

APPENDIX D

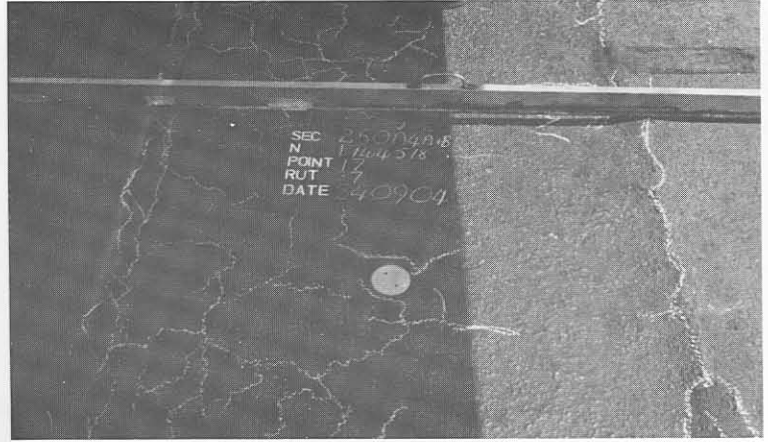
PHOTOGRAPHIC RECORD OF HEAVY VEHICLE SIMULATOR (HVS) TESTS
ON PAVEMENTS WITH LIGHTLY CEMENTITIOUS LAYERS

CONTENTS:

- PLATE D.1 RELATIVELY DEEP PAVEMENT: ROAD 1932 - CRACKING AND DEFORMATION OF HVS TEST SECTION 250A4A&B (VARIABLE LOADING: 40 TO 100 kN; TYRE PRESSURE: 690 kPa)
- PLATE D.2 RELATIVELY DEEP PAVEMENT: ROAD 1932 - EXCESSIVE DEFORMATION ON HVS TEST SECTION 251A4A OWING TO COMPACTION OF THE BASE LAYER (VARIABLE LOADING: 70, 100 kN; TYRE PRESSURE: 690 kPa)
- PLATE D.3 RELATIVELY DEEP PAVEMENT: ROAD 1932 - CRACKING AND DEFORMATION OF HVS TEST SECTION 260A4 (TRAFFICKING DUAL WHEEL LOAD: 40 kN; TYRE PRESSURE: 520 kPa)
- PLATE D.4 RELATIVELY DEEP PAVEMENT: ROAD 1932 - CRACKING AND PUMPING ON HVS TEST SECTION 274A4 (TRAFFICKING DUAL WHEEL LOAD: 40 kN; TYRE PRESSURE: 520 kPa)
- PLATE D.5 RELATIVELY DEEP PAVEMENT: ROAD 1932 - CRACKING AND DEFORMATION ON HVS TEST SECTION 274A4 (TRAFFICKING DUAL WHEEL LOAD: 40 kN; TYRE PRESSURE: 520 kPa)
- PLATE D.6 RELATIVELY DEEP PAVEMENT: ROAD 1932 - CRACKING AND PUMPING ON HVS TEST SECTION 275A4 (TRAFFICKING DUAL WHEEL LOAD: 40 kN; TYRE PRESSURE: 700 kPa)
- PLATE D.7 RELATIVELY DEEP PAVEMENT: ROAD 1932 - CRACKING AND DEFORMATION ON HVS TEST SECTION 289A4 (TRAFFICKING DUAL WHEEL LOAD: 70 kN; TYRE PRESSURE: 700 kPa)
- PLATE D.8 RELATIVELY DEEP PAVEMENT: ROAD 1932 - INITIAL STABILISATION CRACKING AT THE START OF THE TEST ON HVS TEST SECTION 294A4
- PLATE D.9 RELATIVELY DEEP PAVEMENT: ROAD 1932 - CRACKING AND HIGH DEGREE OF PUMPING ON HVS TEST SECTION 294A4 (TRAFFICKING DUAL WHEEL LOAD: 100 kN; TYRE PRESSURE: 700 kPa)
- PLATE D.10 HORIZONTAL CRACKING IN CEMENTED BASE OF THE RELATIVELY DEEP PAVEMENT, PRIOR TO HVS TESTING ON ROAD 1932 AT ROOIWAL
- PLATE D.11 CRACKING IN THE CEMENTED BASE LAYER OWING TO HVS TRAFFICKING ON THE RELATIVELY DEEP PAVEMENT, ROAD 1932 AT ROOIWAL
- PLATE D.12 CRUSHING IN THE CEMENTED BASE LAYER OWING TO HVS TRAFFICKING ON THE RELATIVELY DEEP PAVEMENT, ROAD 1932 AT ROOIWAL
- PLATE D.13 DETAIL OF RELATIVELY SHALLOW PAVEMENT STRUCTURE ON ROAD 2212 AT BULTFONTEIN (TVL)
- PLATE D.14 RELATIVELY SHALLOW PAVEMENT: ROAD 2212 - FATIGUE CRACKING, DEFORMATION AND CRUSHING ON HVS TEST SECTION 306A4 (TRAFFICKING DUAL WHEEL LOAD: 40 kN; TYRE PRESSURE: 700 kPa)

- PLATE D.15 RELATIVELY SHALLOW PAVEMENT: ROAD 2212 - FATIGUE CRACKING AND DEFORMATION ON HVS TEST SECTION 307A4 (TRAFFICKING DUAL WHEEL LOAD: 70 kN; TYRE PRESSURE: 700 kPa)
- PLATE D.16 RELATIVELY SHALLOW PAVEMENT: ROAD 2212 - FATIGUE CRACKING AND DEFORMATION ON HVS TEST SECTION 308A4 (TRAFFICKING DUAL WHEEL LOAD: 100 kN; TYRE PRESSURE: 700 kPa)
- PLATE D.17 RELATIVELY SHALLOW PAVEMENT: ROAD 2212 - FATIGUE CRACKING AND DEFORMATION ON HVS TEST SECTION 309A4 (TRAFFICKING SINGLE WHEEL LOAD: 150 kN; TYRE PRESSURE: 1445 kPa)
- PLATE D.18 RELATIVELY SHALLOW PAVEMENT: ROAD 2212 - FATIGUE CRACKING AND DEFORMATION ON HVS TEST SECTION 309A4 (TRAFFICKING SINGLE WHEEL LOAD: 150 kN; TYRE PRESSURE: 1445 kPa)
- PLATE D.19 RELATIVELY SHALLOW PAVEMENT: ROAD 2212 - EXCESSIVE DEFORMATION DEVELOPMENT DURING THE FINAL STAGES OF TESTING (41 803 REPETITIONS) ON HVS TEST SECTION 309A4 (TRAFFICKING SINGLE WHEEL LOAD: 150 kN; TYRE PRESSURE: 1445 kPa)
- PLATE D.20 RELATIVELY SHALLOW PAVEMENT: ROAD 2212 - EXCESSIVE FATIGUE AND CRUSHING FAILURE AT THE END OF THE TEST (41 803 REPETITIONS) ON HVS TEST SECTION 309A4, MEASURING POINT 4 (TRAFFICKING SINGLE WHEEL LOAD: 150 kN; TYRE PRESSURE: 1445 kPa)
- PLATE D.21 RELATIVELY SHALLOW PAVEMENT: ROAD 2212 - EXCESSIVE FATIGUE AND CRUSHING FAILURE AT THE END OF THE TEST (41 803 REPETITIONS) ON HVS TEST SECTION 309A4, MEASURING POINT 5,5 (TRAFFICKING SINGLE WHEEL LOAD: 150 kN; TYRE PRESSURE: 1445 kPa)
- PLATE D.22 RELATIVELY SHALLOW PAVEMENT: ROAD 2212 - CLOSE VIEW OF THE CRUSHING (COMPRESSION) FAILURE OF THE CEMENTED BASE LAYER AT THE END OF THE TEST (41 803 REPETITIONS) ON HVS TEST SECTION 309A4, (TRAFFICKING SINGLE WHEEL LOAD: 150 kN; TYRE PRESSURE: 1445 kPa)
- PLATE D.23 RELATIVELY DEEP PAVEMENT: ROAD 1932 - EXCESSIVE CRUSHING FAILURE AT THE END OF THE TEST (48 000 REPETITIONS) ON HVS TEST SECTION 337A4 (TRAFFICKING SINGLE WHEEL LOAD: 150 kN; TYRE PRESSURE: 1445 kPa)
- PLATE D.24 RELATIVELY DEEP PAVEMENT: ROAD 1932 - CRUSHING FAILURE AT THE END OF THE TEST (143 000 REPETITIONS) ON HVS TEST SECTION 338A4. DEFORMATION APPROXIMATELY 10 mm (TRAFFICKING SINGLE WHEEL LOAD: 150 kN; TYRE PRESSURE: 960 kPa)
- PLATE D.25 RELATIVELY SHALLOW PAVEMENT: ROAD 2212 - PREPARATION OF THE 40 m REHABILITATION TEST SECTIONS, USING A HEAVY VIBRATORY ROLLER IN A "CRACK AND SEAT" OPERATION

- PLATE D.26 RELATIVELY SHALLOW PAVEMENT: ROAD 2212 - PREPARATION OF THE REHABILITATION TEST SECTIONS, USING A HEAVY VIBRATORY ROLLER IN A "CRACK AND SEAT" OPERATION. NOTE THE CRACK DEVELOPMENT IN THE CEMENTED BASE LAYER.
- PLATE D.27 RELATIVELY SHALLOW PAVEMENT: ROAD 2212 - REHABILITATION SECTIONS: ASPECTS OF THE 150 mm GRANULAR BASE LAYER ON TOP OF THE PRECRACKED CEMENTED LAYER
- PLATE D.28 RELATIVELY SHALLOW PAVEMENT: ROAD 2212 - REHABILITATION SECTIONS: ASPECTS OF THE 35 mm ASPHALT PREMIX LAYER ON TOP OF THE PRECRACKED CEMENTED LAYER



(a) Relatively fine cracks after $1,74 \times 10^6$ repetitions (E80s).



(b) Approximately 20 mm deformation after $2,4 \times 10^6$ repetitions (E80s).

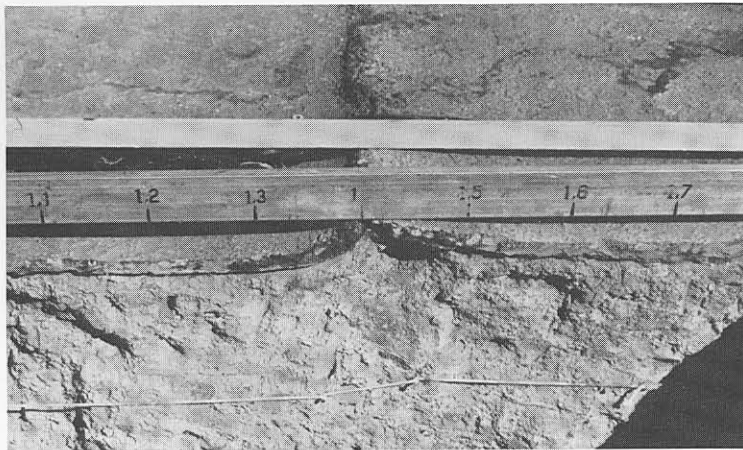
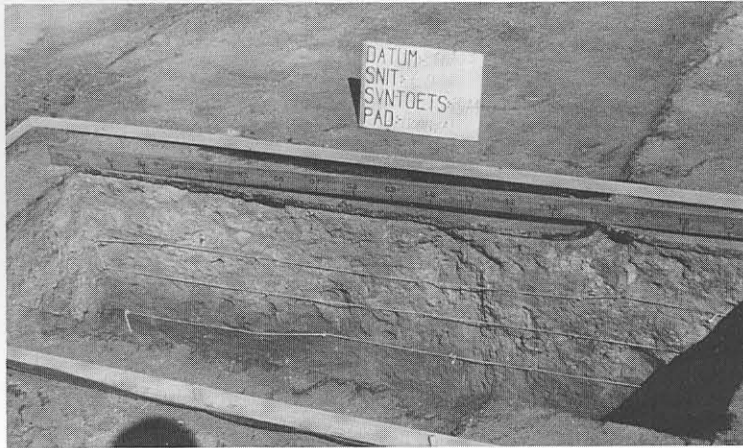


PLATE D.2 RELATIVELY DEEP PAVEMENT: ROAD 1932 – EXCESSIVE DEFORMATION ON HVS TEST SECTION 251A4A OWING TO COMPACTION OF THE BASE LAYER (VARIABLE LOADING: 70, 100 kN; TYRE PRESSURE: 690 kPa).



(a) Relatively fine crack pattern after $1,95 \times 10^6$ repetitions (E80s). Note the waterbottels for introduction of depth water (20 mm to 450 mm) on the side of the section at measuring positions 9 to 15.

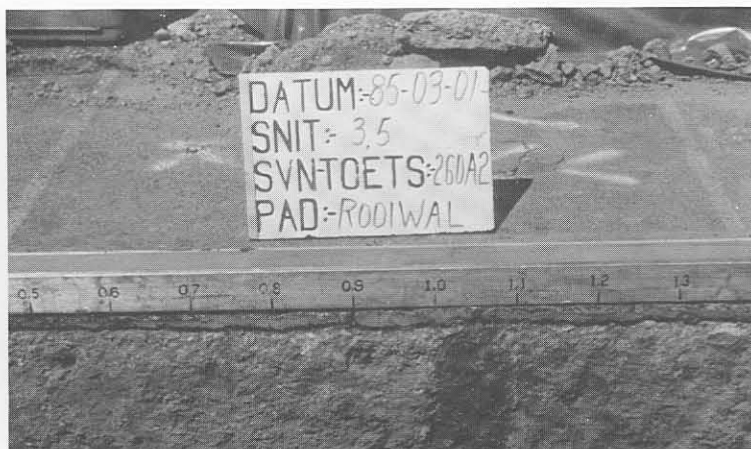
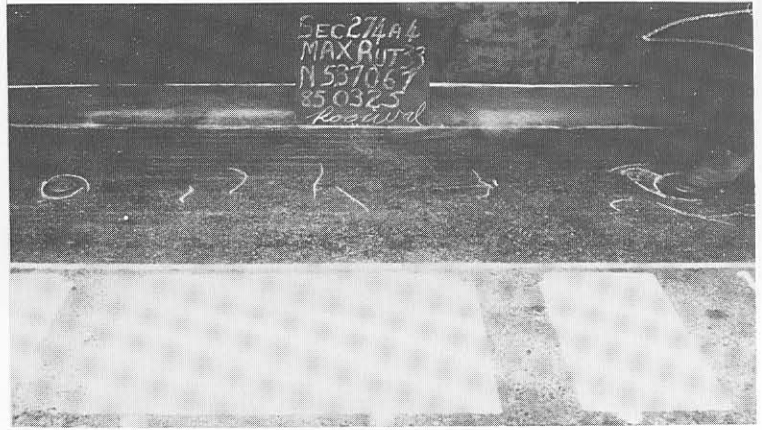


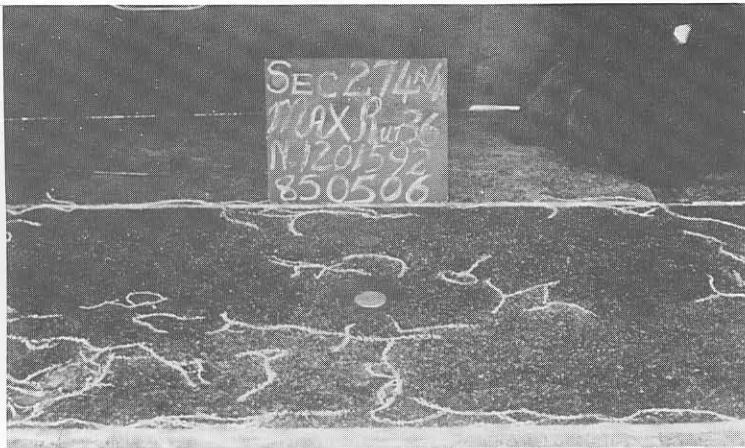
PLATE D.3 RELATIVELY DEEP PAVEMENT: ROAD 1932 – CRACKING AND DEFORMATION OF HVS TEST SECTION 260A4 (TRAFFICKING DUAL WHEEL LOAD: 40 kN; TYRE PRESSURE: 520 kPa).



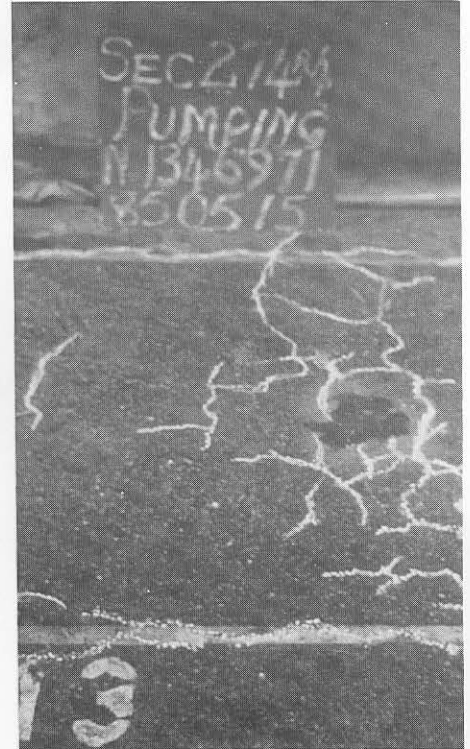
(a) Condition before testing; some fine cracking evident from measuring points 9 to 15 at the start of the test.



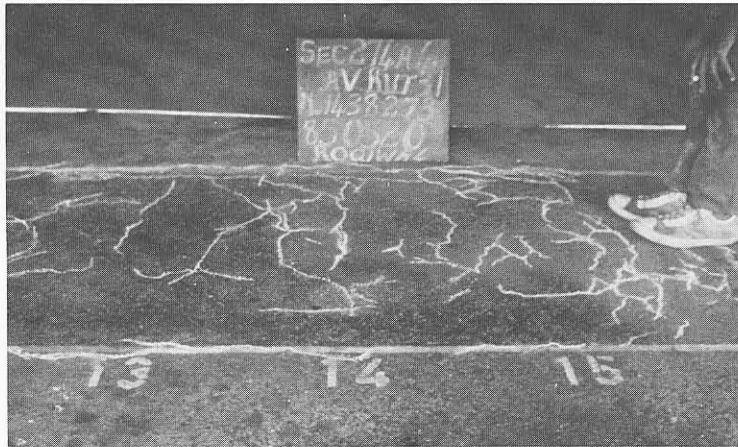
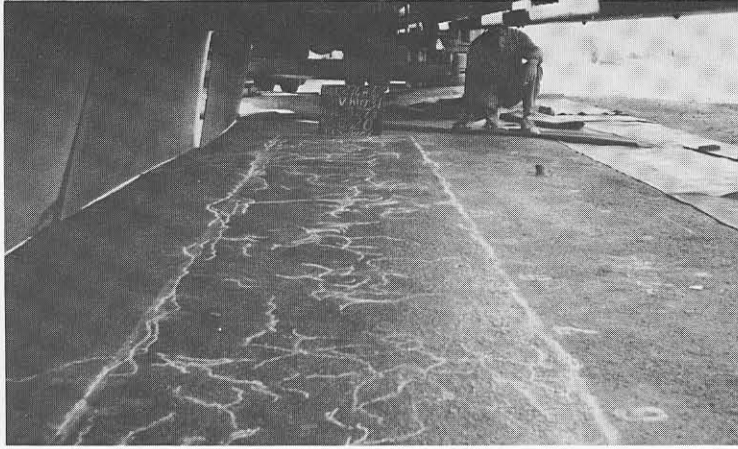
(b) Initiation of crack development after approximately 537 067 repetitions (E80s).



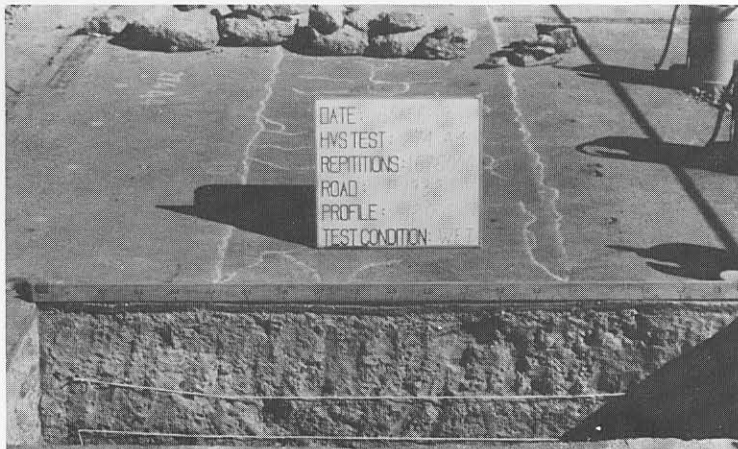
(c) Crack development after $1,20 \times 10^6$ repetitions (E80s).



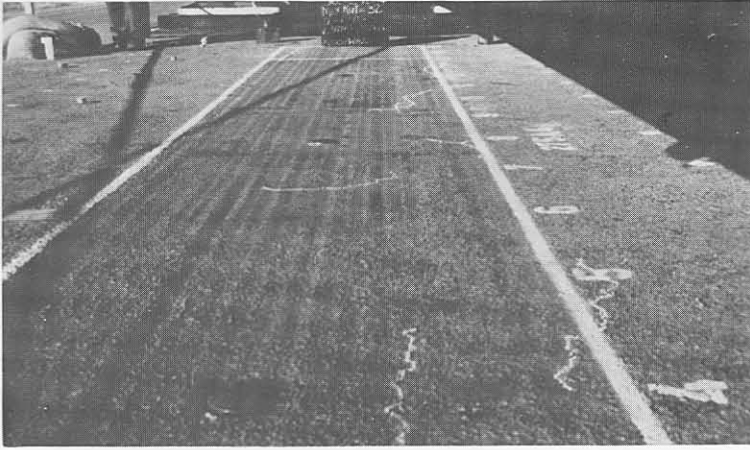
(d) Cracking and pumping after $1,35 \times 10^6$ repetitions (E80s).



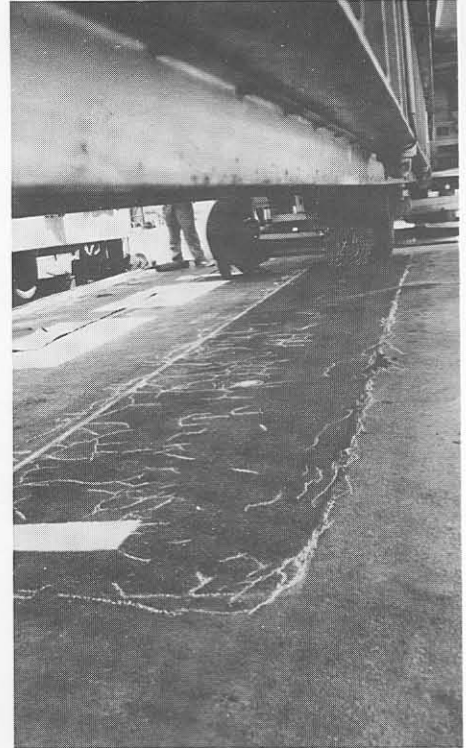
(a) Relatively fine crack pattern after $1,44 \times 10^6$ repetitions (E80s).



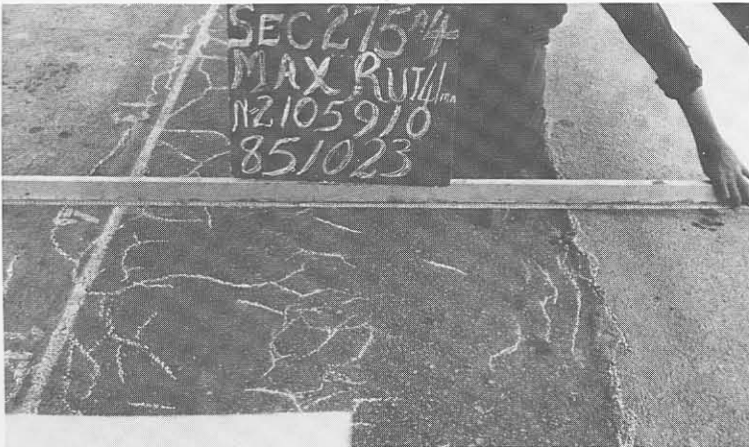
(b) Deformation less than 8 mm at end of test.



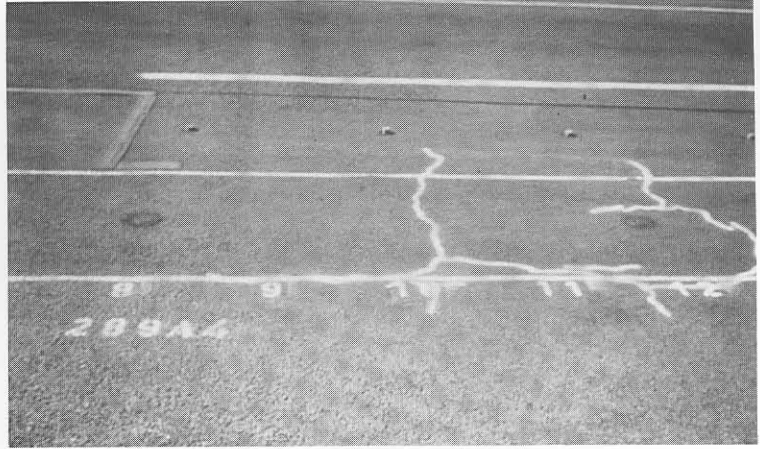
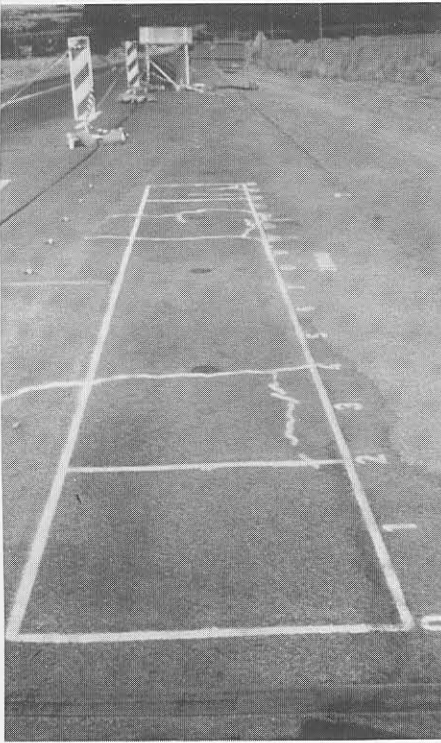
(a) Initial state of section with some cracking at start of test.



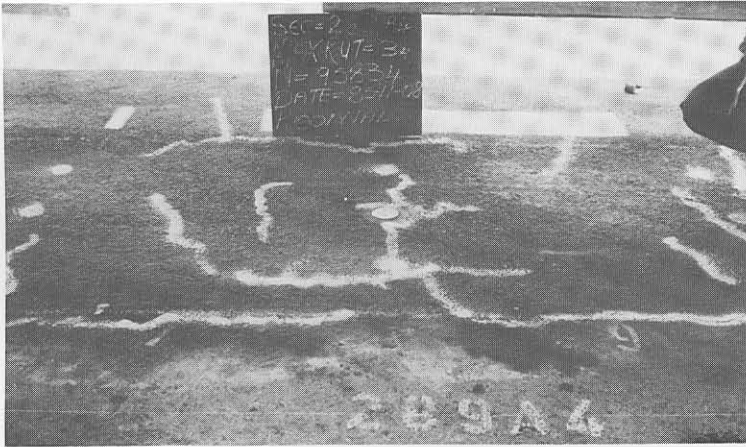
(b) Relatively fine cracking at end of test.



(c) Pumping of the crushed cemented base material.



(a) Initial stabilisation cracking before HVS testing.



(b) Crack development after 95 834 70 kN repetitions.



(c) Final cracking and deformation (approximately 22 mm) on section.

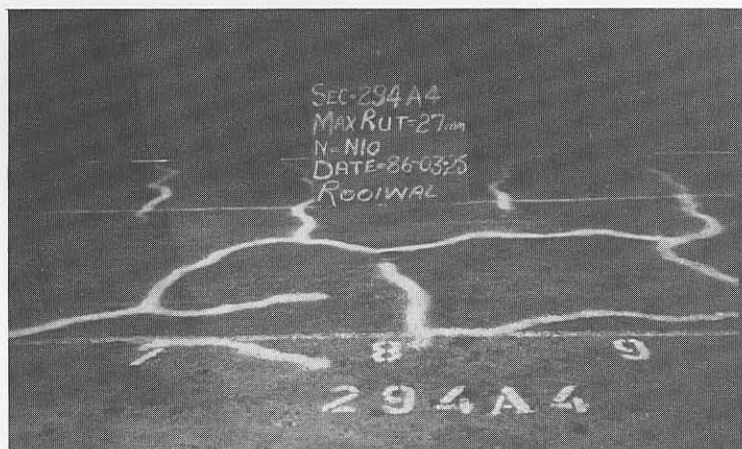
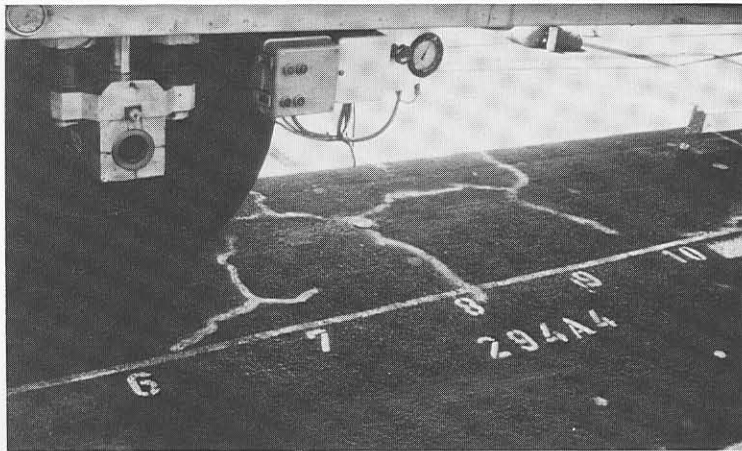
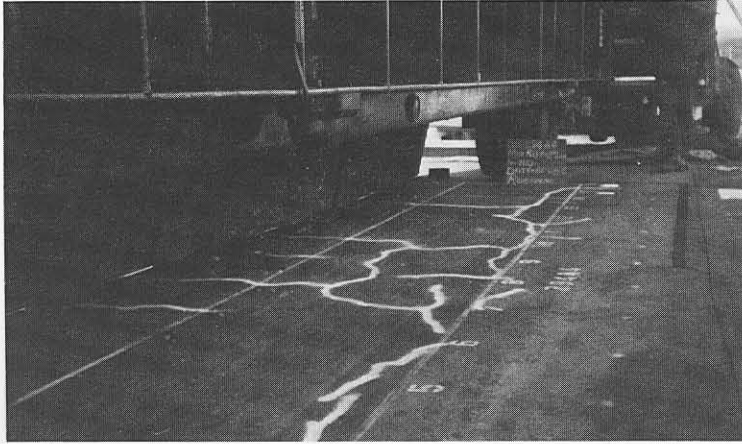


PLATE D.8 RELATIVELY DEEP PAVEMENT: ROAD 1932 – INITIAL STABILISATION CRACKING AT THE START OF THE TEST ON HVS TEST SECTION 294A4.

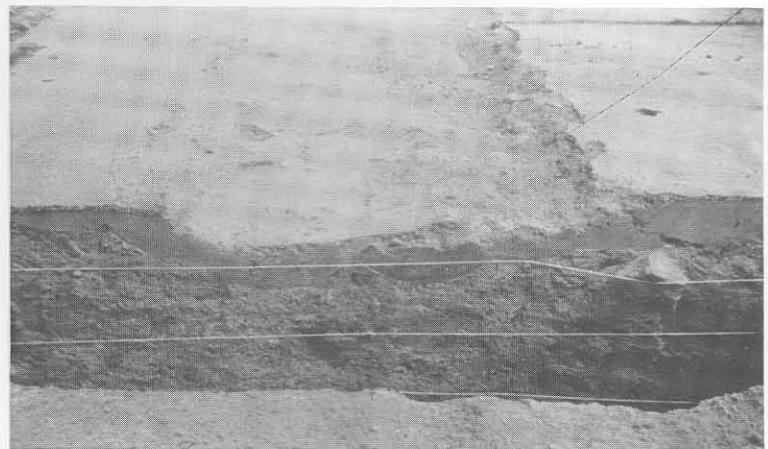


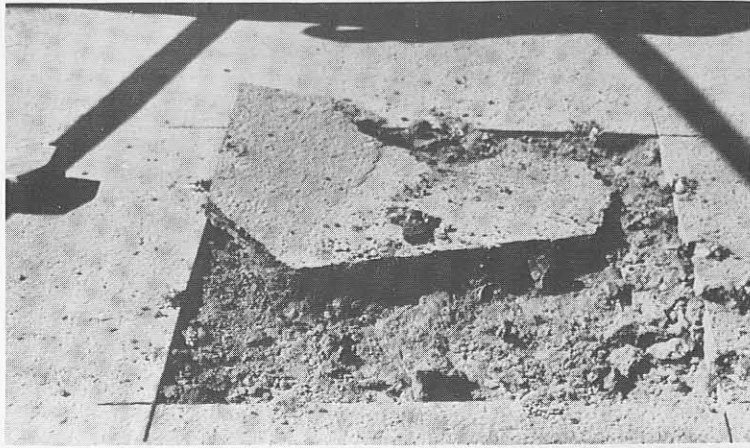
(a) Relatively fine cracking after $1,44 \times 10^6$ 100 kN repetitions.



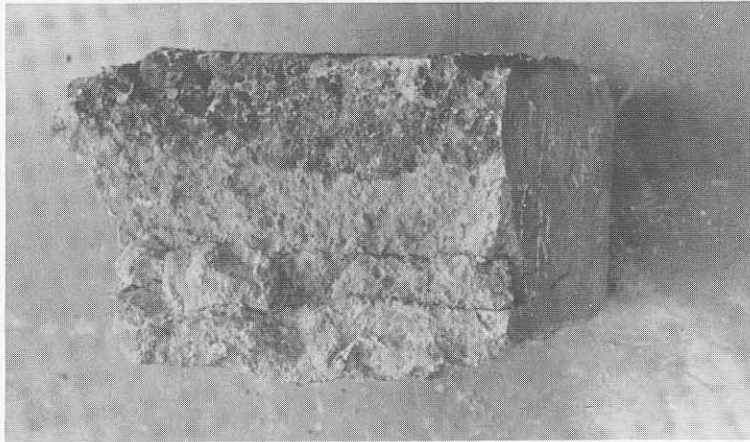
(b) Artificial surface water introduction on section.

(c) Excessively high degree of potholing owing to the loss crushed cemented base material after introduction of surface water.





(a) Relatively loose surfacing owing to horizontal cracking in the cemented base.



(b) Horizontal cracking in the cemented base, prior to HVS testing.

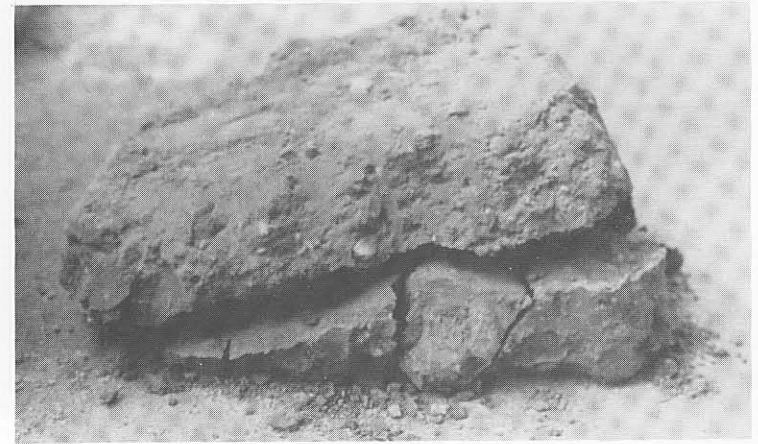
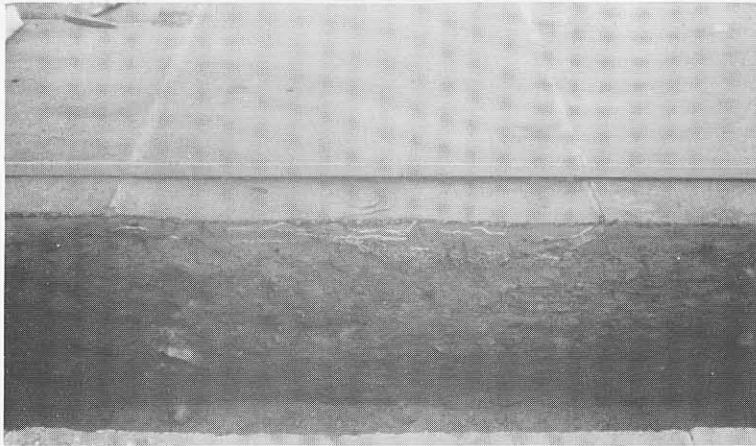
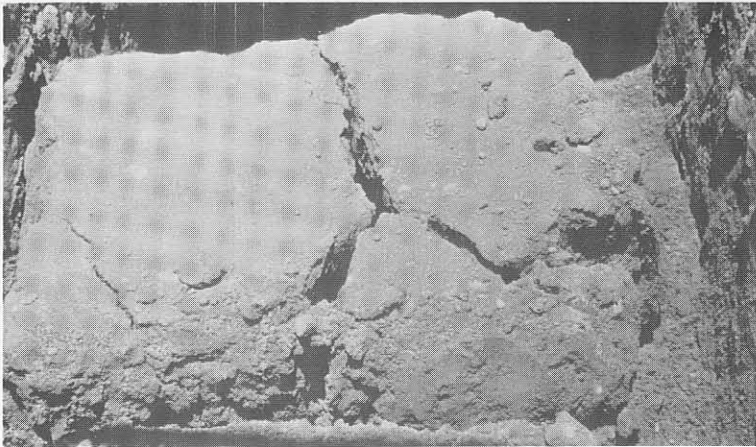
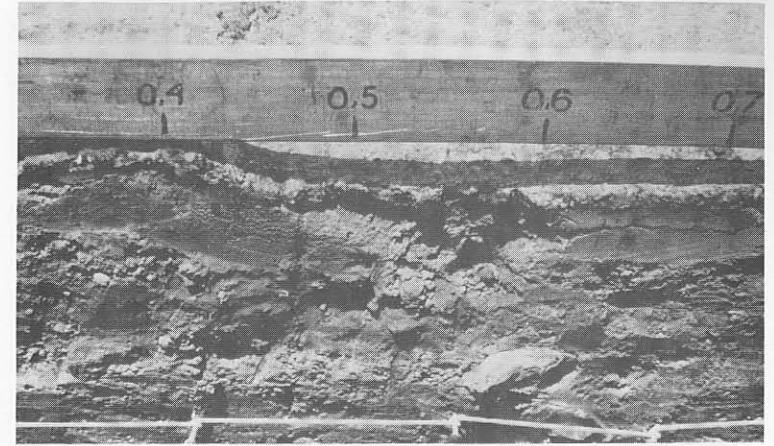


PLATE D.10 HORIZONTAL CRACKING IN THE CEMENTED BASE OF THE RELATIVELY DEEP PAVEMENT, PRIOR TO HVS TESTING ON ROAD 1932 AT ROOIWAL.



(a) Progress of both horizontal cracking and crushing of the top 50 mm to 75 mm of the cemented base after HVS testing.



(b) Fatigue cracking in cemented base layer.





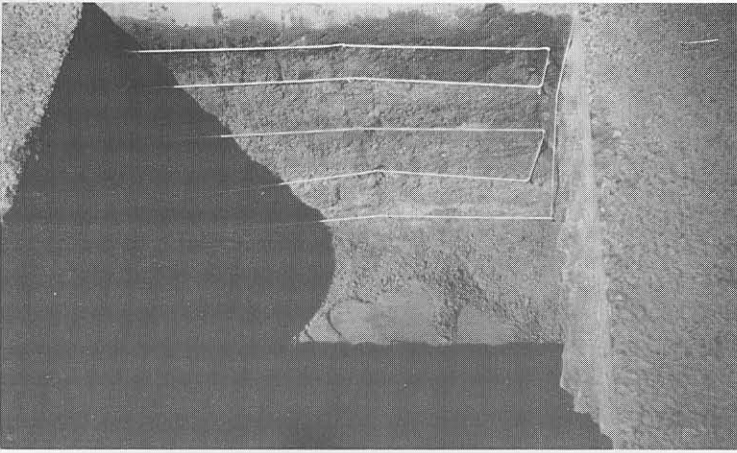
(a) Final crushed state (compression failure) in the top 50 mm to 75 mm of the cemented base layer, after testing in relatively dry conditions.



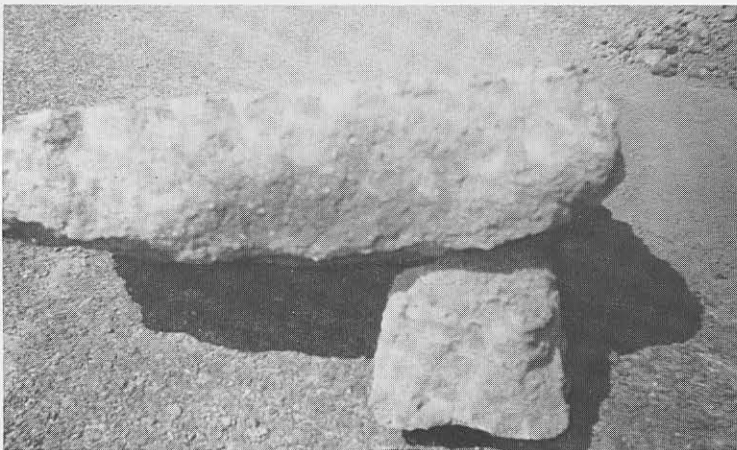
(b) Potholing (approximately 75 mm) and loss of crushed base material after testing in soaked conditions on Section 294A4.

(c) Relatively low deformation (approximately 10 mm) after testing in the relatively dry conditions on Section 294A4.

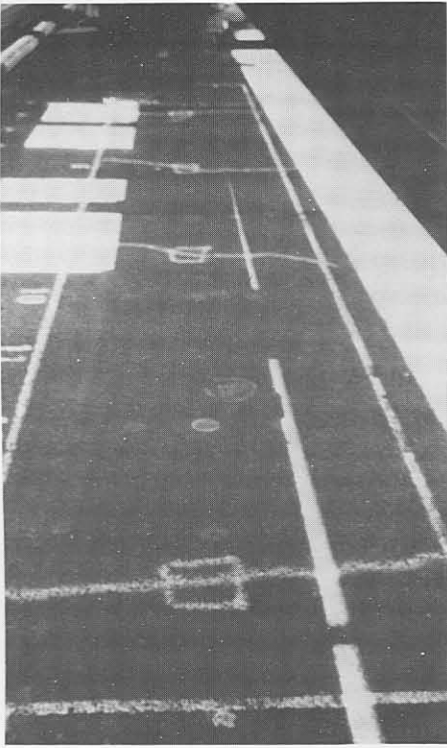
← Relatively weak interlayer, between well cemented base and subbase layer



(b) Stabilisation crack.



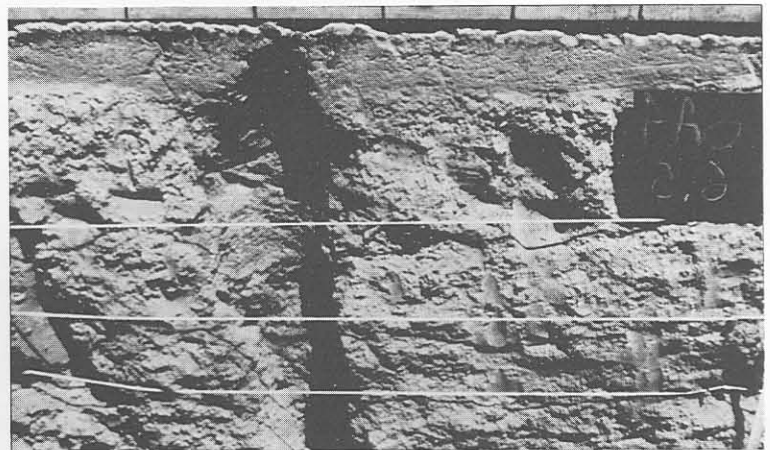
(c) Chunks of well cemented Ferricrete and Granophyre (3 % PBFC).



(a) Initial stabilisation cracking at the start of the test.



(b) Fatigue cracking (100 mm × 100 mm blocks) after approximately $1,0 \times 10^6$ repetitions (E80s).



(c) Crushing and deformation (approximately 12 mm) of the cemented base at the end of the test.



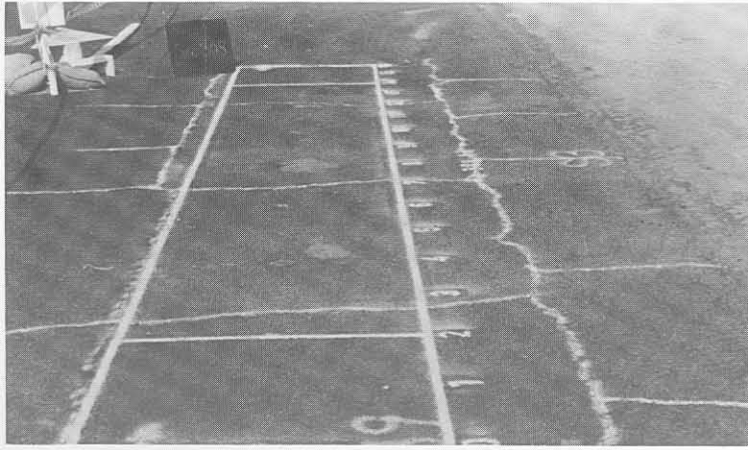
(a) Fatigue cracking after approximately 731 783 70 kN repetitions.



(b) Fatigue cracking after approximately $1,46 \times 10^6$ 70 kN repetitions.



(c) Fatigue cracking after approximately $2,45 \times 10^6$ 70 kN repetitions.



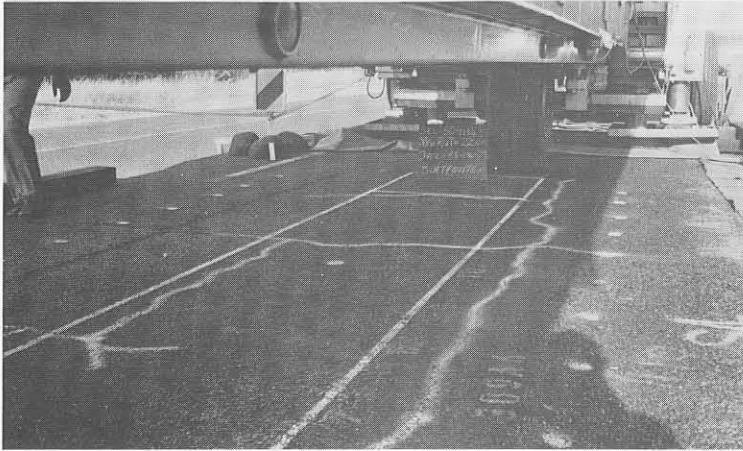
(a) Initial stabilisation cracks at start of test.



(b) Final fatigue cracking and crushing after approximately $2,64 \times 10^6$ 100 kN repetitions.



(c) Final deformation (approximately 24 mm) at measuring point 13,5 after approximately $2,64 \times 10^6$ 100 kN repetitions.



(a) Initial stabilisation cracking at start of test.



(b) Fatigue cracking and deformation (approximately 40 mm) after 11 331 repetitions of a 150 kN, 1445 kPa single aircraft wheel load.

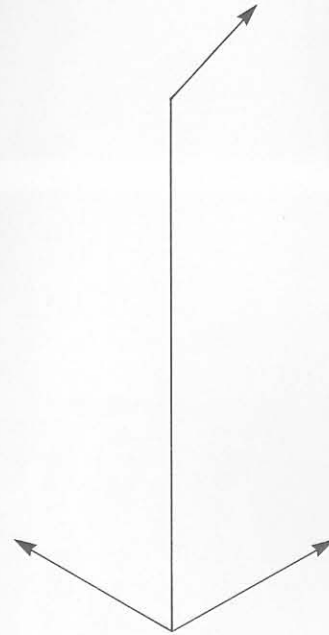
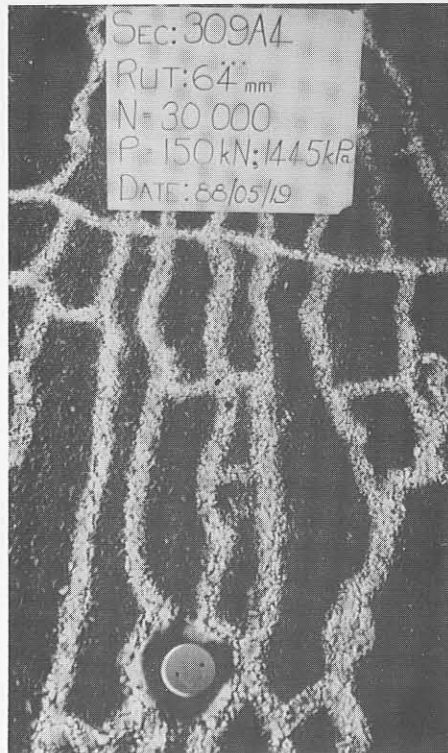


PLATE D.17 RELATIVELY SHALLOW PAVEMENT: ROAD 2212 – FATIGUE CRACKING AND DEFORMATION ON HVS TEST SECTION 309A4 (TRAFFICKING SINGLE WHEEL LOAD: 150 kN; TYRE PRESSURE: 1445 kPa).

(a) Fatigue cracking and deformation (maximum 40 mm) after 11 331 repetitions.



(b) Further fatigue cracking and deformation (maximum 64 mm) after 30 000 repetitions.



(c) Further fatigue cracking and deformation (maximum 89 mm) after 41 803 repetitions..

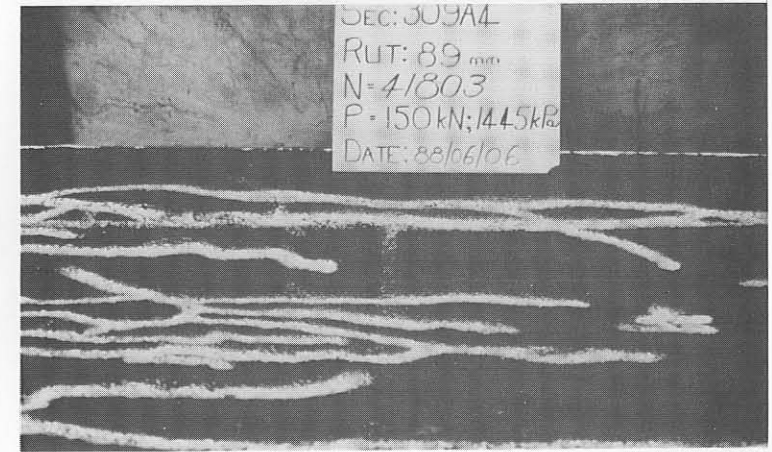
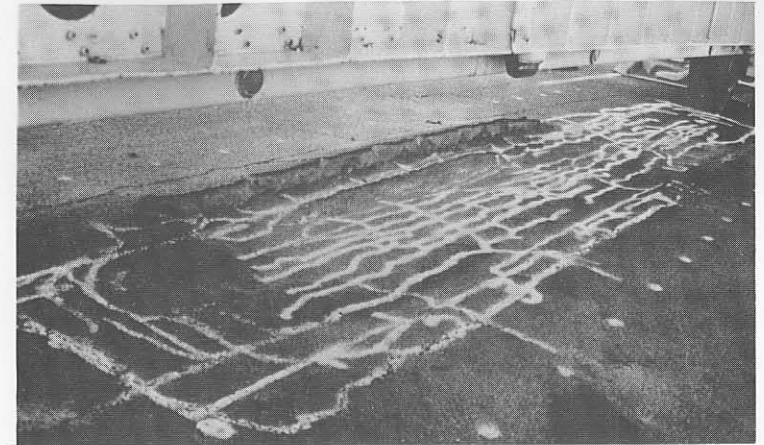
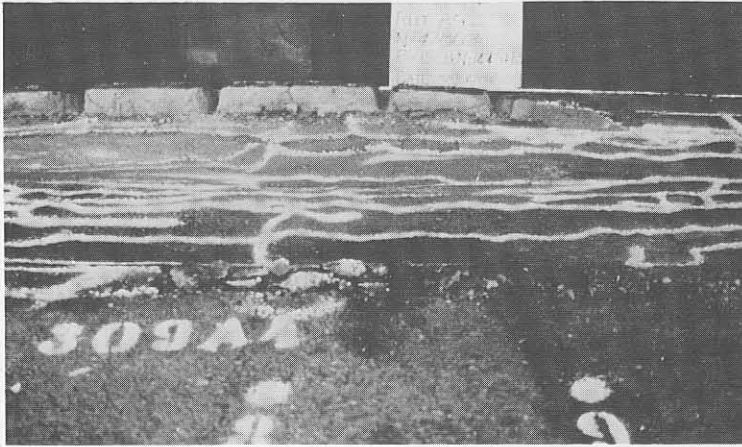


PLATE D.18 RELATIVELY SHALLOW PAVEMENT: ROAD 2212 – FATIGUE CRACKING AND DEFORMATION ON HVS TEST SECTION 309A4 (TRAFFICKING SINGLE WHEEL LOAD: 150 kN; TYRE PRESSURE: 1445 kPa).



Upheaving of cemented base material outside the tested area, owing to the “punching” of the base material into the weak interlayer, and subsequent horizontal movement of the base material towards the outside of the section

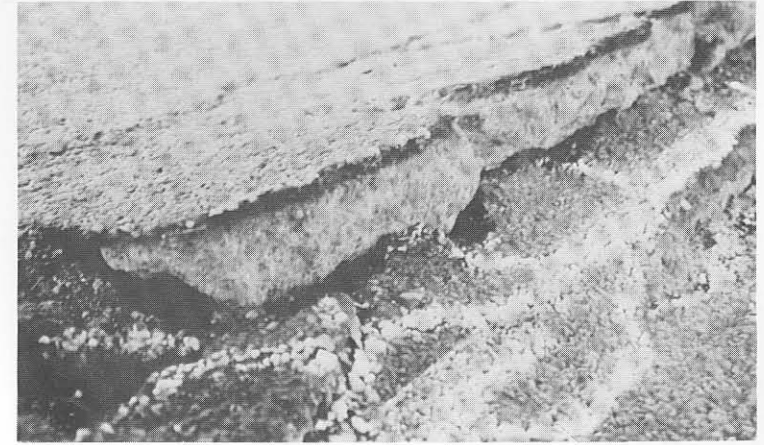


PLATE D.19 RELATIVELY SHALLOW PAVEMENT: ROAD 2212 – EXCESSIVE DEFORMATION DEVELOPMENT DURING THE FINAL STAGES OF TESTING (41 803 REPETITIONS) ON HVS TEST SECTION 309A4 (TRAFFICKING SINGLE WHEEL LOAD: 150 kN; TYRE PRESSURE: 1445 kPa).

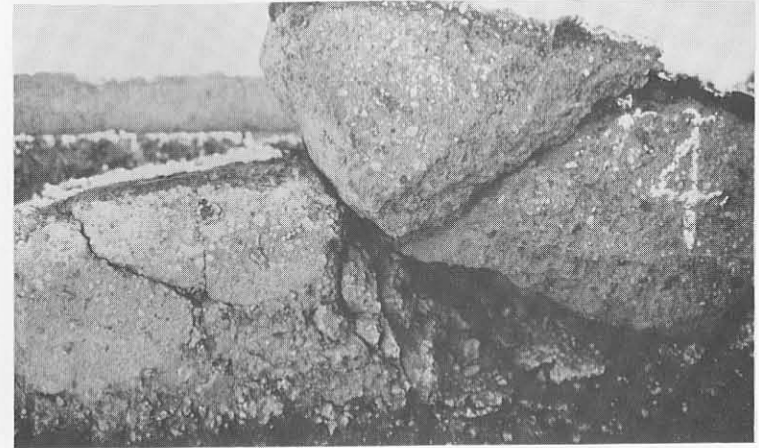
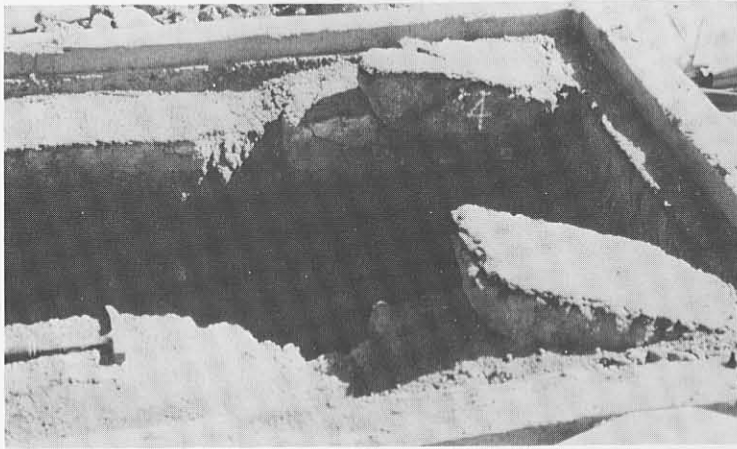


PLATE D.20 RELATIVELY SHALLOW PAVEMENT: ROAD 2212 – EXCESSIVE FATIGUE AND CRUSHING FAILURE AT THE END OF THE TEST (41 803 REPETITIONS) ON HVS TEST SECTION 309A4, MEASURING POINT 4 (TRAFFICKING SINGLE WHEEL LOAD: 150 kN; TYRE PRESSURE: 1445 kPa).

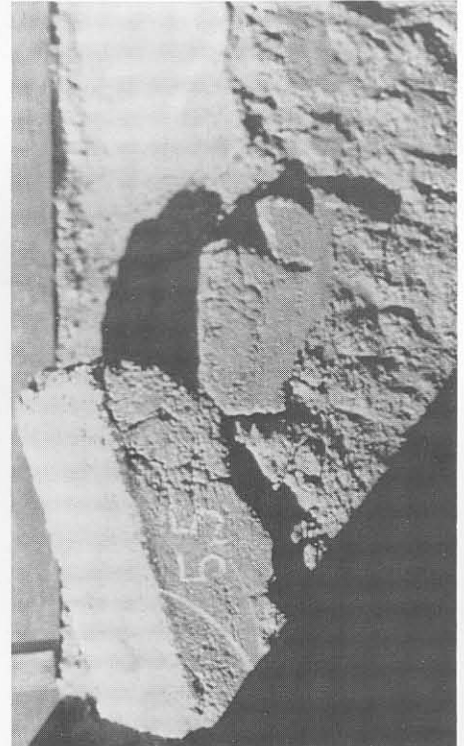
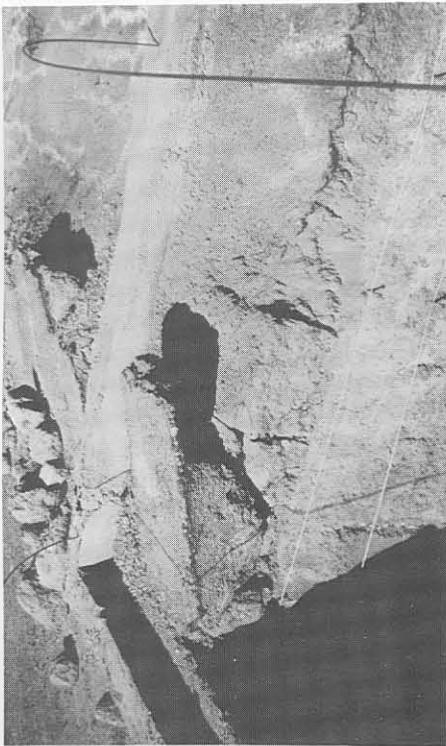
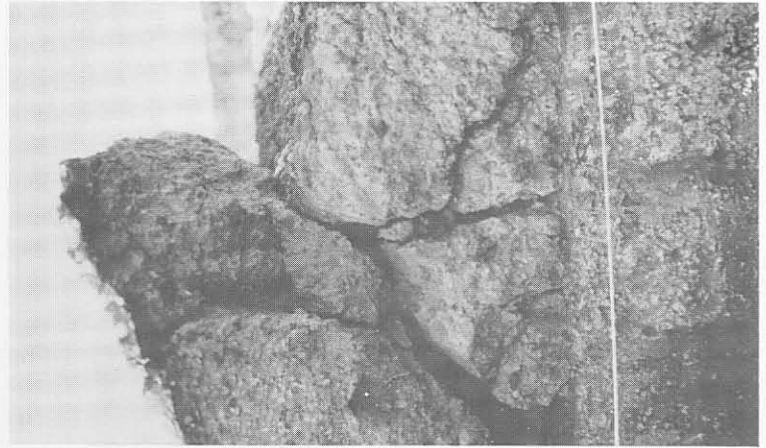
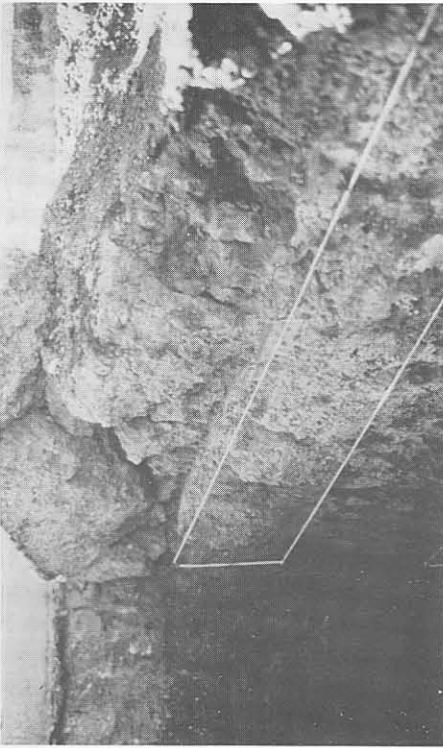


PLATE D.21 RELATIVELY SHALLOW PAVEMENT: ROAD 2212 – EXCESSIVE FATIGUE AND CRUSHING FAILURE AT THE END OF THE TEST (41 803 REPETITIONS) ON HVS TEST SECTION 309A4, MEASURING POINT 5 (TRAFFICKING SINGLE WHEEL LOAD: 150 kN; TYRE PRESSURE: 1445 kPa).

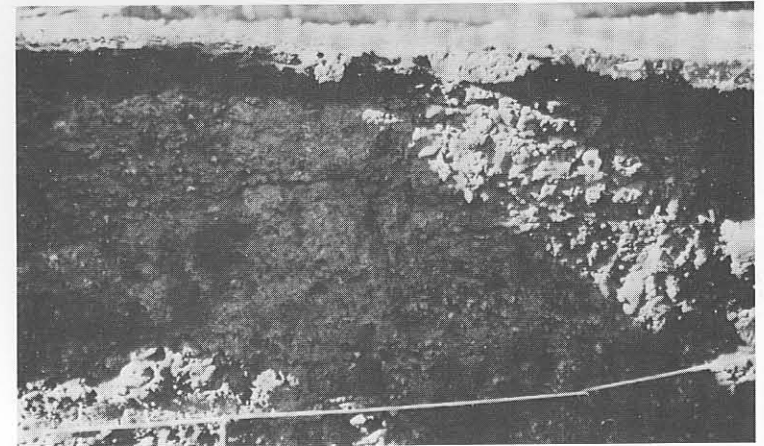
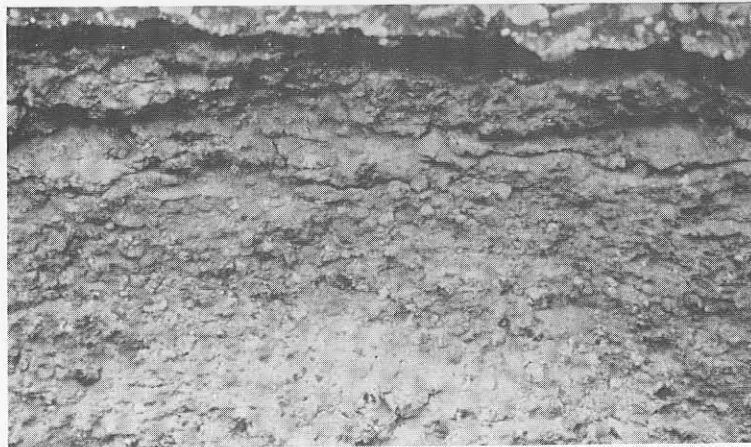
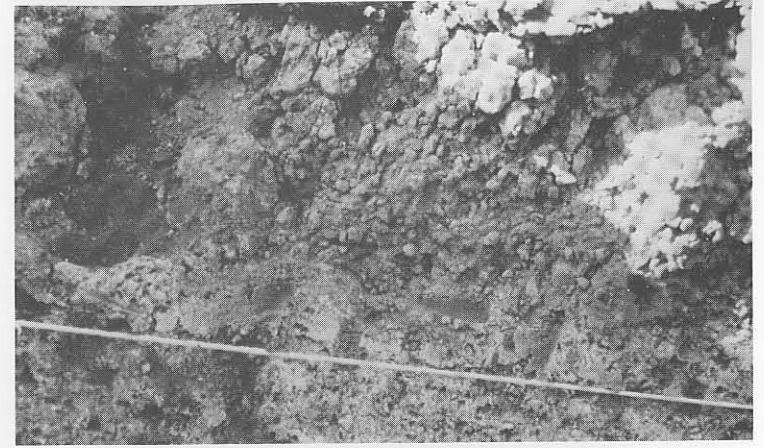


PLATE D.22 RELATIVELY SHALLOW PAVEMENT: ROAD 2212 – CLOSE VIEW OF THE CRUSHING (COMPRESSION) FAILURE OF THE CEMENTED BASE LAYER AT THE END OF THE TEST (41 803 REPETITIONS) ON HVS TEST SECTION 309A4 (TRAFFICKING SINGLE WHEEL LOAD: 150 kN; TYRE PRESSURE: 1445 kPa).

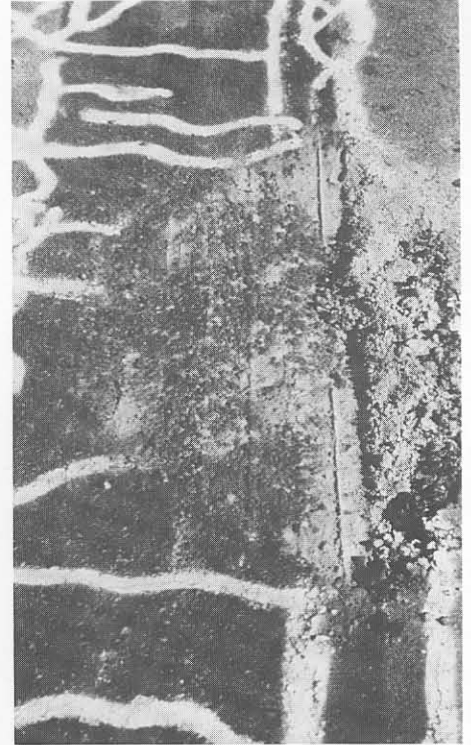
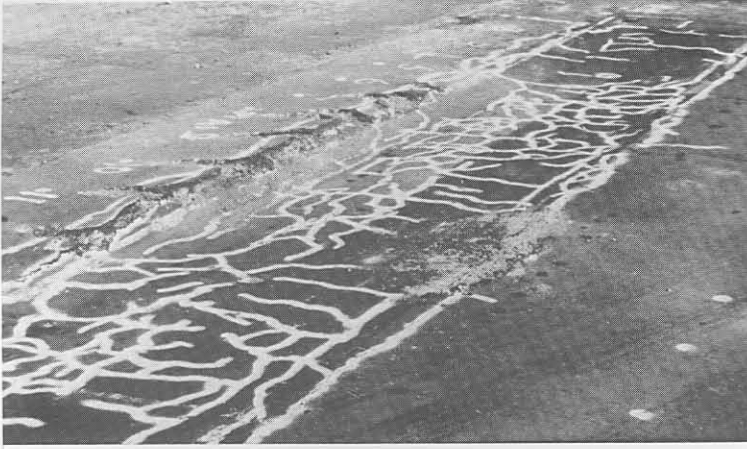
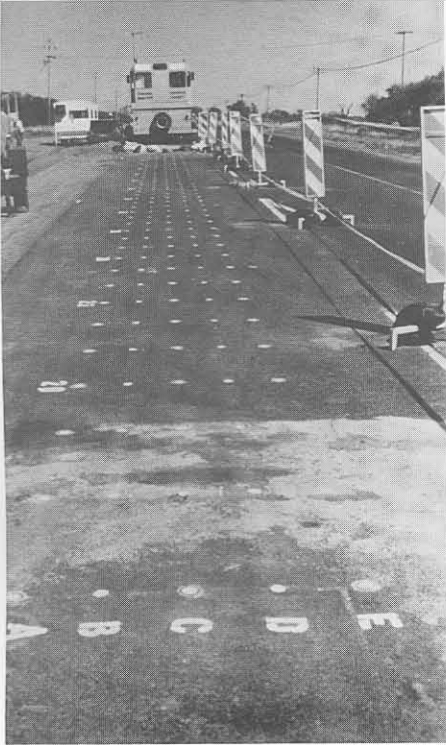


PLATE D.23 RELATIVELY DEEP PAVEMENT: ROAD 1932 – EXCESSIVE CRUSHING FAILURE AT THE END OF THE TEST (48 000 REPETITIONS) ON HVS TEST SECTION 337A4 (TRAFFICKING SINGLE WHEEL LOAD: 150 kN; TYRE PRESSURE: 1445 kPa).

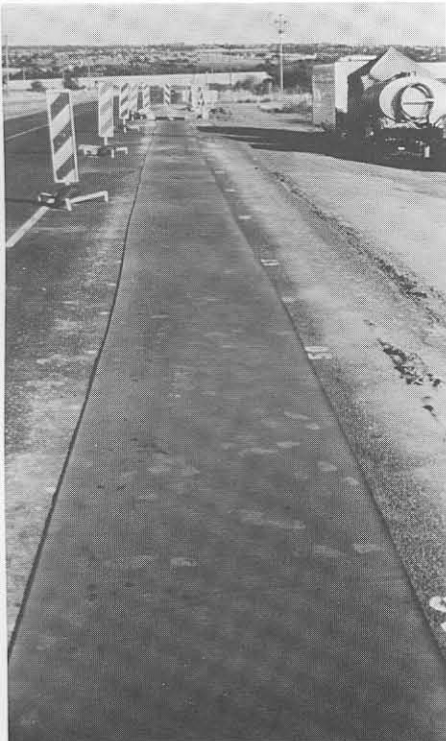


PLATE D.24 RELATIVELY DEEP PAVEMENT: ROAD 1932 – CRUSHING FAILURE AT THE END OF THE TEST (143 000 REPETITIONS) ON HVS TEST SECTION 338A4. DEFORMATION APPROXIMATELY 10 mm (TRAFFICKING SINGLE WHEEL LOAD: 150 kN; TYRE PRESSURE: 960 kPa).

(a) Layout of the rehabilitation section on which the "crack and seat" method had been applied.



(b) Measurement of surface deflection prior to "crack and seat" operation.



(c) Rubbermatress (3 mm) used as protection of the surface seal on the experimental section during the "crack and seat" operation.



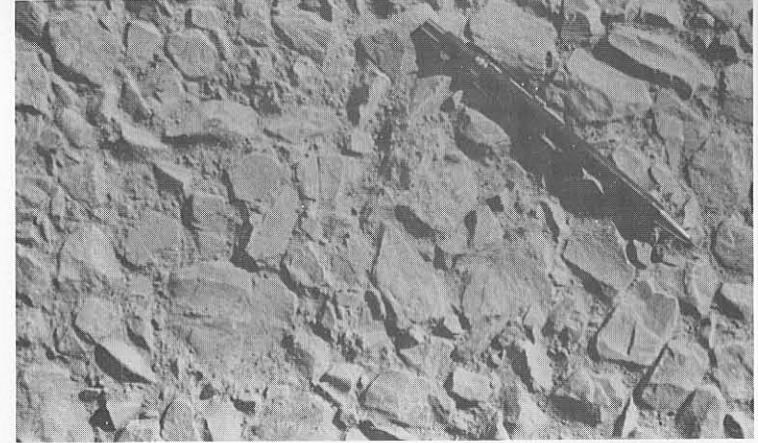
(d) Vibratory roller in operation during the "crack and seat" method.



PLATE D.26 RELATIVELY SHALLOW PAVEMENT: ROAD 2212 – PREPARATION OF THE REHABILITATION TEST SECTIONS, USING A HEAVY VIBRATORY ROLLER IN A “CRACK AND SEAT” OPERATION. NOTE THE CRACK DEVELOPMENT IN THE CEMENTED BASE LAYER.



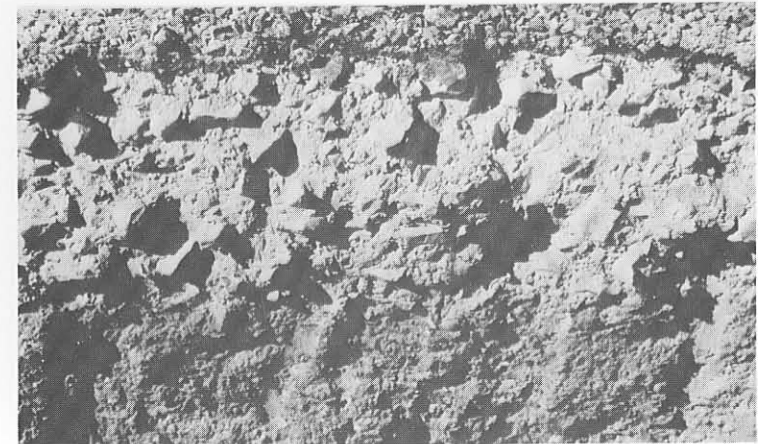
(a) Granular base material on the precracked cemented subbase.



(b) Mosaic pattern of the 150 mm G1 – granular base prior to application of the prime coat.



(c) Base layer after the application of the prime coat.



(d) Test pit indicating the 150 mm G1 – base layer on top of the precracked cemented layer.



(a) Brooming of surface of the cemented base layer after the "crack and seat" operation, before the application of the prime coat.



(b) Surface of the precracked cemented base after application of the prime coat.



(c) Final surface of the 35 mm asphalt premix section (40 m in length).