APPENDIX A

PHOTOGRAPHIC RECORD OF HVS TESTS

HVS TEST AT MARIANNHILL, N3/1

SECTIONS

1 (215A3)

2 (217A3)

3 (218A3)

(a) Successful recovery of a solid block of stabilized material from the upper stabilized subbase layer.

(b) Successful recovery of a solid block of stabilized material from the lower stabilized subbase layer. Note smooth interfaces between the layers.

Stabilized subbase layers (weathered granite)

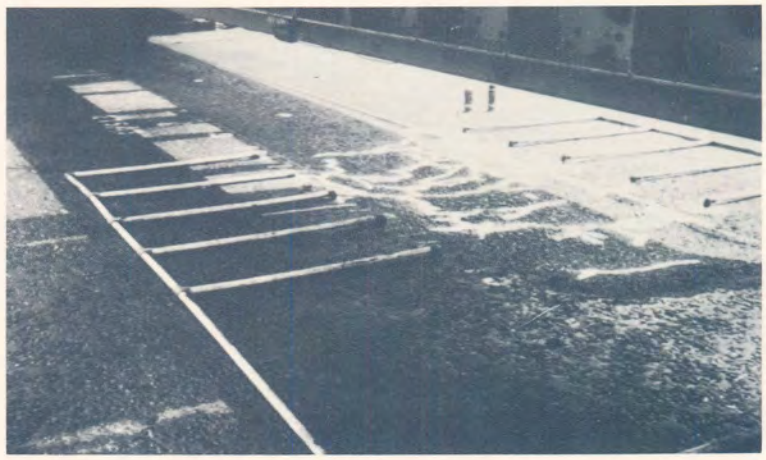
(c) Excavated depth profile of the road structure.

PLATE 1:

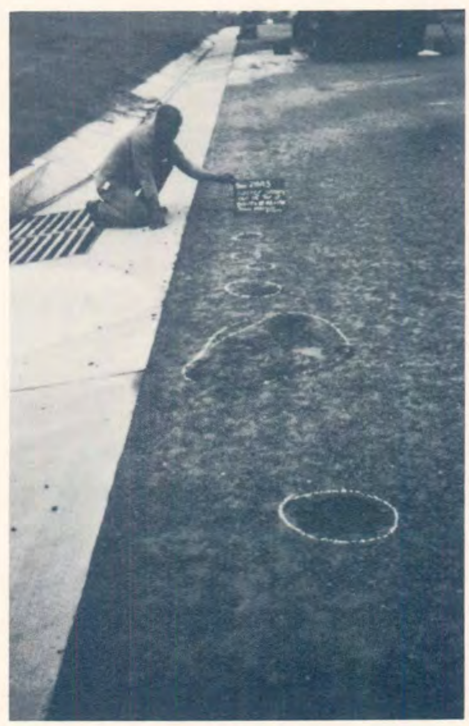
MARIANNHILL, N3/1: EXCAVATION OF A TEST PIT PRIOR TO HVS TESTING. NOTE THE TWO YELLOW-BROWN STABILIZED WEATHERED GRANITIC SUBBASES UNDERNEATH THE ASPHALT LAYER.

(a) General view of HVS test at Mariannhill, Section 3 (218A3).

(b) HVS test 1 (215A3): Note the water inlet pipes on the front part of the test section. The white paint indicates the fatigue cracking of the asphalt during the wet test. The uncracked section at the back, is an indication of the surface during dry test conditions. E80s on dry test section: 21 × 10^6.



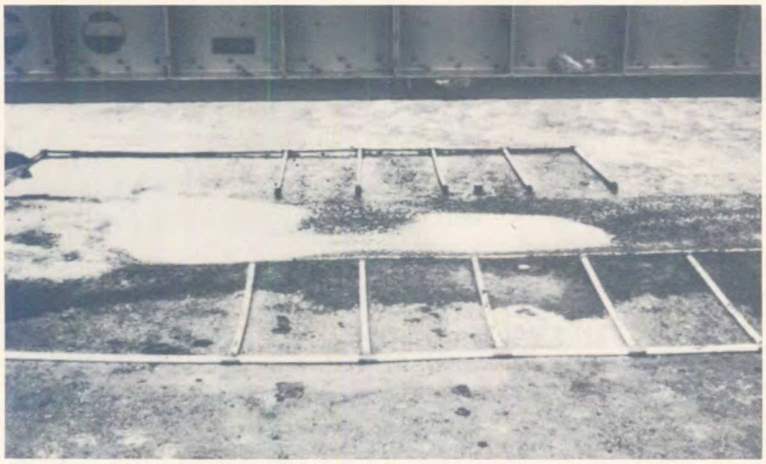
(c) 21 mm of permanent deformation (rut) on wet section. E80s on wet test section: 0,8 × 10^6.



(d) Water seepage from the bottom of the asphalt layer, approximately 30 m from the actual HVS test section, during the wet test. The horizontal slope of the top of the subbase layers runs diagonally from the top right to the bottom left of the photograph.

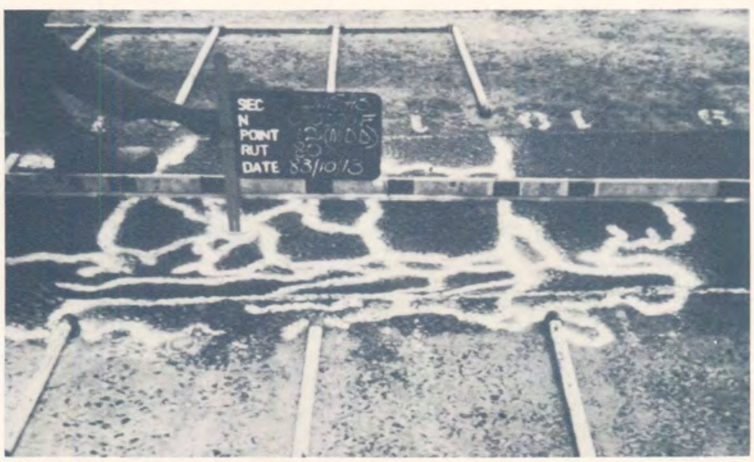
PLATE 2:

HVS TESTS AT MARIANNHILL ON SECTION 1 (215A3) AND SECTION 3 (218A3).



(a) Rutting of Section 1 during wet conditions. (Upper subbase saturated)

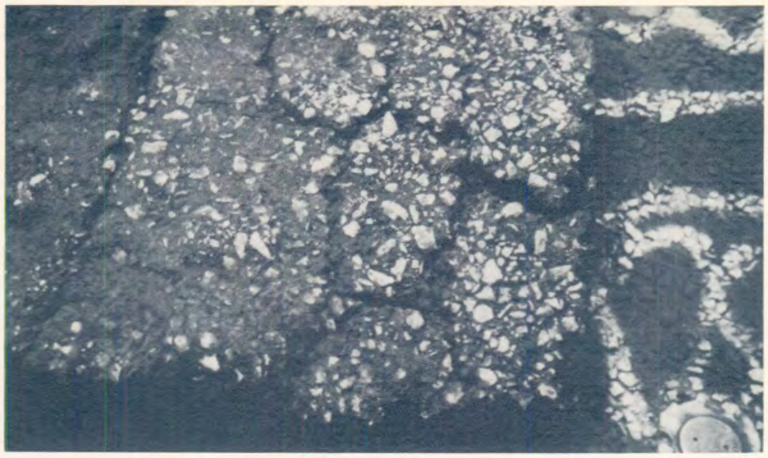
(b) Pumping from upper subbase during the wet test.



(c) Maximum rut of 80 mm on MDD12. Note the fatigue cracking of the asphalt layer. E80s on wet test section: 6,8 × 10^6

PLATE 3:

GENERAL VIEW OF THE BEHAVIOUR OF SECTION 1 (215A3), DURING THE WET TEST.



(a) Bottom of asphalt base layer. Note the fatigue cracks and some stripping of asphalt.

(b) Visible cracks on top of the upper stabilized subbase layer after the removal of the asphalt in (a).

(c) Recovered granulated upper subbase material within the trafficked area. Note blocks of the same material recovered from the untrafficked area.

PLATE 4:

EXCAVATED TRENCH ACROSS SECTION 1 AFTER THE WET TEST.

→ Fatigue cracks on asphalt

← Recovered lower stabilized subbase layer

(a) Recovered cracked lower stabilized subbase layer within the trafficked area after the test. (Blocks on top of asphalt)

← Recovered lower stabilized subbase layer

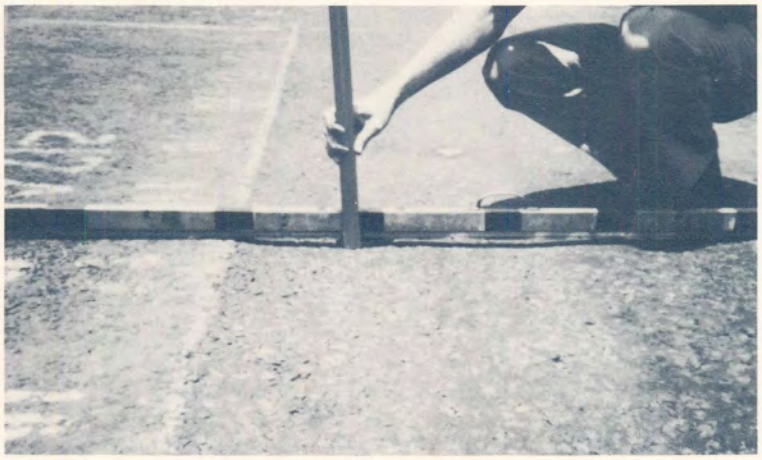
→ Selected subgrade layer

(b) Printed crack pattern of the bottom of the lower stabilized subbase on the top of the unexcavated selected subgrade layer.

PLATE 5:

EXCAVATED LOWER STABILIZED SUBBASE LAYER ON SECTION 1 AFTER THE WET TEST.

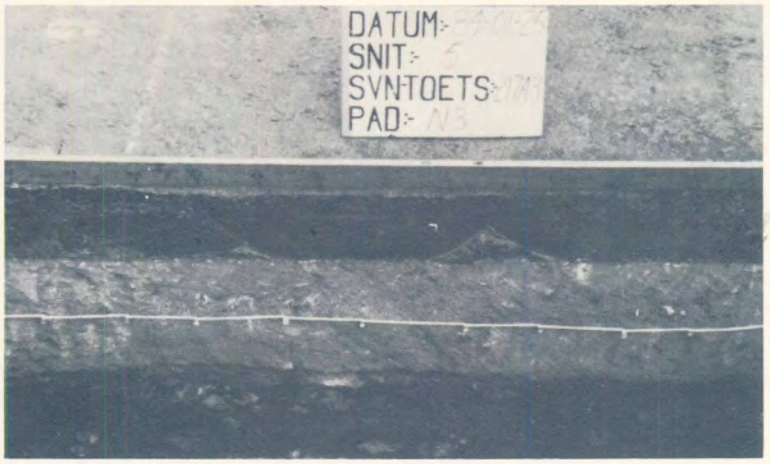
(a) General view of the surface of Section 2 (217A3) after 32×10^6 E80s in the dry state.



(b) Maximum rut of 20 mm on top of the asphalt layer. Rut originated from the asphalt surfacing and base layer only. (32×10^6 E80s)

PLATE 6:

VIEW OF THE SURFACE CONDITION ON SECTION 2 (217A3), AFTER THE HVS TEST IN THE DRY STATE. (NORMAL ENVIRONMENTAL CONDITIONS)



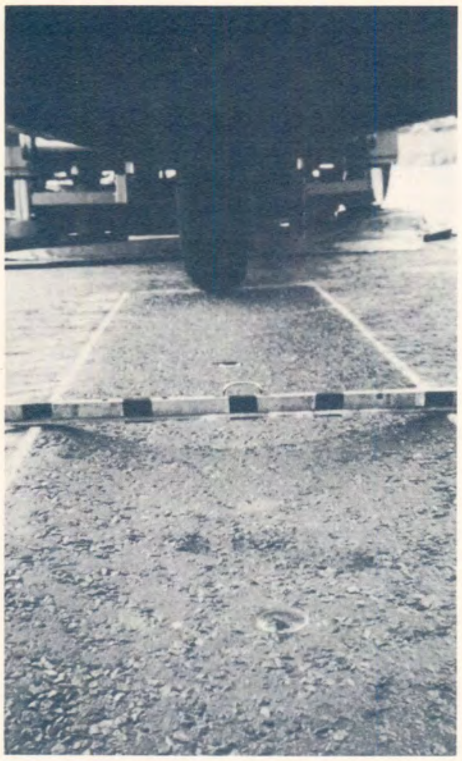
Stabilized subbase layers

(a) Trench across the test section at the point of maximum rut (20 mm). Note the relatively perfect condition of the stabilized subbase layers, although cracked. (32×10^6 E80s)

(b) Recovered cracked upper stabilized subbase layer after $3{,}6 \times 10^6$ E80s.

PLATE 7:

EXCAVATED TRENCH ACROSS SECTION 2 (217A3) AFTER THE DRY TEST.

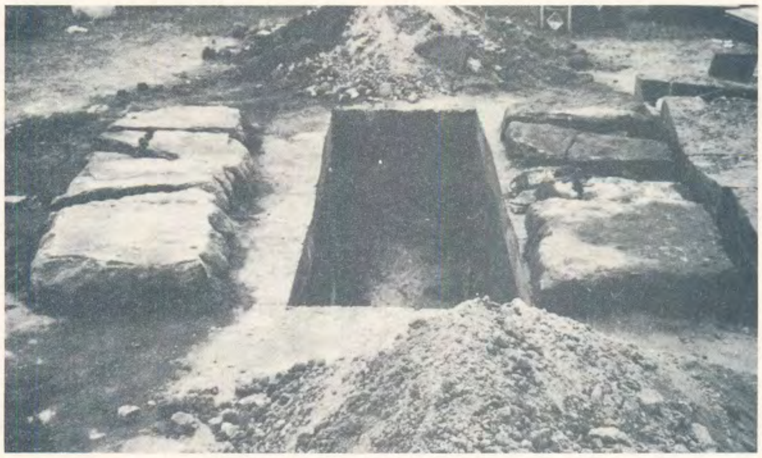


(a) General view of the surface of the test section after 32 000 actual repetitions with the single wheel load at 150kN. (Contact pressure: 1445kPa)

(b) Trench across test section after test. Note the excessive asphalt deformation, and the minimum amount of rut on top of the upper stabilized subbase. (No carbonation within stabilized subbase layers.)

PLATE 8:

HIGH SINGLE WHEEL LOAD TEST ON SECTION 3 (218A3) IN THE DRY STATE.



(a) General view of the recovered blocks of subbase material. Upper subbase on the right, lower subbase on the left.

Lower subbase →

Upper subbase →

(b) Note the relatively smaller blocks of recovered upper stabilized subbase material, due to fatigue cracking and fracturing. The lower stabilized subbase experienced only fatigue cracking, hence the bigger blocks of material.

PLATE 9:

EXCAVATED TRENCH ACROSS TEST SECTION 3 (218A3), AFTER THE HIGH SINGLE WHEEL LOAD TEST.

HVS TESTS AT "FIGTREE", N2/24

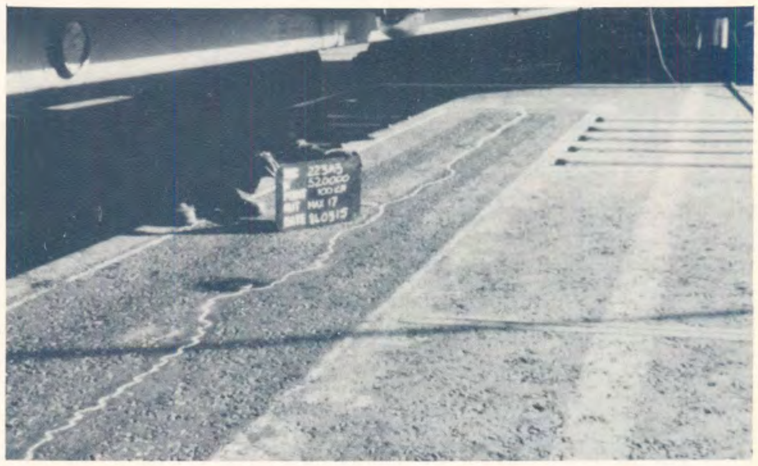
SECTIONS

1 (223 A3)

2 (224 A3)

(a) View of HVS site on the fast lane of the south bound carriageway. Note the settlement cracks.

(b) General view of test on SECTION 1. Note the water inlet pipes on the side of the test section.



(c) Longitudinal crack on SECTION 1.

(d) Maximum permanent deformation of 17 mm after 520 000 repetitions of a 100kN dual wheel load (20 ME80s).

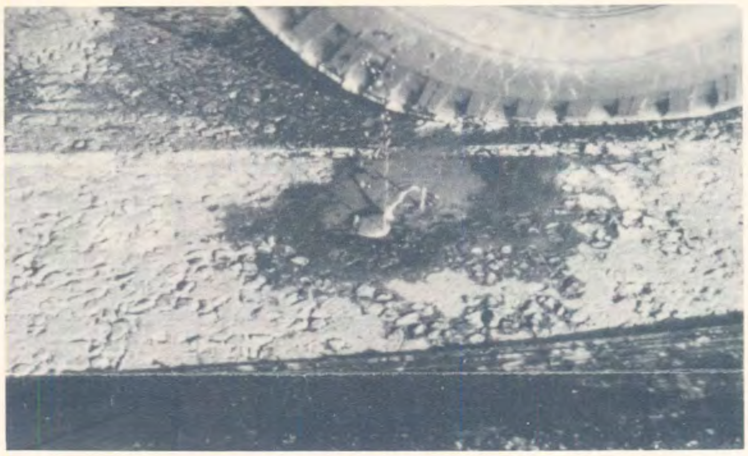
PLATE 1: FIGTREE, N2/24: General view of the HVS site and test sections. Note the longitudinal settlement cracks on both the site and test sections.

(a) Maximum permanent deformation of 38 mm at the crack after water introduction.

(b) Relative position of MDD8 on SECTION 1.

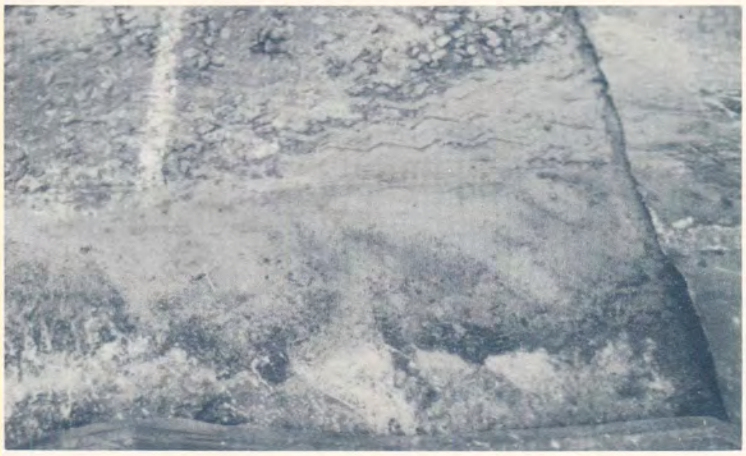
(c) Start of water pumping from the bottom of the crack on SECTION 1.

PLATE 2: Longitudinal crack and water introduction on SECTION 1.



(a) Pore pressure release through nuclear moisture and density measuring hole, next to the HVS test section.

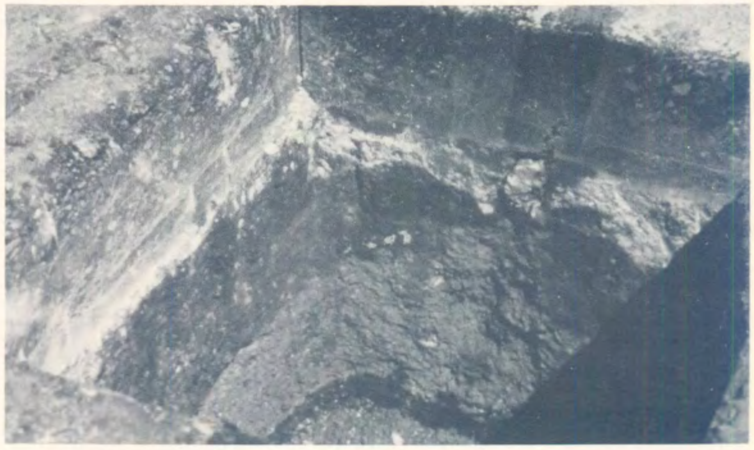
(b) Fines starting to pump through the longitudinal crack.



(c) Fines on the side of the test section after the "saturated" test.

PLATE 3: Pumping of fines from the upper lime-stabilized subbase layer (weathered Granite) on SECTION 1.

(a) Excavated test pit across the crack indicating that the crack exists in all the layers of the road structure.



(b) Relative low pH zone at the position of the crack (dark red colour – high pH zone), determined with Phenolthalien.

(c) Note the discolouring on the side of the block next to the crack.

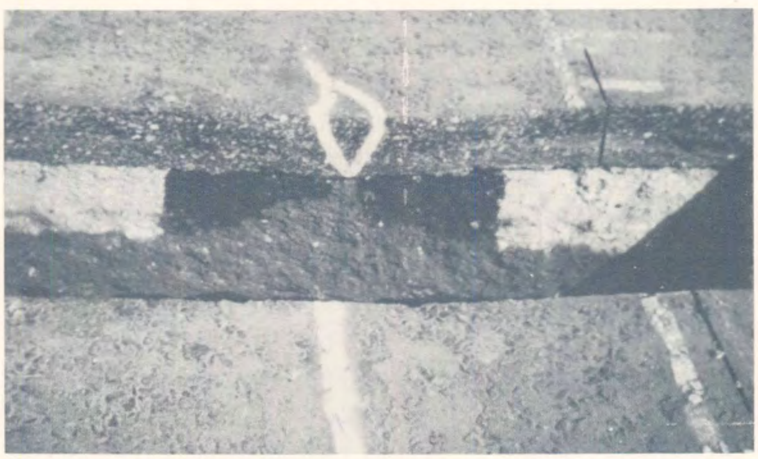
PLATE 4: TEST PIT across the longitudinal crack, between the two test sections.

(a) Face of the test pit, indicating the moisture regime at the position of the crack (point 1,0 on straight-edge). The light brown colour is the well-stabilized weathered Granite subbase layers.

(b) Relative low pH zone at the position of the crack and the bottom of the lower subbase layer. This zone was carbonated, determined with HCL solution. The dark red area is the relative high pH zone.

PLATE 5: Excavated trench across SECTION 1 between measuring points 3 and 4.

(a) Moisture regime at the crack at measuring point 12 on SECTION 1.

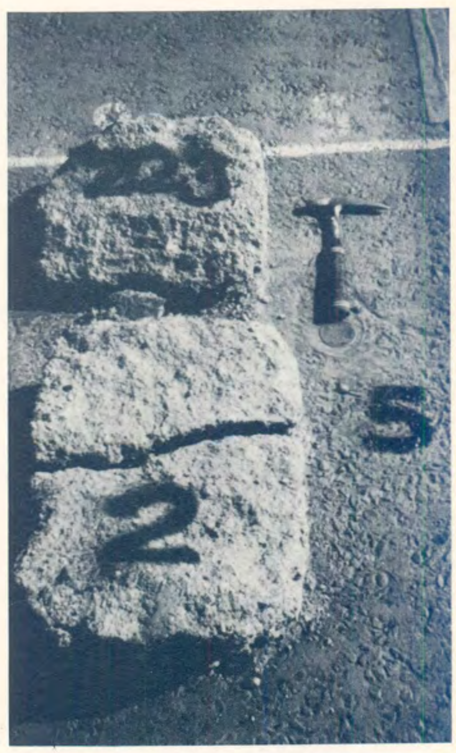


(b) Moisture regime (carbonated) at measuring point 19 on SECTION 2.

PLATE 6: Excavated trenches at measuring points 12 and 19 on SECTION 1 and 2 respectively.

(a) General view of section positions of the two trenches on section 1 and the recovered subbase material.

(b) Recovered upper subbase after 20,6 ME80s. (Semi-saturated). Note the position of the longitudinal crack. The other cracks are traffic associated. (Measuring points 3 to 4).



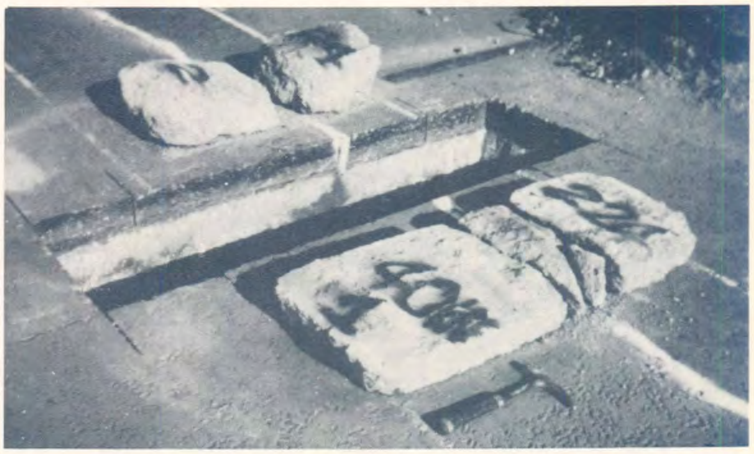
(c) Recovered lower subbase after 20,6 ME80s (Semi-saturated.) The two cracks are non-traffic associated. This layer was partially carbonated. (Measuring points 3 to 4).

PLATE 7: Recovered stabilized subbase layers on SECTION 1.

(a) Recovered upper subbase after 20,6 ME80s on SECTION 1 (saturated). Layer cracked and fractured (Measuring points 11 to 12).

(b) Recovered lower subbase layer after 20,6 ME80s on SECTION 1 (saturated) at measuring points 11 to 12.

(c) General view of recovered subbase layers on SECTION 2.



(d) Recovered upper and lower subbase layers from SECTION 2, measuring points 3 to 4, after 280 494 E80s. Note, only non-traffic associated cracks in the blocks.

PLATE 8: Recovered subbase layers from both TEST SECTIONS 1 and 2.

(a) Upper subbase layer cracked and fractured after 17 255 repetitions with 150 kN single wheel load.

(b) Few blocks recovered from the lower subbase layer. The rest of the layer was soft, granulated and carbonated. Repetitions 17 255 with 150 kN single wheel load.

PLATE 9: Recovered subbase layers between measuring points 18 and 19 on SECTION 2 after 150 kN test during the "dry" conditions.

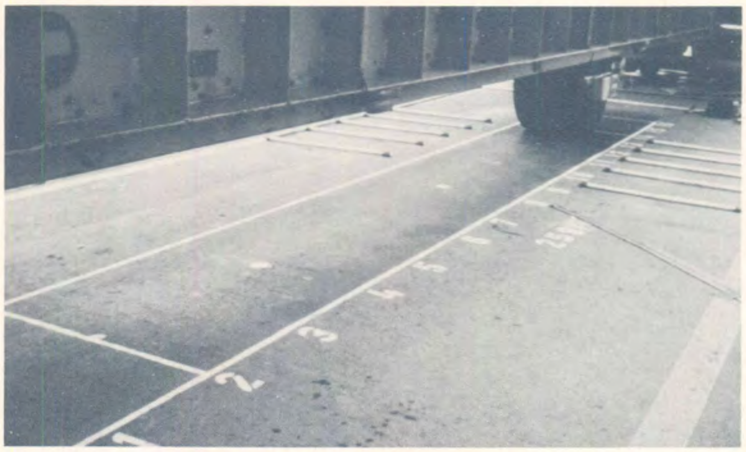
HVS TESTS AT UMGABABA, N2/24

SECTIONS

1 (227A3)

2 (259A3)

(a) Famous Berea Red Sand in a cutting at Umgababa HVS site.



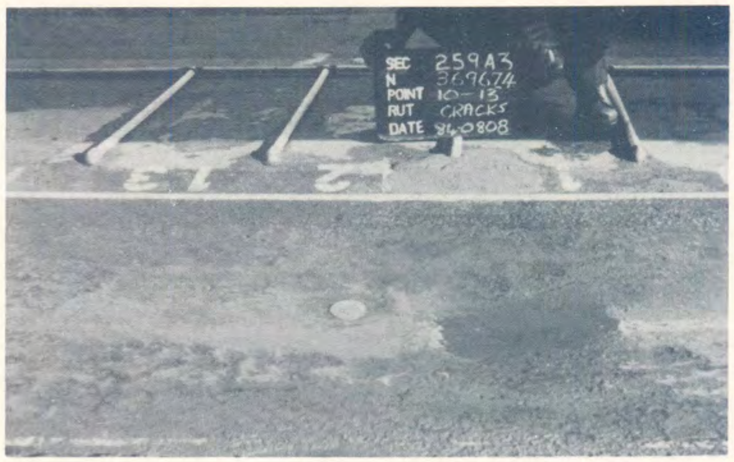
(b) Typical Surface condition of Section 2 in the dry state.

(c) Surface condition of Section 2 after Excess Pore Water Pressure (EPWP) state.

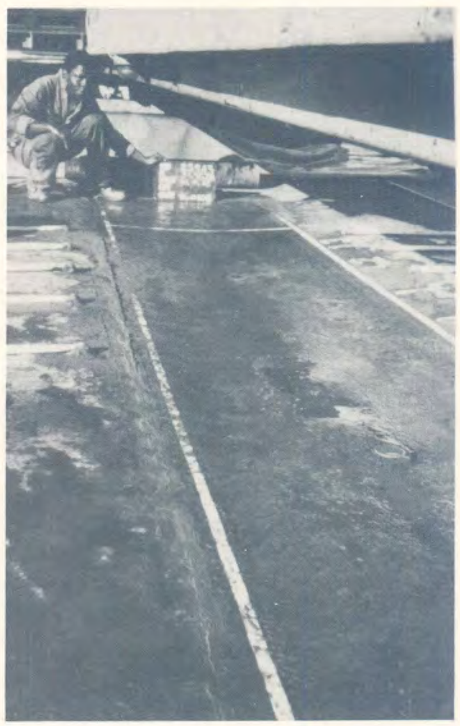
PLATE 1 : Berea Red Sand at Umgababa and the surface condition of Section 2.

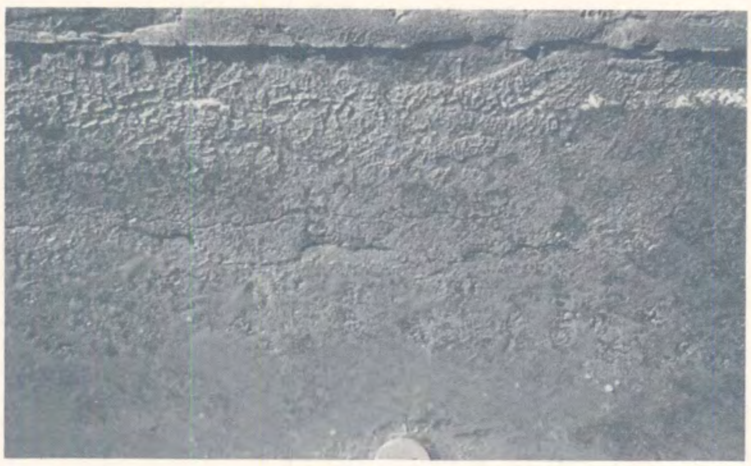
(a) Surface condition of Section 1 after the EPWP state, (62 mm rut after 2067 repetitions at (100kN) Note the white water inlet pipes both sides of the Section.

(b) Pumping on Section 2 through MDD hole at measuring point 12 and longitudinal cracks.



(c) Overhaul view of Section 2 after testing in the EPWP state.



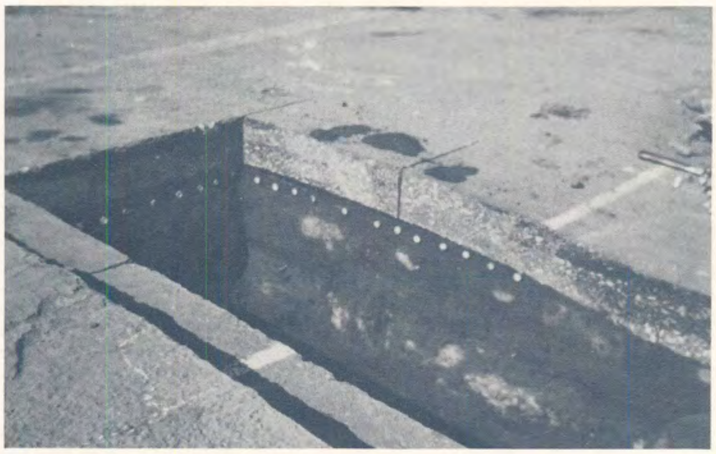


(d) Pumping through longitudinal fatigue crack on Section 2.

PLATE 2 : Pumping during the EPWP state on Sections 1 and 2.

(a) Cross Profiles made across Section 1 after HVS trafficking. NOTE the deformation and recovered stabilized Berea Red subbase material (cracked).

(b) Sideways (horizontal) pumping (erosion) of the lime treated Berea Red upper subbase at the bottom of the heaved asphalt on Section 1.



(c) White markers indicate top of upper subbase on Section 1. Above white markers is the soft pumped layer.

(d) Phenoltalien indication of relative high pH on the top of the upper subbase and the pumped layer.

PLATE 3 : Cross profiles made to study the failure mechanism at Umgababa.

(a) Cross profile across the test Section 1. Note the heaving of the asphalt as a result of the erosion action inside the trafficked area during the EPWP state.

(b) Cross profile on Section 2 after the dry state. No deformation recorded on road surface.

PLATE 4 : Cross profiles on Section 1 and 2 after the EPWP and dry states, respectively.

(a) Cross profile after EPWP on Section 2. Note the thinner subbase inside the trafficked area.

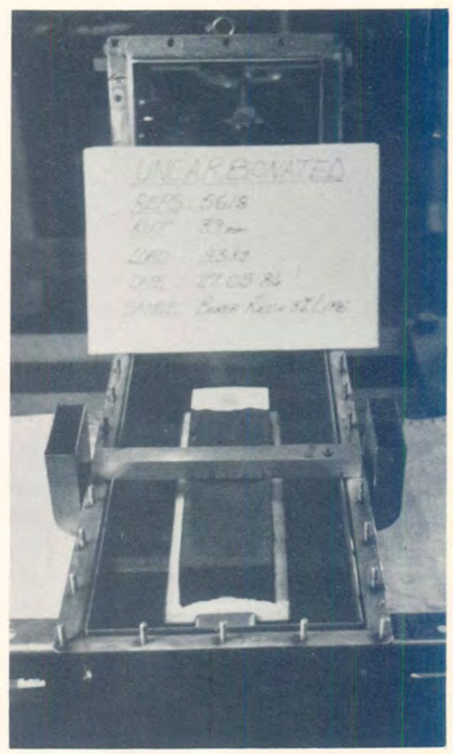
(b) Recovered upper subbase material from Section 2. Note the thinner subbase inside the trafficked area.

(c) Phenolthalien indication of continious relative high pH within both the upper and lower stabilized subbase layers.

PLATE 5 : Cross profiles on Section 2.

(a) Fatigue cracking at the bottom of the asphalt base layer after the EPWP state on Section 2.

(b) Real road failure next to Section 2 in the normal trafficked lane during the time of HVS testing on Section 2.



(c) Typical specimen of Berea Red material (recovered at Umgababa), after testing in the new Erosion test at NITRR.

PLATE 6 : Fatigue, real road failure and Erosion test specimen.

HVS TESTS AT VAN REENENS PASS, N3/6

SECTIONS

1 (233A3)

2 (234A3)

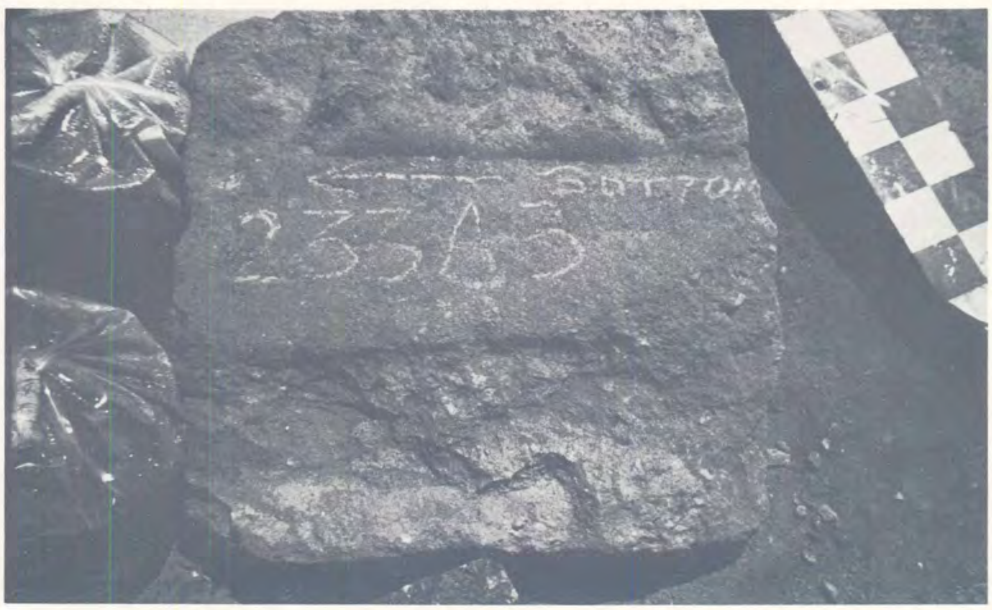
3 (235A3)

A.

B.

PLATE 1: Slope instabilities on National Route N3, at Van Reenens Pass. Note the crack width and the horisontal permanent deformation showed by the yellow line in photograph B.

A. UPPER SUBBASE



B. LOWER SUBBASE

PLATE 2: Upper and lower subbase material recovered from the test pit at Section 1 before any HVS trafficking. Note the white spots of badly mixed stabiliging agent in the upper subbase. The lower subbase show better cementing.

A.

B.

PLATE 3: **A.** Fatigue cracks on the surface of Section 1 after 279 795 actual repetitions of a 70 kN dual wheel load.

B. Closing of cracks at the surface after high temperatures applied to the road surface. Note the permanent deformation on the upper right of the photograph on the test section. The final actual repetitions of a 70 kN dual wheel load was 370 000, and the rut was 20 mm.

A.

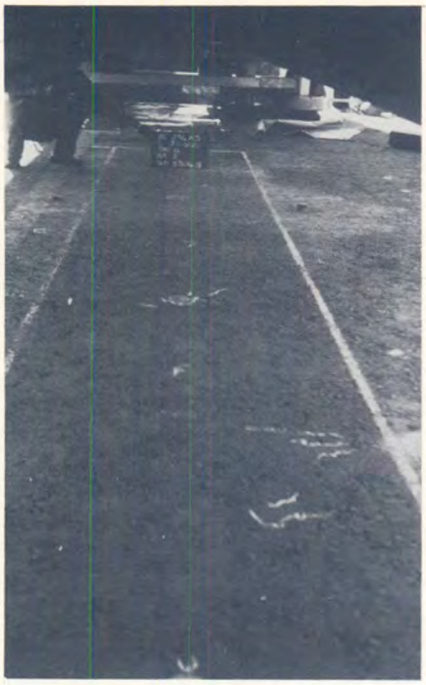
B.

C.

PLATE 4: **A.** Chemical phenol-test indicate well stabilized lower subbase, and poor stabilized upper subbase on Section 1.

B. Cross section profile on Section 1 after HVS test. Note the irregularities at the layer interfaces, and also the two recycled asphalt layers above the upper subbase.

C. Temperature rut at measuring point 8 on HVS Test Section 1. Note that most of the deformation was caused in the wearing course and not in the recycled asphalt base layer.



A.

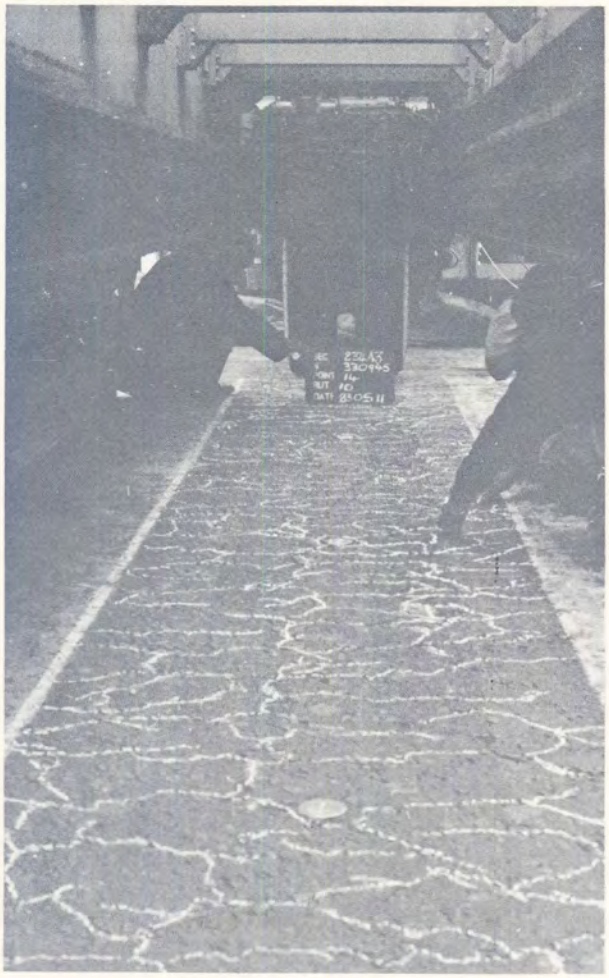
B.

C.

D.

PLATE 5: Fatigue crack growth on HVS Test Section 2.

- **A.** Fine hair cracks after 30 000 repetitions of a 70kN dual wheel load.
- **B.** Sudden crack appearance on the surface after 100 000 repetitions of a 70 kN, and 201 488 repetitions of a 100 kN dual wheel load on Section 2.
- **C.** Increased crack growth after 316 153 total repetitions.
- **D.** Major increase in crack growth from 316 153 to 319 153 total repetitions.

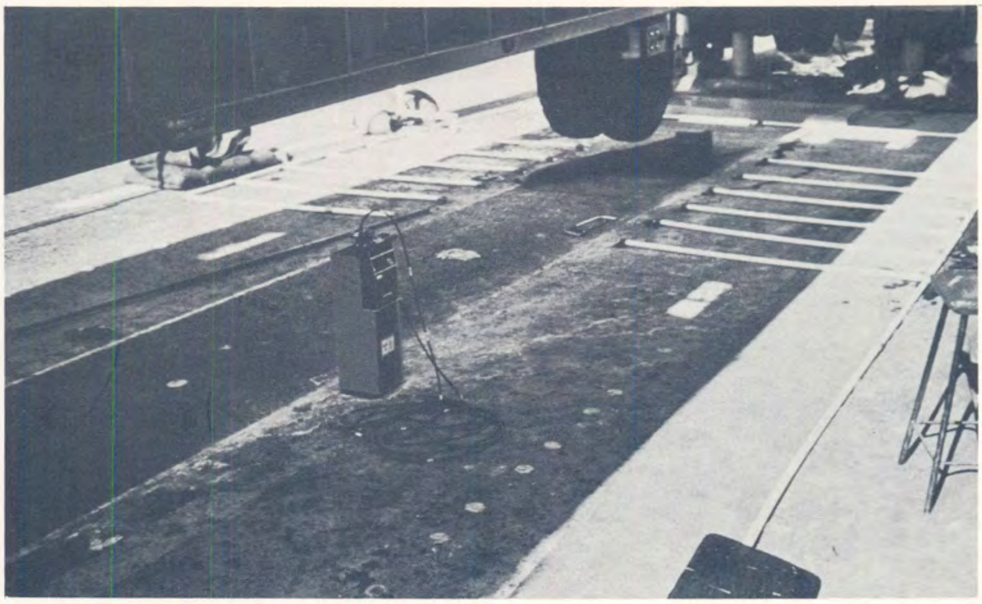


A.

B.

PLATE 6: **A.** Further increase in crack growth after 330 945 total repetitions. Surface water introduced at 330 945.

B. Crack pattern after 396 979 total repetitions. Note zero rut increase from 330 945 to 396 979 total repetitions, under wet surface conditions.



A.

B.

PLATE 7: Surface and subsurface water introduced on Section 2 after 396 979 total repetitions.

A. Water fed-pipes for subsurface water, both sides of the lower end of the test section. Inlet-depth 440 mm.

B. Pumping of fines from the upper subbase through the cracks on the total test section.

A.

B.

C.

PLATE 8: **A.** Final crack pattern and permanent deformation on Test Section 2.

B. Longitudinal cracks on edge of Test Section 2 at point 9, where a local rut of 89 mm was formed.

C. Stripping and total failure of the upper recycled asphalt base layer, where poor aggregates was used.

A.

B.

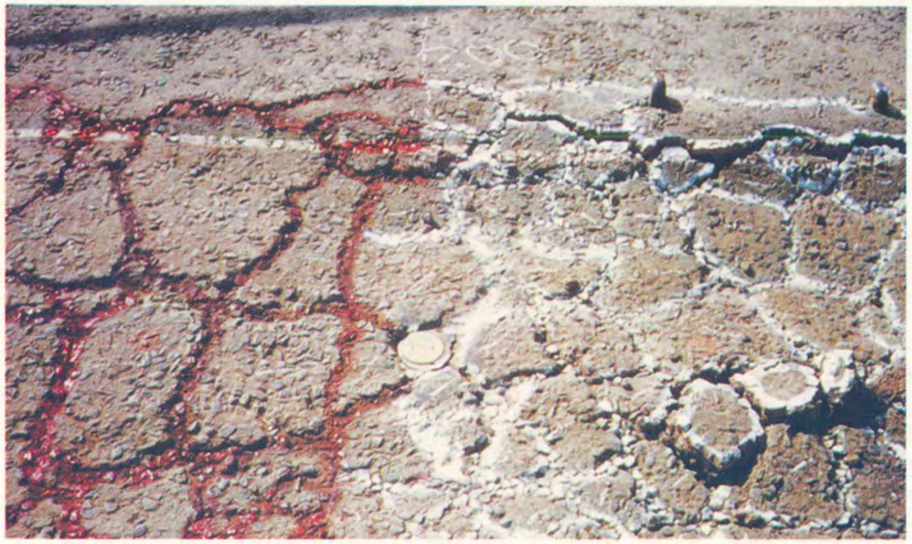
C.

PLATE 9: FINAL CRACK PATTERN ON SECTION 2:

A. Final crack pattern on Section 2. Note the different block sizes of the cracks on the two halves of the test section. Note also the markers on the local rut areas.

B. Final crack pattern where surface and subsurface water was introduced (big and small blocks). Note the end test pit on the top of the photograph.

C. Final crack pattern where only surface water was introduced (big blocks).



A.

B.

C.

PLATE 10: **A.** Final crack pattern at the MDD at measuring point 8. On the left only surface water, and on the right surface and subsurface water was added.

B. Local rut of 65 mm at measuring point 6 (surface water).

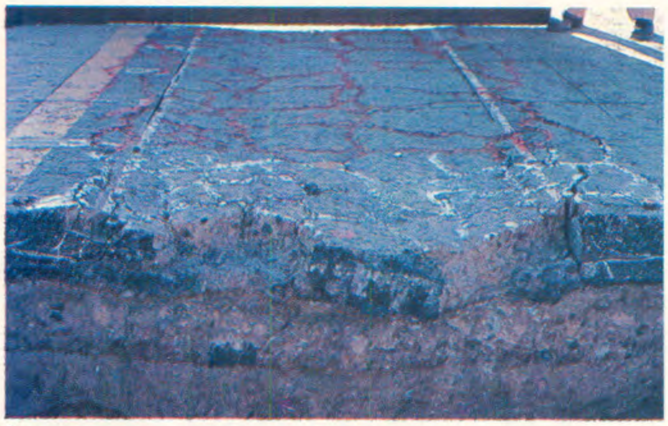
C. Local rut of 89 mm at measuring point 9 (surface and subsurface water). Note the big blocks.

A.

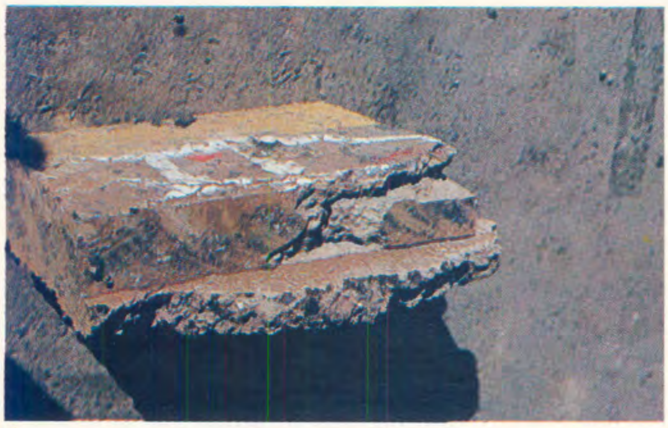
B.

PLATE 11: **A.** Note the three layers in the asphalt. From top to bottom is the 40 mm wearing course and the two 50 mm recycled base layers. Note the middle layer of lighter colour. This is the weak zone in the base layer because of poor aggregates.

B. Fines pumped horisontally into the end test pit. Note the horisontal crack in the weak asphalt layer. Fines was pumped out of this horisontal crack as well as between the upper subbase and base, and between the two subbases.


A.


B.


C.


D.

PLATE 12: CROSS PROFILES:

A. Cross profile on Section 2 at the end of the HVS test showing the vertical cracks from top to bottom where fines was pumped out to the surface. Note the stripping in the base layer on the left.

B. Weak zone start to fail forming smaller block sizes. The bottom of the base layer was not cracked and no fines allowed to migrate to the surface.

C and D: Weak zone stripped and failed. Note the fines at the interface of the recycled layers.

APPENDIX B

INPUT PROGRAM TO PLOT THE THREE DIMENSIONAL BEHAVIOURAL MODEL

B1. Input program

In order to plot the behavioural model in three dimensions, the computer program, DISSPLA, available at the Computer Centre at CSIR, was used. This progrm needs an input program (data) in a certain printout of the program MODEL is given in the following section. The parameters XX, YY and ZZ referred to Radius of Curvature, (RC), Elastic Modulus, (E) and Road Surface Deflection, (RSD), respectively. In the program equations 3.2 and 3.3 (see Section 3.2.14) are used to calculate the elastic modulus and road surface deflection, using the radius of curvature as input starting from 50 m to 940 m in steps of 10 m.

```
    PROGRAM MODEL       74/750   OPT=2,ROUND= A/ S/ M/-D,-DS      FTN 5.1+587          85/01/25. 08.48.04        PAGE      1
DO=-LONG/-OT,ARG=-COMMON/-FIXED,CS= USER/-FIXED,DB=-TB/-SB/-SL/-ER/-ID/-PMD/-ST,PL=50000
FTN5,I=MODEL,L=L.

               PROGRAM MODEL(INPUT,OUTPUT)
      C
              DIMENSION XX(811),YY(811),ZZ(811)
              DIMENSION NINCH(2)
      C
              WRITE(6,900)
              NPUNTE=90
              X=50.
              DO 10 I=1,NPUNTE
                  YY(I) = 5.52787639 *X   +2.51021E-03 * X * X
                  XX(I) = X
                  ZZ(I) =  1.064 * 136000. /X   - 1.563E-04 *136000/X*136000/X
                  WRITE(6,910) XX(I),YY(I),ZZ(I)
                  X = X + 10.
           10 CONTINUE
      C
              CALL CALCMP(NINCH,'P2967',10)
      C**         CALL TK41(4113)
              CALL UNITS('MM')
              CALL MX1ALF('L/CSTO','/')
              CALL MX2ALF('STAND','+')
              CALL PAGE(300.,210.)
              CALL INTAXS
              CALL PHYSOR(10.,10.)
              CALL AREA2D(290.,200.)
              CALL X3NAME('+RADIUS OF CURVATURE,RC(/M)$',100)
              CALL Y3NAME('+EFFECTIVE ELASTICE MODULUS(MPA)$',100)
              CALL Z3NAME('+ROAD SURFACE DEFLECTION,RSD(/UM)$',100)
              CALL VOLM3D(1.,7.5,2.)
              CALL VUABS(30.,-31.,23.)
              CALL GRAF3D(0.,200.,1000.,0.,500.,7500.,0.,200.,2000.)
              CALL CURV3D(XX,YY,ZZ,NPUNTE,0)
      C       XY-VLAK
              CALL GRFITI(0.,0.,0.,1.,0.,0.,0.,1.,0.)
              CALL AREA2D(1.,7.5)
              CALL GRAF(0.,200.,1000.,0.,500.,7500.)
              CALL CURVE(XX,YY,NPUNTE,0)
              CALL END3GR(0)
      C       YZ-VLAK
              CALL GRFITI(0.,0.,0.,0.,1.,0.,0.,1.,1.)
              CALL AREA2D(7.5,2.)
              CALL GRAF(0.,500.,7500.,0.,200.,2000.)
              CALL CURVE(YY,ZZ,NPUNTE,0)
              CALL END3GR(0)
      C       XZ-VLAK
              CALL GRFITI(0.,0.,0.,1.,0.,0.,1.,0.,1.)
              CALL AREA2D(1.,2.)
              CALL GRAF(0.,200.,1000.,0.,200.,2000.)
              CALL CURVE(XX,ZZ,NPUNTE,0)
              CALL END3GR(0)
      C       Z-RIGTING
              CALL SETCLR('RED')
              DO 20 I = 1,NPUNTE,5
                  CALL RLVEC3(XX(I),YY(I),0.,XX(I),YY(I),ZZ(I),0)
           20 CONTINUE
```

```
C       Y-RIGTING
        CALL SETCLR('GREEN')
        DO 30 I = 1,NPUNTE,5
            CALL RLVEC3(XX(I),0.,ZZ(I),XX(I),YY(I),ZZ(I),0)
     30 CONTINUE
C       X-RIGTING
        CALL SETCLR('BLUE')
        DO 40 I = 1,NPUNTE,5
            CALL RLVEC3(0.,YY(I),ZZ(I),XX(I),YY(I),ZZ(I),0)
     40 CONTINUE
        CALL SETCLR('WHITE')
        CALL RLVEC3(0.,0.,2000.,0.,7500.,2000.,0)
        CALL RLVEC3(1000.,0.,2000.,0.,0.,2000.,0)
        CALL RLVEC3(1000.,0.,2000.,1000.,7500.,2000.,0)
        CALL RLVEC3(1000.,7500.,2000.,1000.,7500.,0.,0)
        CALL RLVEC3(1000.,7500.,2000.,0.,7500.,2000.,0)
        CALL RLVEC3(1000.,0.,2000.,1000.,0.,0.,0)
        CALL DASH
        CALL RLVEC3(0.,0.,0.,0.,7500.,0.,0)
        CALL RLVEC3(0.,7500.,0.,0.,7500.,2000.,0)
        CALL RLVEC3(0.,7500.,0.,1000.,7500.,0.,0)
C
        CALL ENDPL(0)
        CALL DONEPL
        STOP
    900 FORMAT('1',/,7X,'X',14X,'Y',14X,'Z')
    910 FORMAT(3F15.5)
        END
```

--VARIABLE MAP--(LO=A)

-NAME-	--ADDRESS	--BLOCK--	PROPERTIES	TYPE	SIZE
I	5517B			INTEGER	
NINCH	5513B			INTEGER	2
NPUNTE	5515B			INTEGER	
X	5516B			REAL	
XX	712B			REAL	811
YY	2365B			REAL	811
ZZ	4040B			REAL	811

--PROCEDURES--(LO=A)

-NAME-	TYPE	ARGS	CLASS
AREA2D		2	SUBROUTINE
CALCMP		3	SUBROUTINE
CURVE		4	SUBROUTINE
CURV3D		5	SUBROUTINE
DASH		0	SUBROUTINE
DONEPL		0	SUBROUTINE
ENDPL		1	SUBROUTINE
END3GR		1	SUBROUTINE
GRAF		6	SUBROUTINE
GRAF3D		9	SUBROUTINE
GRFITI		9	SUBROUTINE
INTAXS		0	SUBROUTINE
MX1ALF		2	SUBROUTINE
MX2ALF		2	SUBROUTINE
PAGE		2	SUBROUTINE
PHYSOR		2	SUBROUTINE
RLVEC3		7	SUBROUTINE
SETCLR		1	SUBROUTINE
UNITS		1	SUBROUTINE
VOLM3D		3	SUBROUTINE
VUABS		3	SUBROUTINE
X3NAME		2	SUBROUTINE
Y3NAME		2	SUBROUTINE
Z3NAME		2	SUBROUTINE

```
          PROGRAM MODEL       74/750  OPT=2,ROUND= A/ S/ M/-D,-DS     FTN 5.1+587          85/01/25. 08.46.04        PAGE      3

--STATEMENT LABELS--(LO=A)
 -LABEL-ADDRESS-----PROPERTIES----DEF          -LABEL-ADDRESS-----PROPERTIES----DEF

     10  INACTIVE    DO-TERM        19              40  INACTIVE    DO-TERM        65
     20  INACTIVE    DO-TERM        55             900    342B      FORMAT         81
     30  INACTIVE    DO-TERM        60             910    346B      FORMAT         82

--ENTRY POINTS--(LO=A)
 -NAME---ADDRESS--ARGS---

  MODEL      13B      0

--I/O UNITS--(LO=A)
 -NAME--- PROPERTIES-------------

  TAPE6    FMT/SFO

--STATISTICS--

  PROGRAM-UNIT LENGTH              5524B =  2900
  CM STORAGE USED                 61000B =  25088
  COMPILE TIME                    0.309 SECONDS
```

TABLE B2 - Calculated E and RSD values for the different RC values

RC (m)	E (MPa)	RSD (µm)
Y	Y	Z
50.00000	282.66934	1663.72608
60.00000	340.70934	1557.32089
70.00000	399.25138	1439.46841
80.00000	458.29546	1328.19300
90.00000	517.84158	1228.05336
100.00000	577.88974	1139.45152
110.00000	638.43994	1061.28555
120.00000	699.49219	992.28356
130.00000	761.04648	931.10267
140.00000	823.10281	876.66710
150.00000	885.66118	827.98734
160.00000	948.72160	784.24825
170.00000	1012.28406	744.76800
180.00000	1076.34855	708.97640
190.00000	1140.91510	676.39543
200.00000	1205.98368	646.62288
210.00000	1271.55430	619.31871
220.00000	1337.62697	594.19412
230.00000	1404.20168	571.00256
240.00000	1471.27843	549.53256
250.00000	1538.85722	529.60184
260.00000	1606.93806	511.05259
270.00000	1675.52093	493.74753
280.00000	1744.60585	477.56678
290.00000	1814.19281	462.40517
300.00000	1884.28182	448.17017
310.00000	1954.87286	434.77897
320.00000	2025.96595	422.16206
330.00000	2097.56108	410.25193
340.00000	2169.65825	398.99200
350.00000	2242.25746	388.33074
360.00000	2315.35872	378.22188
370.00000	2388.96201	368.62378
380.00000	2463.06735	359.49886
390.00000	2537.67473	350.81312
400.00000	2612.78416	342.53572
410.00000	2688.39562	334.63864
420.00000	2764.50913	327.09634
430.00000	2841.12468	319.88553
440.00000	2918.24227	312.98489
450.00000	2995.86190	306.37489
460.00000	3073.98358	300.03760
470.00000	3152.60729	293.95652
480.00000	3231.73305	288.11647
490.00000	3311.36085	282.50344
500.00000	3391.49070	277.10446
510.00000	3472.12258	271.90756
520.00000	3553.25651	266.90161
530.00000	3634.89248	262.07631
540.00000	3717.03049	257.42207
550.00000	3799.67054	252.92997
560.00000	3882.81263	248.59169
570.00000	3966.45677	244.39949
580.00000	4050.60295	240.34612
590.00000	4135.25117	236.42481
600.00000	4220.40143	232.62921
610.00000	4306.05374	228.95339
620.00000	4392.20809	225.39177
630.00000	4478.86447	221.93912
640.00000	4566.02291	218.59052
650.00000	4653.68338	215.34134
660.00000	4741.84589	212.18722
670.00000	4830.51045	209.12407
680.00000	4919.67705	206.14800
690.00000	5009.34569	203.25536
700.00000	5099.51637	200.44268
710.00000	5190.18910	197.70672
720.00000	5281.36386	195.04436
730.00000	5373.04067	192.45268
740.00000	5465.21952	189.92892
750.00000	5557.90042	187.47043
760.00000	5651.08335	185.07471
770.00000	5744.76833	182.73941
780.00000	5838.95535	180.46225
790.00000	5933.64441	178.24111
800.00000	6028.83551	176.07393
810.00000	6124.52866	173.95878
820.00000	6220.72384	171.89381
830.00000	6317.42107	169.87725
840.00000	6414.62034	167.90742
850.00000	6512.32166	165.98272
860.00000	6610.52501	164.10162
870.00000	6709.23041	162.26264
880.00000	6808.43785	160.46440
890.00000	6908.14733	158.70556
900.00000	7008.35885	156.98483
910.00000	7109.07242	155.30100
920.00000	7210.28802	153.65288
930.00000	7312.00567	152.03935
940.00000	7414.22536	150.45934