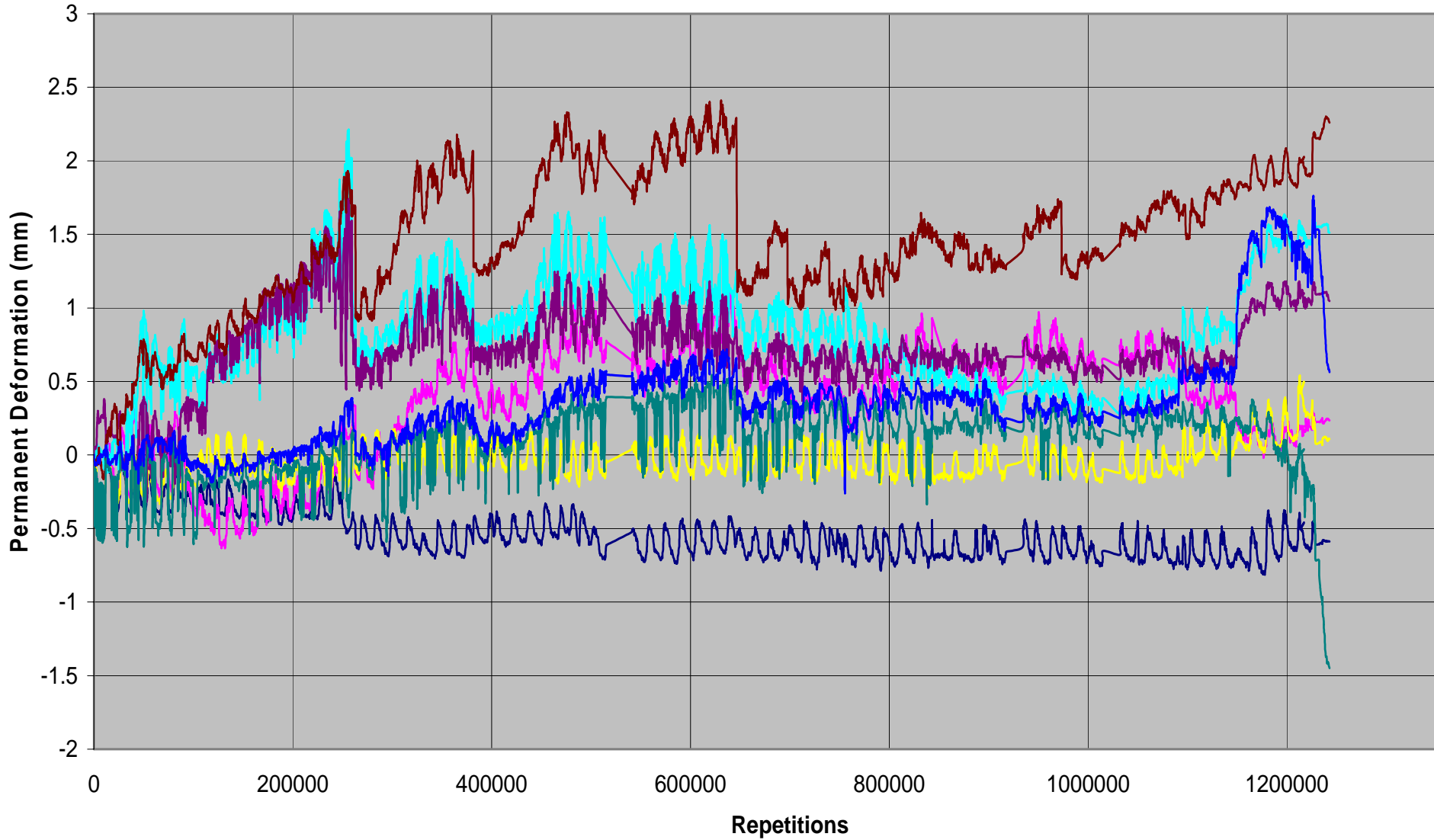
DEFLECTIONS OF JDMD'S SECTION 458A4 (cracked)

Strong Base Concrete Section



PERMANENT DEFORMATION OF JDMD's SECTION 458A4 (crack)

Strong Base Concrete Section



JDMD 10

JDMD 11

JDMD 12

JDMD 13

JDMD 14

JDMD 15

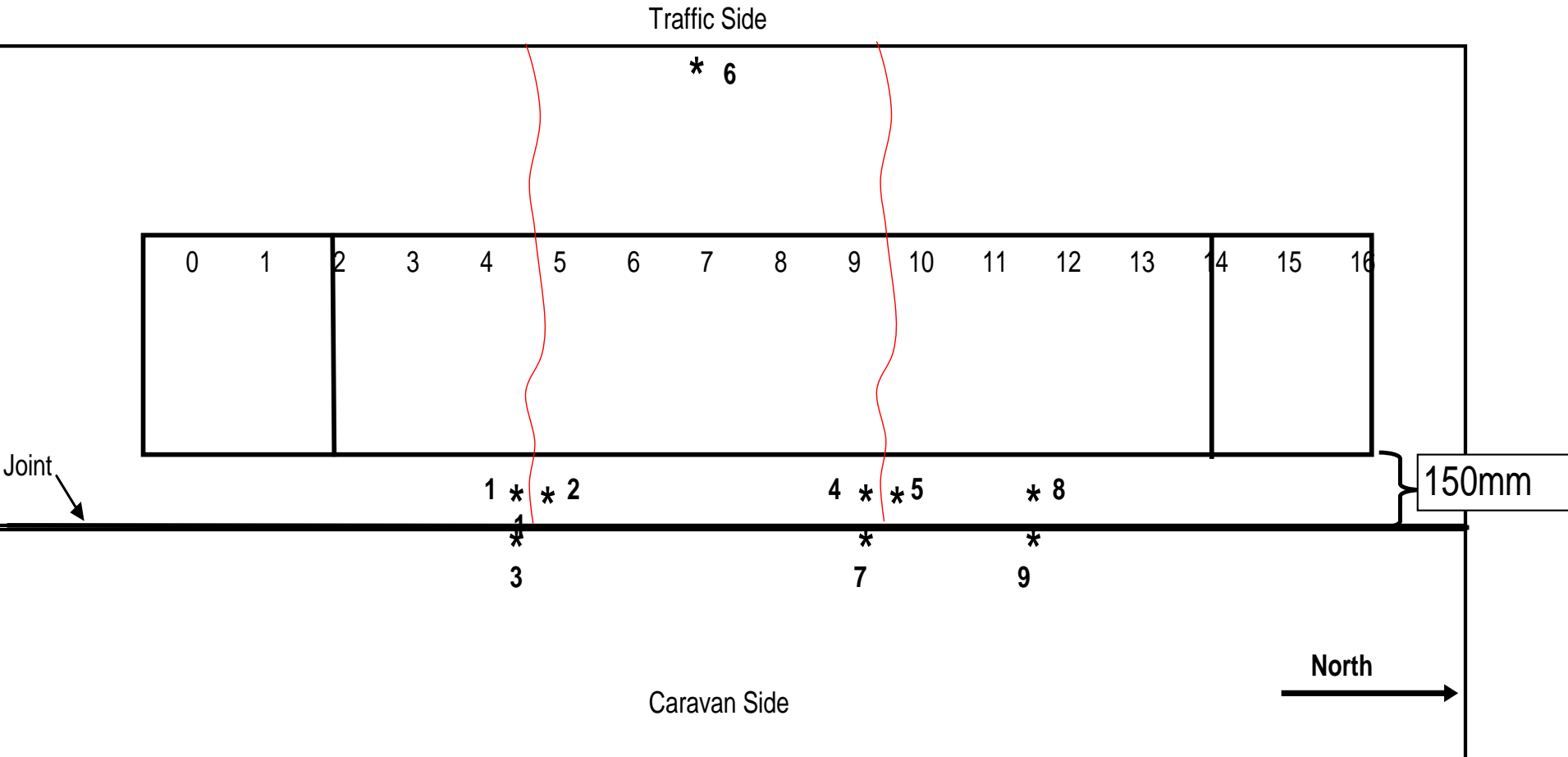
JDMD 16

JDMD 17

459A4: Edge loading “tied” shoulder (strong base, with 50mm ETB)

- Section failed after 237 567 reps
- 200 000 dry, 37 567 reps wet (fail in its 1st wet cycle)
- Starting date: 20 Feb 09, end 11 March 09, 18 Days
- Ave slab thickness: 68mm

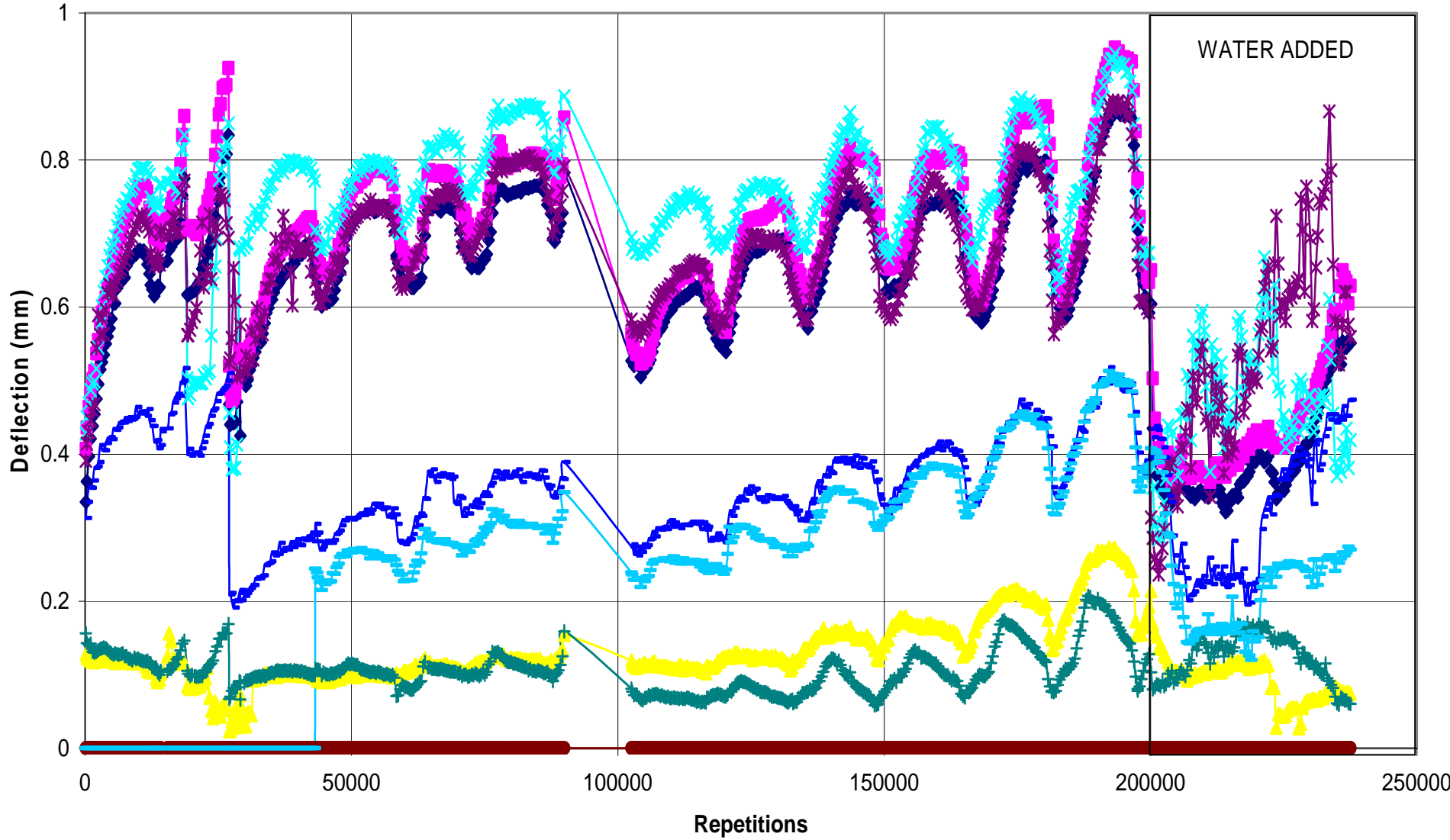
LAYOUT OF JDMD's FOR SECTION 459A4





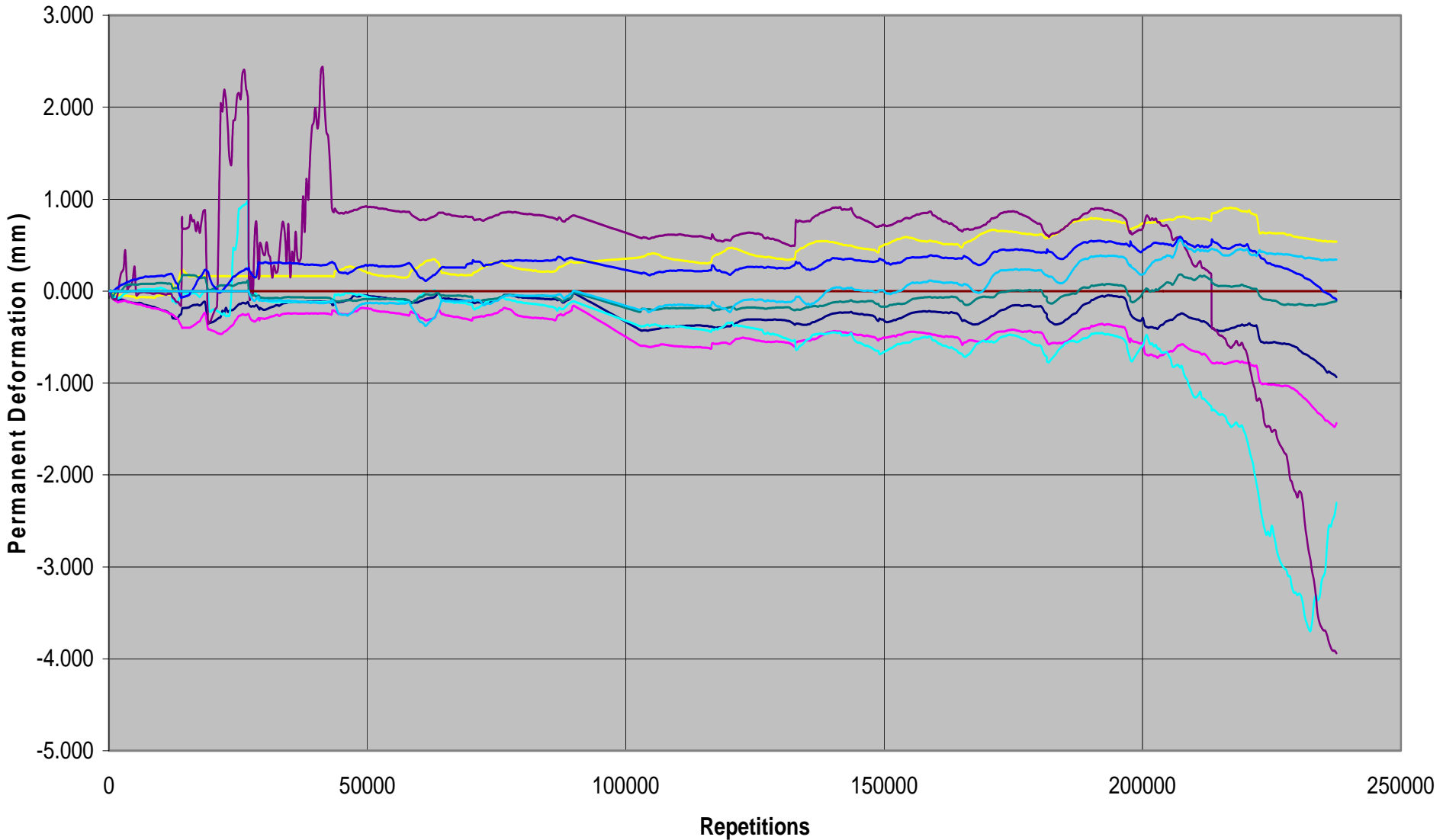
DEFLECTIONS OF JDMD'S SECTION 459A4 (cracked)

Joint with Steel

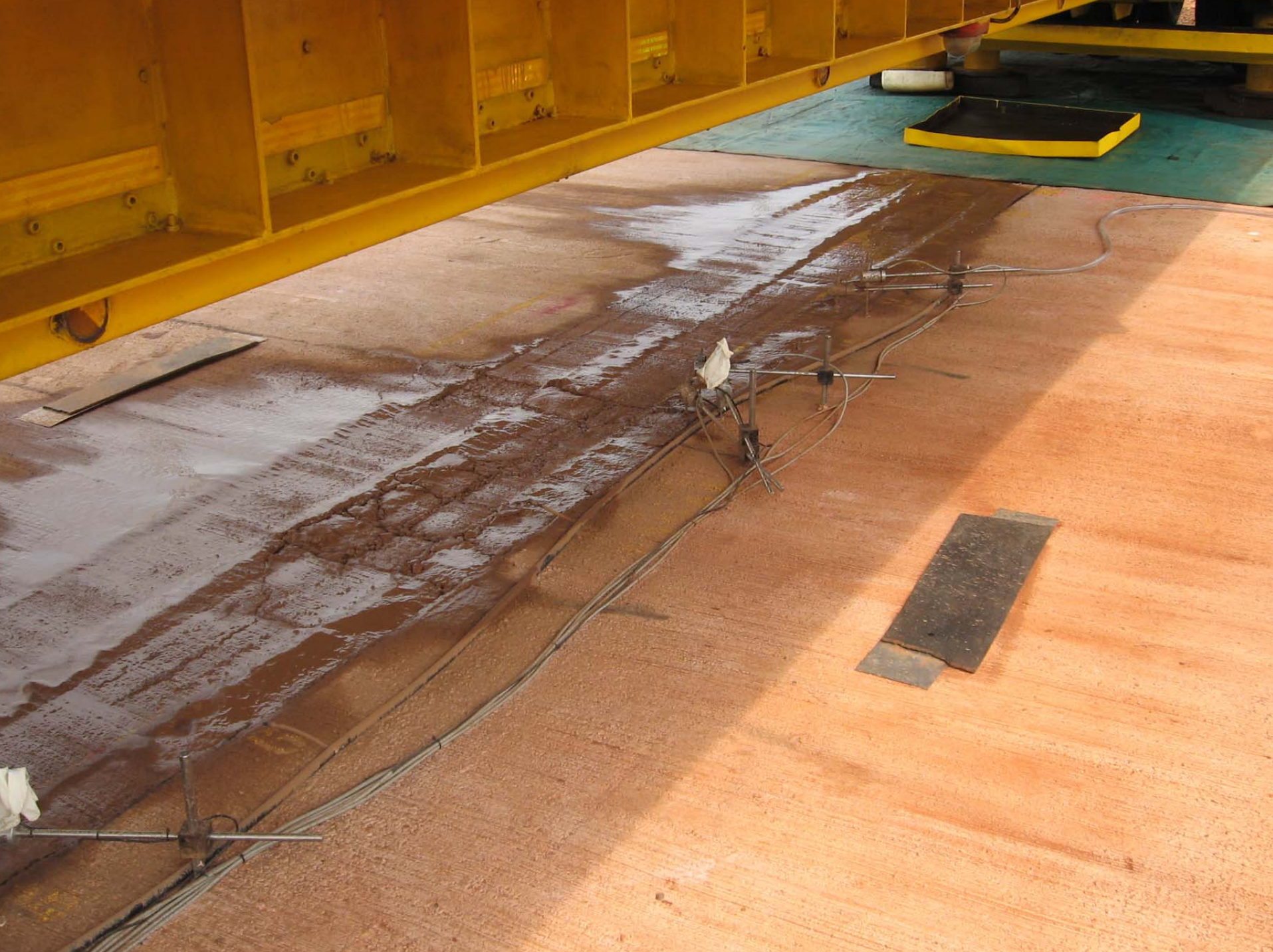


PERMANENT DEFORMATION OF JDMD'S SECTION 459A4 (crack)

Joint with Steel



— JDMD 1 — JDMD 2 — JDMD 3 — JDMD 4 — JDMD 5 — JDMD 6 — JDMD 7 — JDMD 8 — JDMD 9



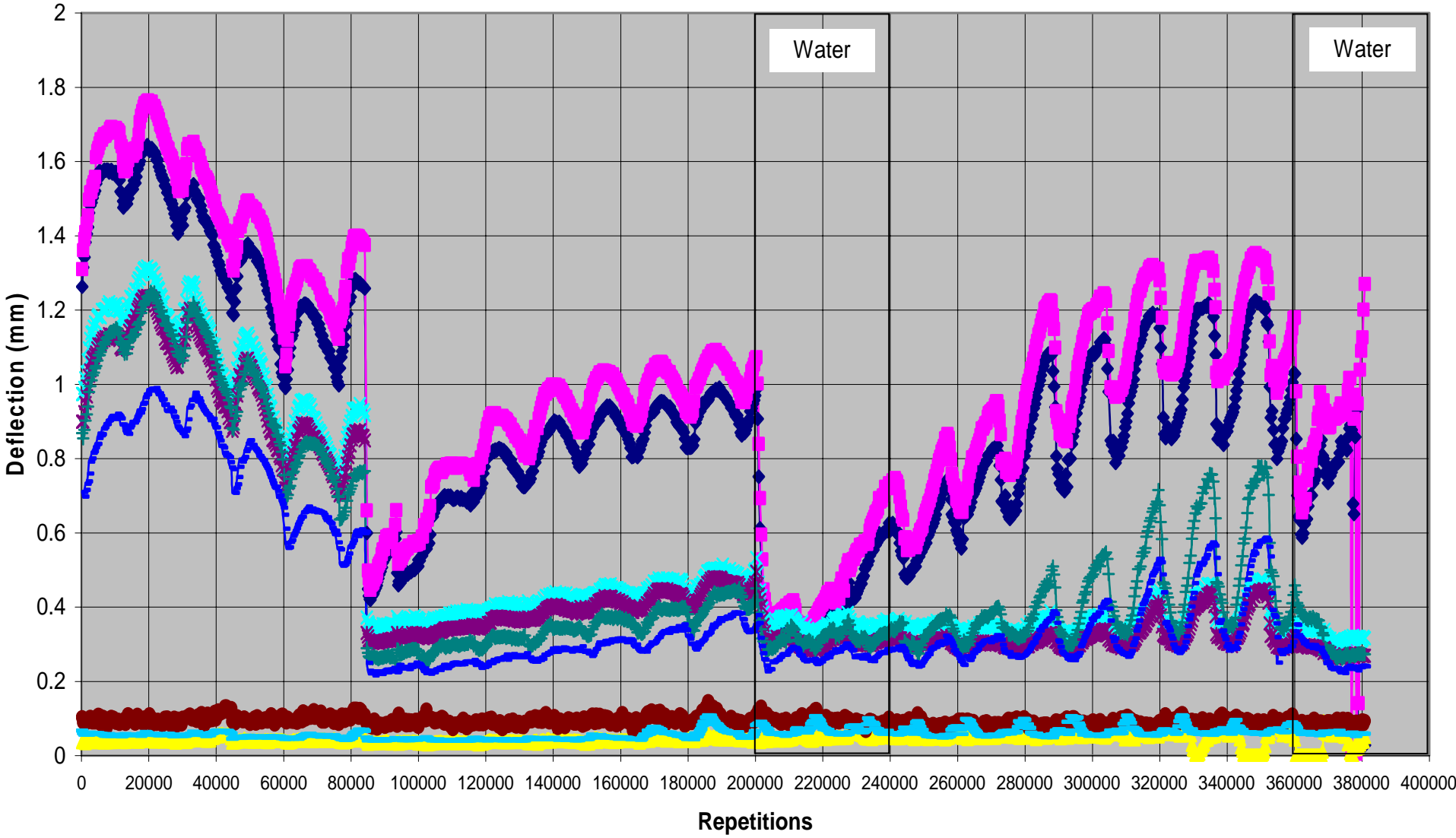


460A4: Edge loading “un-tied” shoulder (strong base, 50mm ETB)

- Section failed after 381 048 reps
- 200 000 dry, 40 000 wet, 120 000 dry, 21 048 wet (fail)
- Starting date: 12 march 09, end 8 April 09 (28 days)
- Ave slab thickness: 65mm

DEFLECTIONS OF JDMD's SECTION 460A4 (cracked)

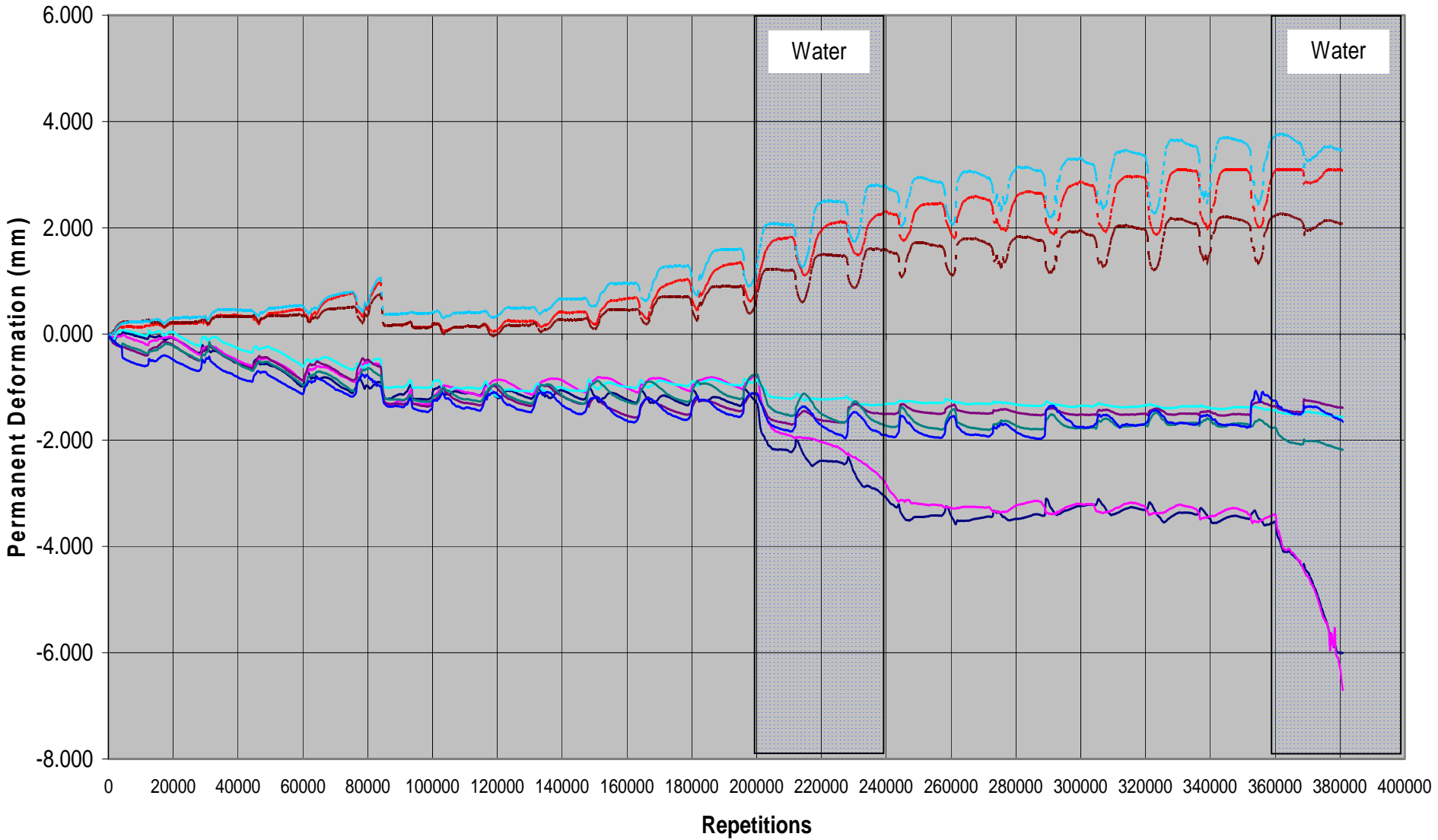
Joint with NO Steel



◆ JDMD 1 ■ JDMD 2 ▲ JDMD 3 × JDMD 4 * JDMD 5 ● JDMD 6 + JDMD 7 ○ JDMD 8 × JDMD 9

PERMANENT DEFORMATION OF JDMD's SECTION 460A4 (crack)

Joint with NO Steel



HVS 04
SECTION: 460A4
DATE : 8-4-09
N : 381048
CRACKS : YES
WET/DRY : DRY (WET)
POINTS : (1-8) (13-16)
TIME : 09H50
LOAD : 40 KN
POINT : ORANGE

SECTION FAILURE







461A4: Centre loading “Day joint” test (strong base, 50mm ETB)

- Starting date: 9 April 09
- Failed after 365 972 reps (Friday 11 May)
- Failed 6 000 reps into its 2nd watering cycle
- 33 days of testing





Lessons learned so far...

- Material is sensitive to curling & warping
 - Care to be taken along free and longitudinal edges
- No dramatic differences between the structural support (strong vs weak base)
- In dry state pavement life is exceptionally high
- In wet state pavement life is reduced 10 fold
 - Pavement is sensitive to the ingress of water
 - 3 factors are important
 - Crack width, crack spacing and quality of the base
 - More attention is required to prevent base from eroding during wet periods