

CONCRETE REPAIRS & JOINT SEALING ON NATIONAL ROUTE N1-19 FROM KLEIN RIETSPRUIT TO N12/POTCH

John W Hodgson

BVi Consulting Engineers Western Cape (Pty) Ltd

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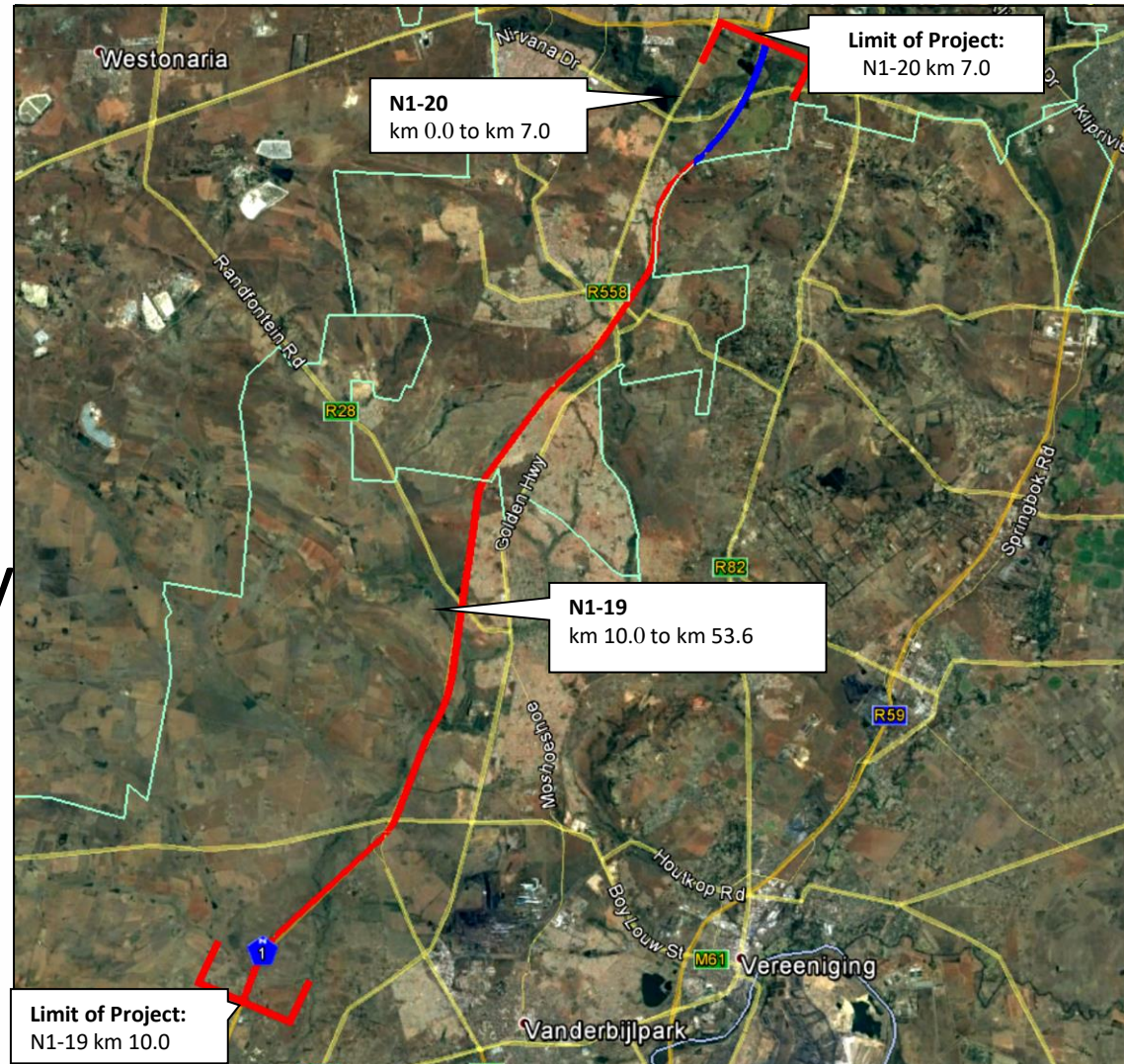
INTRODUCTION

- Contract SANRAL N.001-190-2017/1
- SANRAL Project Manager : Mr. O Sengwane
- Contractor : Roadmac Surfacing
- Sub-Contractor : Kevin Pickard Projects
- Consulting Engineers : BVi Consulting
Engineers WC
- Commencement date : April 2022
- Construction Period : 18 months



PROJECT LOCALITY

- Gauteng
- CoJ & Emfuleni
- Length – 50 km
- Dual carriageway
- Constructed:
 - 1980/1981
 - Four contracts



PROJECT BACKGROUND

- As-built pavement structure:

PAVEMENT LAYER	DESCRIPTION
Surfacing	235 mm Portland Cement Concrete - jointed
Subbase	100 mm C1
Upper Selected Subgrade	150 mm G5



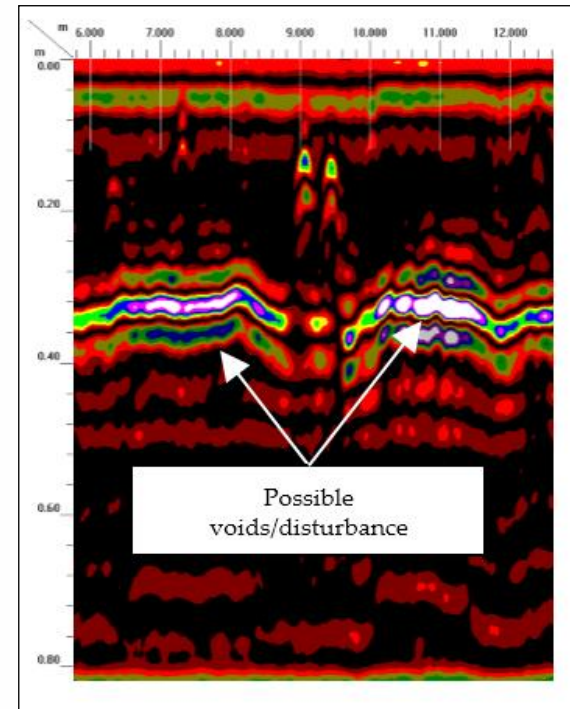
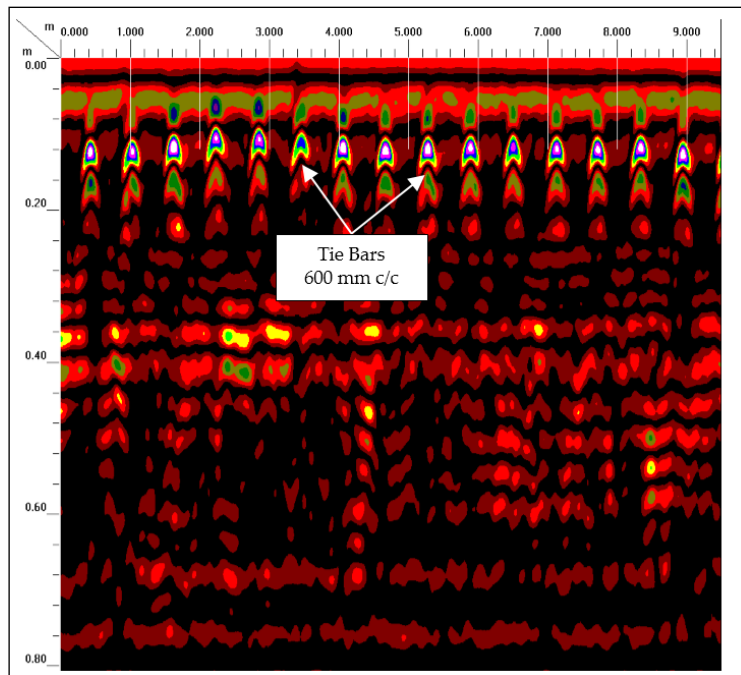
PROJECT BACKGROUND

- Materials Investigation – Load Transfer
 - Load transfer efficiency (LTE) tested through falling weight deflectometer (FWD) measurements with a 40 kN load over joints and cracks;
 - LTE across transverse joints – 96%;
 - LTE across longitudinal cracks – 65%;
 - LTE across transverse cracks – 94%;
 - LTE acceptable (>60%).



PROJECT BACKGROUND

- Materials Investigation – GPR Survey



PROJECT BACKGROUND

- Pavement History
 - Visual Condition:
 - Spalled longitudinal cracks



PROJECT BACKGROUND

- Pavement History
 - Visual Condition:
 - Failed concrete patch with rebar exposed (previous strip repair)



PROJECT BACKGROUND

- Pavement History
 - Visual Condition:
 - Typical D-shaped edge break along transverse joint



FINDINGS & CHALLENGES DURING CONSTRUCTION

- Subbase
 - Existing subbase appeared intact and stabilised;
 - Minimal raveling – some under longitudinal crack;
 - Tender allowed for both C4 replacement & lean mix concrete – latter preferred;
 - Challenged the view during design that longitudinal cracks developed due to poor subbase support.



FINDINGS & CHALLENGES DURING CONSTRUCTION

- Longitudinal cracks during construction
 - Long cracks developed in adjacent slabs after cutting and removal of cracked slab;
 - Indicative of stress relief;
 - Two findings following removal of slabs:
 - Different diameter tie bars in longitudinal joints; and
 - Depth of saw cut typically 30mm to 40mm.



FINDINGS & CHALLENGES DURING CONSTRUCTION

- Longitudinal cracks during construction
 - Tie bar diameter:
 - Diameter dependent on distance of joint from free edge;
 - Different diameter tie bars therefore not unexpected;
 - Y16 tie bars along portion of southbound carriageway along both joints – section have few longitudinal cracks;
 - International (e.g. Australia) trends indicate use of \leq Y12 tie bars.



FINDINGS & CHALLENGES DURING CONSTRUCTION

- Longitudinal cracks during construction
 - Depth of saw cut:
 - Saw cut joint usually cut to $\frac{1}{4}$ slab thickness;
 - Purpose of the saw cut to create a weakened plane to ensure crack development along these joints;
 - Insufficient cut depth may result in cracks elsewhere in the slab;
 - With both longitudinal joints tied, movement would further be restricted at the joint;
 - Could have led to uncontrolled cracking;



FINDINGS & CHALLENGES DURING CONSTRUCTION

- Longitudinal cracks during construction
 - Depth of saw cut:
 - Appeared as if entire pavement acted as a single slab in width, being constrained by tie bars;
 - Longitudinal cracks could have developed along its centre to release excessive stress;
 - Could explain longitudinal cracks in slabs adjacent to those removed for full depth repair.



FINDINGS & CHALLENGES DURING CONSTRUCTION

- Horizontal cracks
 - Developed \pm one third to half-depth within the concrete slab.



FINDINGS & CHALLENGES DURING CONSTRUCTION

- Horizontal cracks
 - Limited research show horizontal cracking usually associated with CRCP; no reference to JCP;
 - Horizontal cracking in CRCP usually associated with reinforcement – develop along plane of reinforcement;
 - Significant tensile stress develop in vicinity of longitudinal steel due to environmental load and steel restraint;



FINDINGS & CHALLENGES DURING CONSTRUCTION

- Horizontal cracks
 - Transverse cracks develop $\pm 300\text{mm}$ to 500mm from transverse joint;
 - Possibility that this can be related to the shallow cut depth of transverse joints;
 - Slabs in compression leading to the development of horizontal cracks, progressing horizontally and upwards.

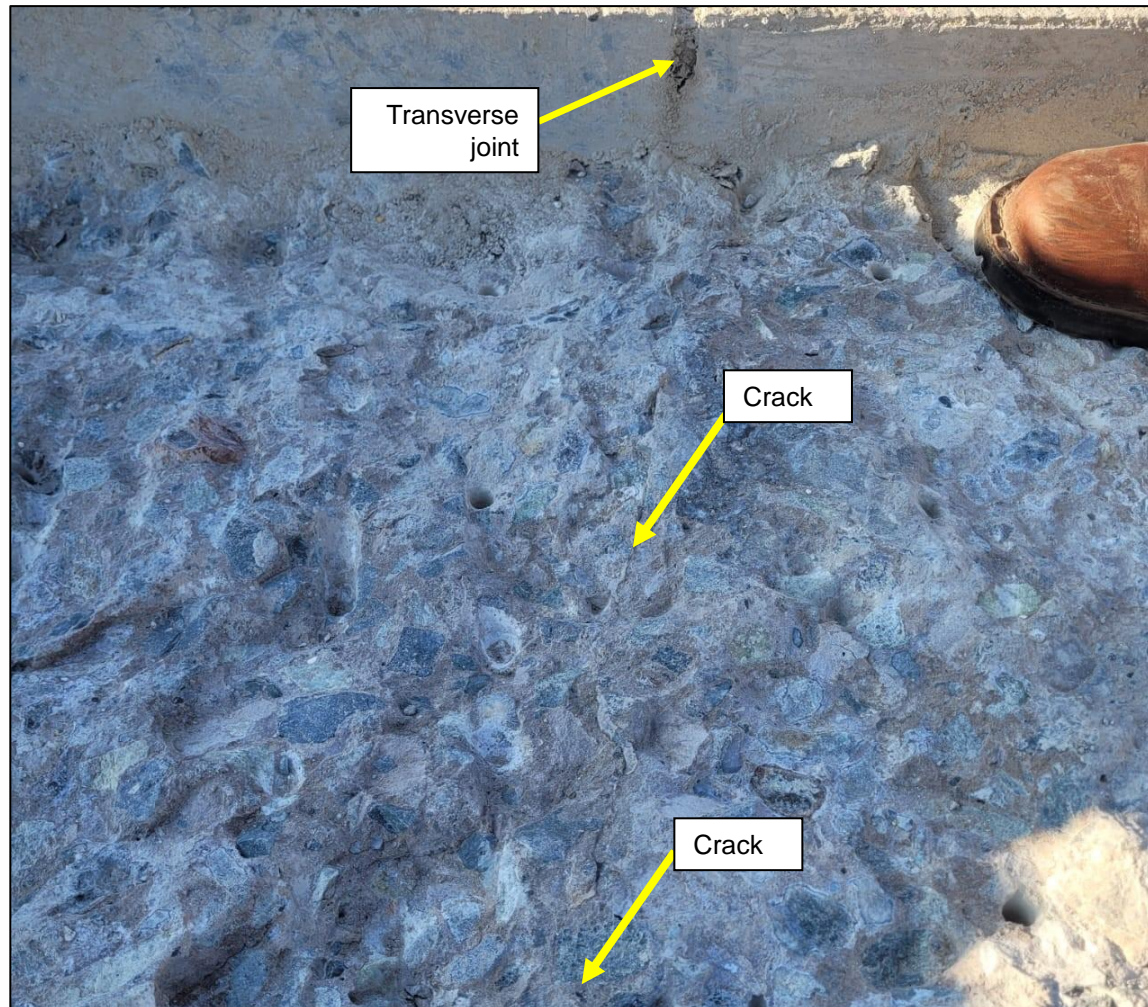


FINDINGS & CHALLENGES DURING CONSTRUCTION

- Horizontal cracks



FINDINGS & CHALLENGES DURING CONSTRUCTION



FINDINGS & CHALLENGES DURING CONSTRUCTION

- Construction Progress
 - Concrete repairs:



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- Construction Progress
 - Concrete repairs:



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 - Concrete repairs:



FINDINGS & CHALLENGES DURING CONSTRUCTION

- Construction Progress
 - Concrete repairs:



FINDINGS & CHALLENGES DURING CONSTRUCTION

- Construction Progress
 - Joint resealing:
 - >450 000 m of joints to be removed and resealed;
 - Process includes reaming, installation of a backing chord and application of sealant;
 - DowSil 890 SL silicone sealant used on project.



CONCLUSIONS

- Actual failure mechanism different to that identified during design.
- Longitudinal cracking probably due to excessive tie bar thickness.
- Horizontal cracking at transverse joints probably due to shallow saw cuts.



QUESTIONS/DISCUSSION

