Attachments

Attachment-1

List of Received Quality Related Documents

Quality Specification Documents Received from Nishimatsu Construction

No.1	Quality Control Document (Embankment, Sub-grade)	Field Density Test Report Field Density Test Report Material Test report Trial Embankemnt Report	Sub-grade Embankment
No.2	Quality Control Document (Base course)	Field Density Test Report Field Density Test Report Material Test Report Trial Mix	Base Course Sub-Base Course
No.3	Quality Control Document (Surface Course, Binder Course)	Pavement Surface Smoothness Test Report Field Density Test Report Field Density Test Report Field Density Test Report Field Density Test Report Material Test report Trial Mix Report	 Surface Course Binder Course Surface Course Binder Course
No.4	Request for Inspection No.1	Completion of Base course Completion of Sub-base course Completion of Subgrade Proof rolling Proof rolling	 Shoulder Subgrade
No.5	Request for Inspection No.2	Tack Coat Prime Coat Urban District Road Box Culvert Surface Course Binder Course	
No.6	Request for Inspection No.3	Material for Cross Drainage Cross Draiange Work Cross Draiange Work Cross Draiange Work	RC Pipe Access Road Section 1 Section 2
No.7	Photograph No.1 (Before and Completion)	Earth Work	Removal fo Asphalt Removal fo Structure Embankment Sub-grade
		Pavement work	Replacement sub-grade Sub-base course Base course Asphalt road base Surface course Shoulder pavement Access road pavement
No.8	Photograph No.2	Road Facilitties Work	Road Signs Guide Posts Road Marking Reflective Pavement Studs
		Drainage Structure Work	Drainage Pipe Installation Box culvert Earth Ditch Precast Sideditch
No.9	Photograph Album No.2	Sec 2 Sta.18-23+700	Earth Work Sub-base course work Base Course Binder Course Surface Course Box culvert Cross Drainage
		Road Facility Work	Access Road Work Hump Work Sign Board Fence Guide Posts Road Marking
No.10	Photograph No.3 (Qality Control)	Pavement Surface Smoothness Test Report Sampling of FDT Material test for Asphalt	

Quality Specification Documents Received from NIPPO

No.1	Quality Control Document	Sub-base course, Base course	Material Test Report Trial Mix Report Field density test for Sub-base course Field density test for Base course
No.2	Quality Control Document	Replacement sub-grade	Material Test Report Trial Mix Report Field density test for Replacement Sub-grade
		Sub-grade, Shoulder sub-grade	Material Test Report Field density test for Sub-grade Field density test for Shoulder sub-grade
No.3	Quality Control Document	Asphaltic base course	Material Test Report Trial Mix Report Temperature of asphalt at the plant Temperature of asphalt on the road Marshall Stability Test Aggregate gradingTest Soxhlet Density Test of Core Sampling
		Surface course	Material Test Report Trial Mix Report Temperature of asphalt at the plant Temperature of asphalt on the road Marshall Stability Test Aggregate grading of Mix Soxhlet Extraction Field Density Test of Core Sampling
No.4	Quality Control Document	Shoulder surface course	Temperature of asphalt at the plant Temperature of asphalt on the road Marshall Stability Test Aggregate grading of Mix Soxhlet Extraction Field Density Test for Core Sampling
		Access Road	Field Density Test for Sub grade Field density test for Base course Temperature of asphalt at the plant Temperature of asphalt on the road Marshall Stability Test Soxhlet Extraction Field Density Test of Core Sampling for Surface course
No.5	Quality Control Document	Surface course	Smooth Test for Cross section Smooth Test for Londitudinal Direction
No.6	Reqest for Inspection No..1	Drainage Pipe Installation Drainegae Pipe Installation	New Extension
No.7	Reqest for Inspection No..2	Drainage Pipe Installation Drainage Pipe Installation	Access to Road Access to House
No.8	Reqest for Inspection No..3	Box culvert Precast side ditch completion of extension for replacement sub-grade completion of replacement sub-grade Density test for Sub-grade Proof Rolling for Sub-grade Proof Rolling for Shoulder sub-grade	
No.9	Reqest for Inspection No..4	Completionf of Sub-base course Thichness of Sub-base course Density test for Sub-base course	elevation, width
No.10	Reqest for Inspection No..5	Completion of Base Course Thickness of Base course Density test for Base course Completion of Asphaltic Road Base Core sampling of Asphaltic road base Completion of Surface course and shoulder surface course Core sampling of surface course and shoulder surface course Prime coat Tack coat	

Quality Specification Documents Received from Katahira

No	No Documents
1	Design statement
2	Quantity statement
3	Document overview of project cost estimation
4	Design drawings
5	Cerificaiton report
6	Tender document at first phase
7	Tender document at second phase
8	Defect liability inspection report at first phase
9	Defect liability inspection report at second phase

Attachment-2

Record of Minute of Meeting with JICA and MOT

Minutes of Discussions
on
the Ex-Post Situation Survey
for
the Project for the Improvement of Dusty-Nizhniy Pyandzh Road
in
the Republic of Tajikistan

In response to requests from Ministry of Transport, the Government of Tajikistan (hereinafter referred to as the "MOT"), Japan International Cooperation Agency (hereinafter referred to as "JICA"), decided to conduct an Ex-Post Situation Survey (hereinafter referred to as the "Survey") for the Project for the Improvement of Duisty-Nizhniy Pyandzh Road (hereinafter referred to as the "Project"). JICA dispatched the Survey team headed by Mr. Kenshiro TANAKA, an Advisor of Grant Aid Project Management Division 1, Financing Cooperation Implementation Department, JICA, and had a series of discussions on the Survey from May 5 to 7, 2014 in Dushanbe, Tajikistan.

As the result of the discussions, both parties confirmed the main items for the Survey described on the attached sheets hereto;

Dushanbe, May 7, 2014

Mr. Kenshiro TANAKA
Leader of Survey Team
Advisor of Grant Aid Project Management
Division 1
Financing Cooperation Implementation
Department, JICA

Mr. Sherali Gangalzoda
First Deputy Minister
Ministry of Transport
The Republic of Tajikistan

ATTACHMENT

1. Objective of the Survey

- The Survey will identify the causes of the damages happened on Duisty-Nizhniy Pyandzh Road developed by the Project.
- For the steep section around 14k300m of Duisty-Nizhniy Pyandzh Road, which is damaged significantly and requires an urgent repair work, the Survey will recommend emergency repair methods, which Tajikistan local road management offices are capable of managing effectively, and support the emergency repair work technically, which will be conducted by the Tajikistan side.
- For the flat sections, which are damaged seriously, the Survey will recommend repair and maintenance methods, which Tajikistan local road management offices are capable of managing for repair and maintenance works.

2. Survey Site

- Duisty-Nizhniy Pyandzh Road developed by the Project (approx. 23.7km, see Attachment)

3. Survey Items and Schedule of the Survey

- MOT was presented the Survey items and schedule by the Survey team. MOT agreed them principally.

4. Undertakings of JICA

- The Survey team will bring "Technical Report 1", including the result of the first field survey and proposals of methods for repair works for damaged sections, on the middle of June at the beginning of the second field survey to have technical discussion with MOT for selection of methods of the repair works.
- The Survey team will send "Technical Report 2", including repair techniques and methods, quantity and cost of the repair works, to MOT by the end of mid-July 2014, which will make MOT able to prepare for the repair works.
- The Survey team will send "Technical Report 3", including technical consideration of the result of the repair work and the final result of the Survey to MOT by the end of mid-September 2014, which will make MOT be able to comment of technical issues. The Survey team will reflect the comments and send a final report to MOT by the end of October 2014.

5. Undertakings of MOT

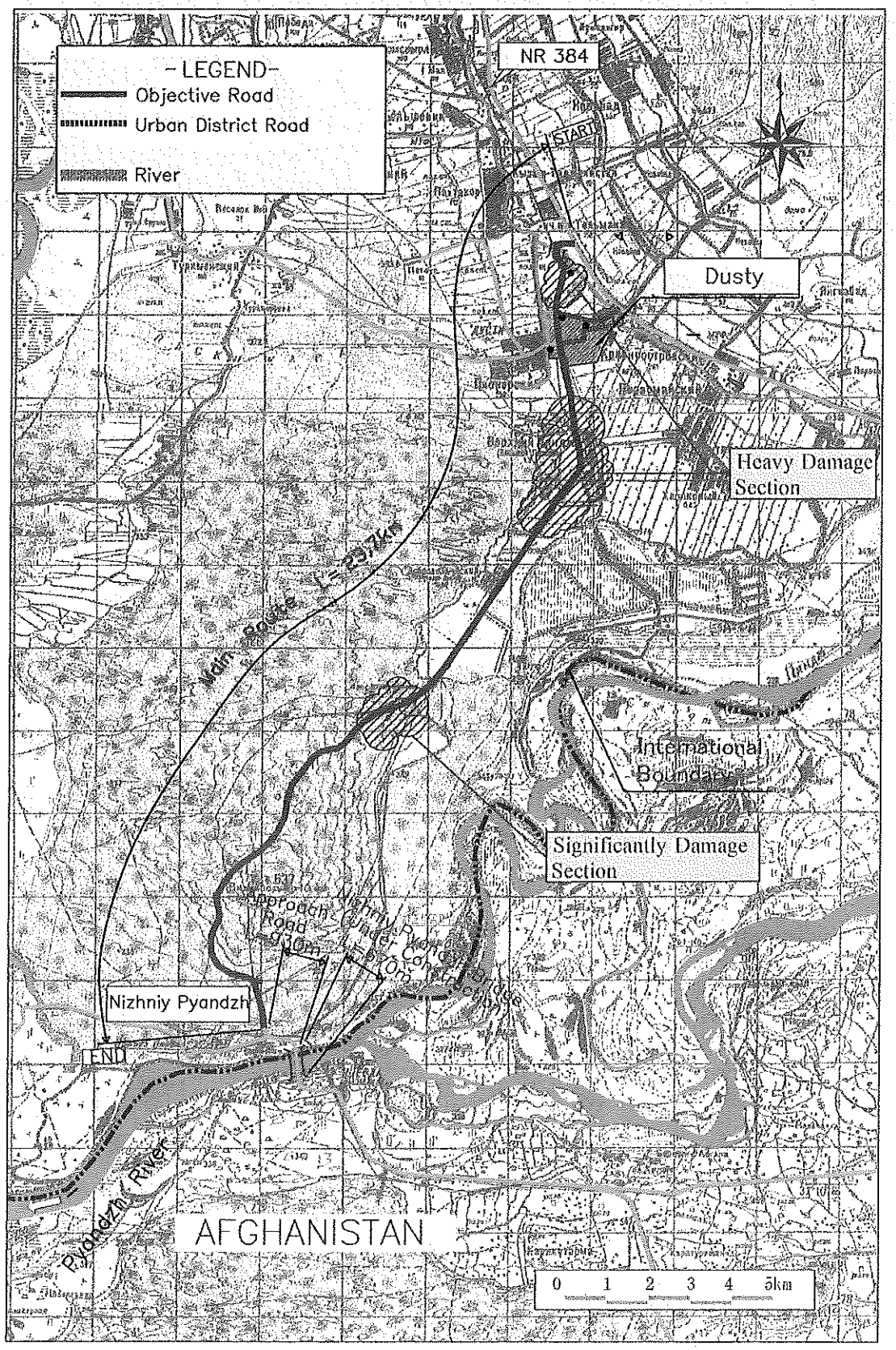
- MOT will ensure the security of the field survey conducted by the Survey team.
- MOT will accommodate the Survey team with following items for the first field survey.
  - Assistance of obtaining necessary permission for the various tests on the survey road,

- Provision of weather data,
- Provision of vehicle type loading data,
- Provision of unit price and suppliers of materials and equipment for the emergency repair work,
- Provision of unit price of work items,
- Implementation of traffic census (two days (May 6 and 7), two places, three shifts),
- Lending tools (shovel, pickaxe, etc.) for sampling,
- Tests of pavement materials in MOT Lab.,
- Recovery of trial pits,
- Assistance of sampling pavement materials,
- Ensuring traffic safety measures for the on-road survey works, and
- Provision of other necessary data.

- MOT will accommodate the Survey team with a following item for the second field survey. Details will be discussed in the beginning of the second filed survey.
  - Provision of insufficient data in the first field survey and additional data.
- MOT will accommodate the Survey team with following items for third field survey (technical assistance for the emergency repair work). Details will be discussed in the beginning of the third filed survey.
  - MOT will conduct the emergency repair work, agreed between MOT and the Survey team. MOT will bear the cost of the emergency repair work.
  - MOT will assign counterpart engineers for technical transfer by the Survey team.
  - MOT will ensure traffic safety measures for the emergency repair work.

(End)

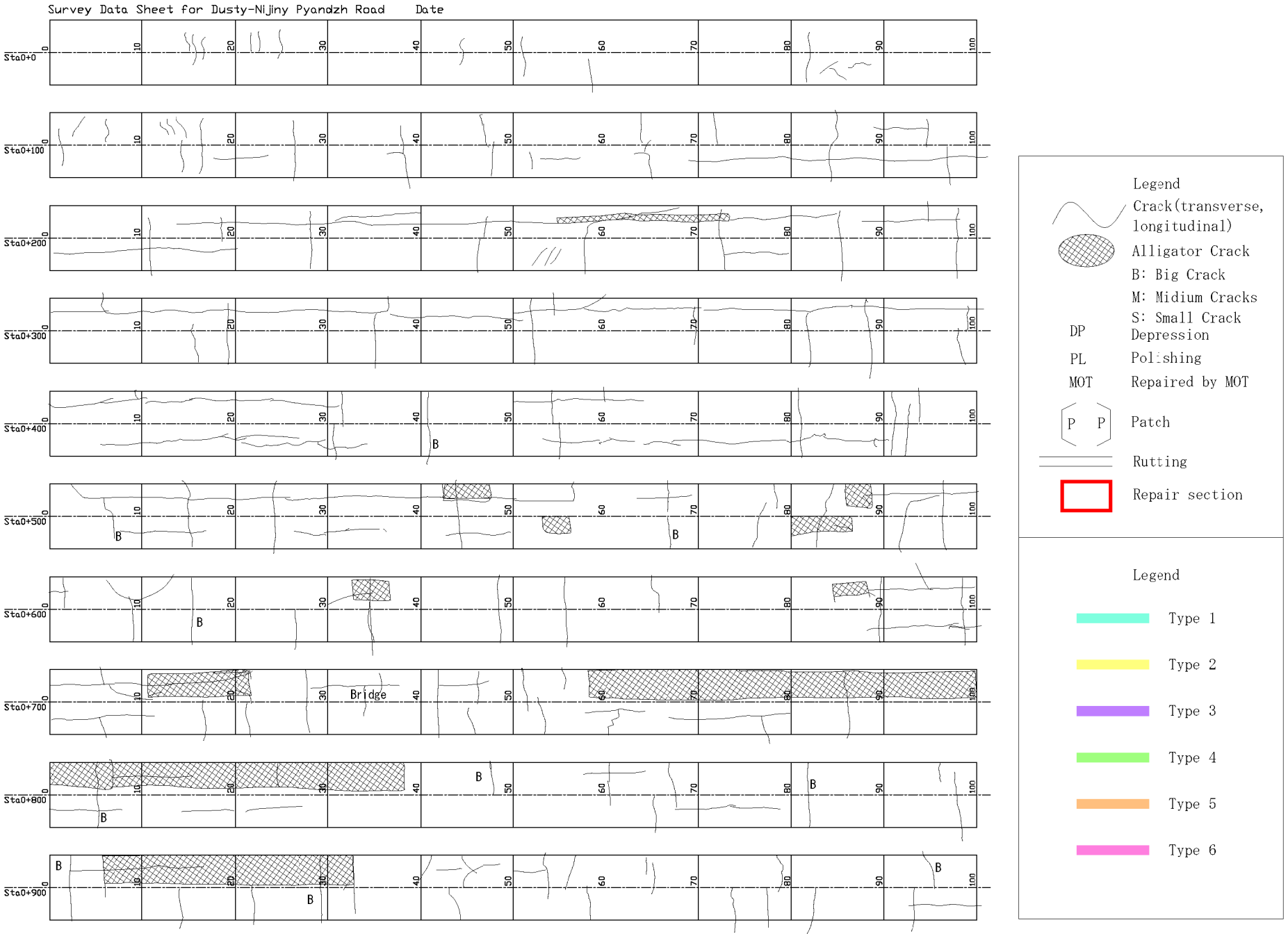
Attachment: Survey Site Map



LOCATION MAP

Attachment-3

Result of Pavement Inventory Survey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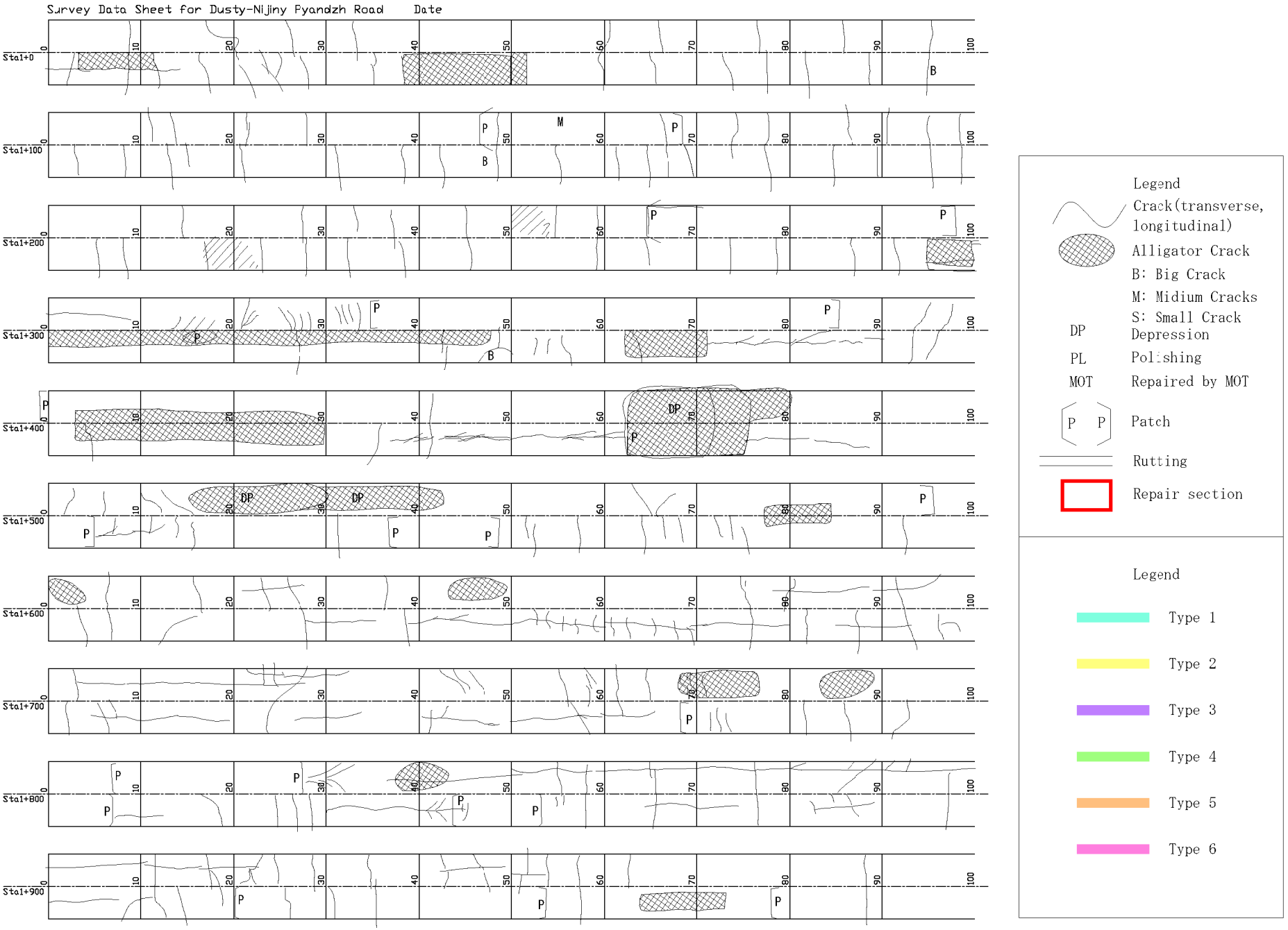
Date
Sta0+0
Sta0+100
Sta0+200
Sta0+300
Sta0+400
Sta0+500
Sta0+600
Sta0+700
Sta0+800
Sta0+900
0
10
20
30
40
50
60
70
80
90
100
B
Bridge
Legend
Crack(transverse, longitudinal)
Alligator Crack
B: Big Crack
M: Midium Cracks
S: Small Crack
DP
Depression
PL
Polishing
MOT
Repaired by MOT
P P
Patch
Rutting
Repair section
Legend
Type 1
Type 2
Type 3
Type 4
Type 5
Type 6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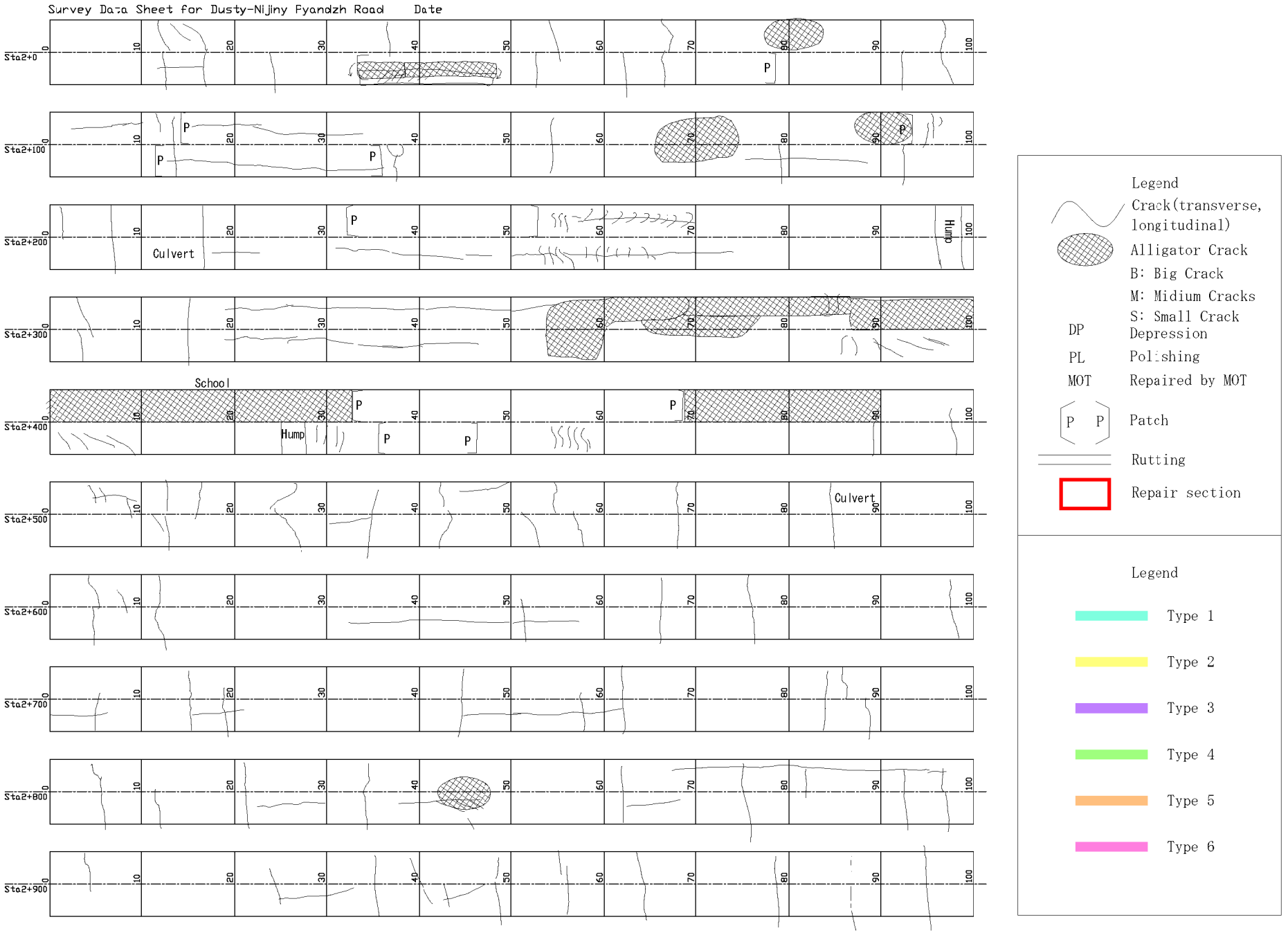
Sta1+0
Sta1+100
Sta1+200
Sta1+300
Sta1+400
Sta1+500
Sta1+600
Sta1+700
Sta1+800
Sta1+900
Legend
Crack(transverse, longitudinal)
Alligator Crack
B: Big Crack
M: Midium Cracks
S: Small Crack
DP Depression
PL Polishing
MOT Repaired by MOT
P P Patch
Rutting
Repair section
Legend
Type 1
Type 2
Type 3
Type 4
Type 5
Type 6

A3-2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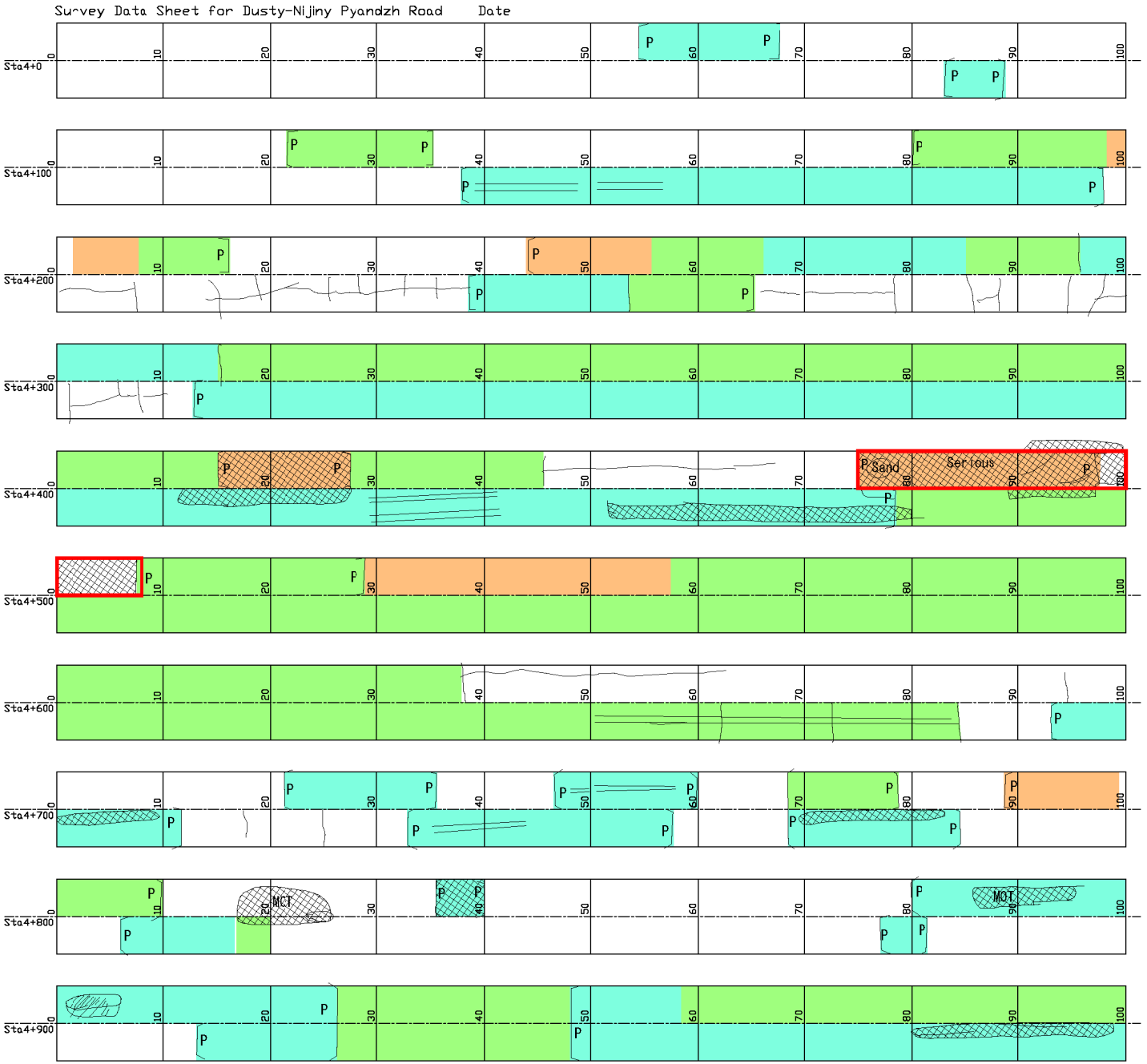
Culvert
Hump
Sta2+300
Sta2+400
School
Hump
Sta2+500
Culvert
Sta2+600
Sta2+700
Sta2+800
Sta2+900
P
Legend
Crack(transverse, longitudinal)
Alligator Crack
B: Big Crack
M: Midium Cracks
S: Small Crack
DP Depression
PL Polishing
MOT Repaired by MOT
P P Patch
Rutting
Repair section
Legend
Type 1
Type 2
Type 3
Type 4
Type 5
Type 6


Survey Data Sheet for Dusty-Nijiny Pyandzh Road Date
Sta3+0
Sta3+100
Sta3+200
Sta3+300
Sta3+400
Sta3+500
Sta3+600
Sta3+700
Sta3+800
Sta3+900
P
PL
Hump
DP
Legend
Crack(transverse, longitudinal)
Alligator Crack
B: Big Crack
M: Midium Cracks
S: Small Crack
DP Depression
PL Polishing
MOT Repaired by MOT
P P Patch
Rutting
Repair section
Legend
Type 1
Type 2
Type 3
Type 4
Type 5
Type 6



Legend

Crack(transverse, longitudinal)

Alligator Crack

B: Big Crack

M: Midium Cracks

S: Small Crack

DP Depression

PL Polishing

MOT Repaired by MOT

P P Patch

Rutting

Repair section

Legend

Type 1

Type 2

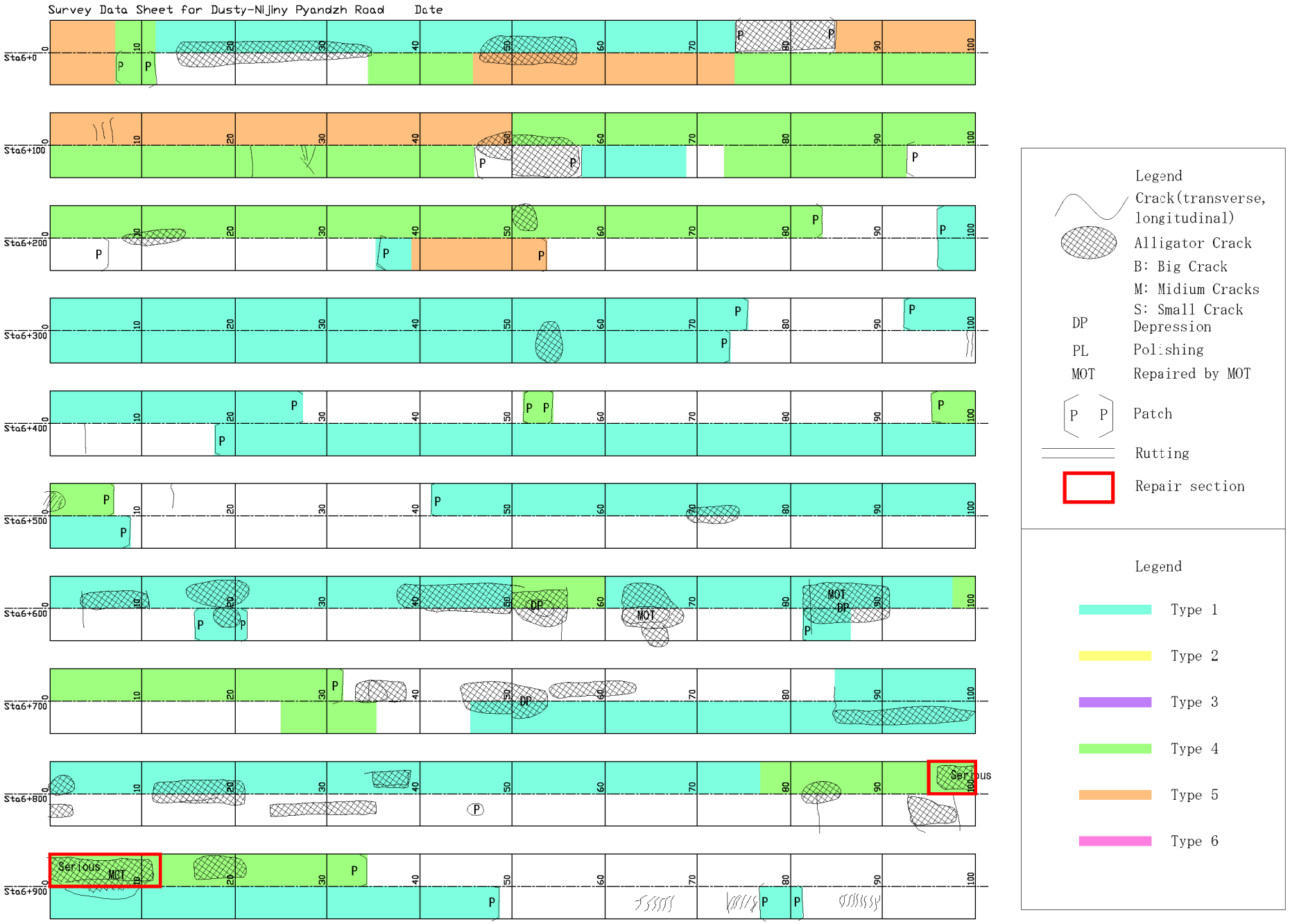
Type 3

Type 4

Type 5

Type 6


Survey Data Sheet for Dusty-Nijny Pyandzh Road
Date
Sta5+0
Sta5+100
Sta5+200
Sta5+300
Sta5+400
Sta5+500
Sta5+600
Sta5+700
Sta5+800
Sta5+900
Sand
Sage
MOT
Road
Cable
Legend
Crack(transverse, longitudinal)
Alligator Crack
B: Big Crack
M: Midium Cracks
S: Small Crack
DP Depression
PL Polishing
MOT Repaired by MOT
Patch
Rutting
Repair section
Legend
Type 1
Type 2
Type 3
Type 4
Type 5
Type 6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Date
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Sta6+200
Sta6+300
Sta6+400
Sta6+500
Sta6+600
Sta6+700
Sta6+800
Sta6+900
Legend
Crack(transverse, longitudinal)
Alligator Crack
B: Big Crack
M: Midium Cracks
S: Small Crack
DP Depression
PL Polishing
MOT Repaired by MOT
Patch
Rutting
Repair section
Legend
Type 1
Type 2
Type 3
Type 4
Type 5
Type 6


Survey Data Sheet for Dusty-Nijiny Pyandzh Road
Date
Sta7+0
Sta7+100
Sta7+200
Sta7+300
Sta7+400
Sta7+500
Sta7+600
Sta7+700
Sta7+800
Sta7+900
0
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30
40
50
60
70
80
90
100
P
Legend
Crack(transverse, longitudinal)
Alligator Crack
B: Big Crack
M: Midium Cracks
S: Small Crack
DP Depression
PL Polishing
MOT Repaired by MOT
P P Patch
Rutting
Repair section
Legend
Type 1
Type 2
Type 3
Type 4
Type 5
Type 6


Survey Data Sheet for Dusty-Nijny Pyandzh Road
Date
Sta8+0
Sta8+100
Sta8+200
Sta8+300
Sta8+400
Sta8+500
Sta8+600
Sta8+700
Sta8+800
Sta8+900
線型
MOT
DP
Legend
Crack(transverse, longitudinal)
Alligator Crack
B: Big Crack
M: Midium Cracks
S: Small Crack
DP Depression
PL Polishing
MOT Repaired by MOT
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Repair section
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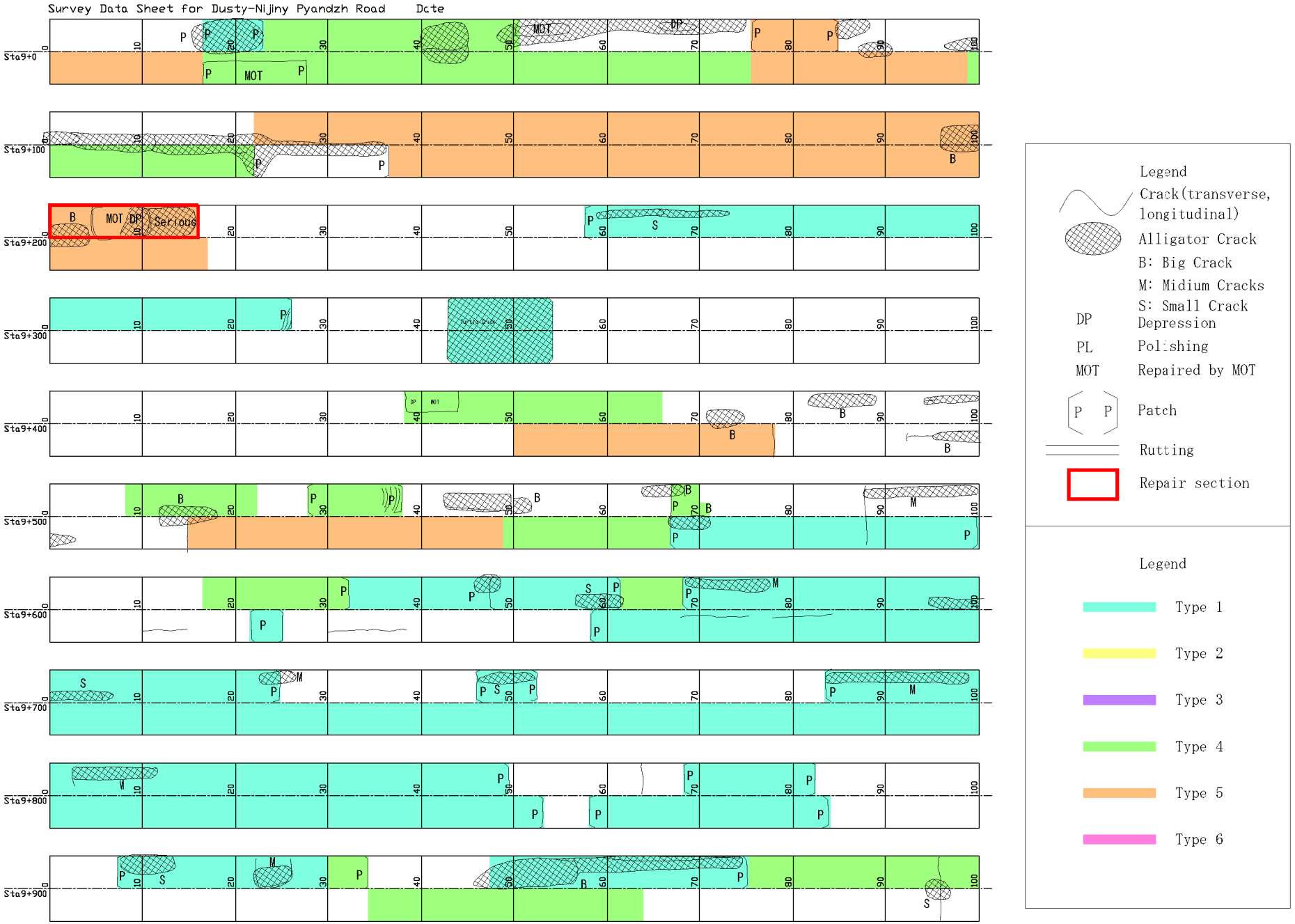
Type 6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Sta9+0
Sta9+100
Sta9+200
Sta9+300
Sta9+400
Sta9+500
Sta9+600
Sta9+700
Sta9+800
Sta9+900
Serious
Legend
Crack(transverse, longitudinal)
Alligator Crack
B: Big Crack
M: Midium Cracks
S: Small Crack
DP Depression
PL Polishing
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Type 5
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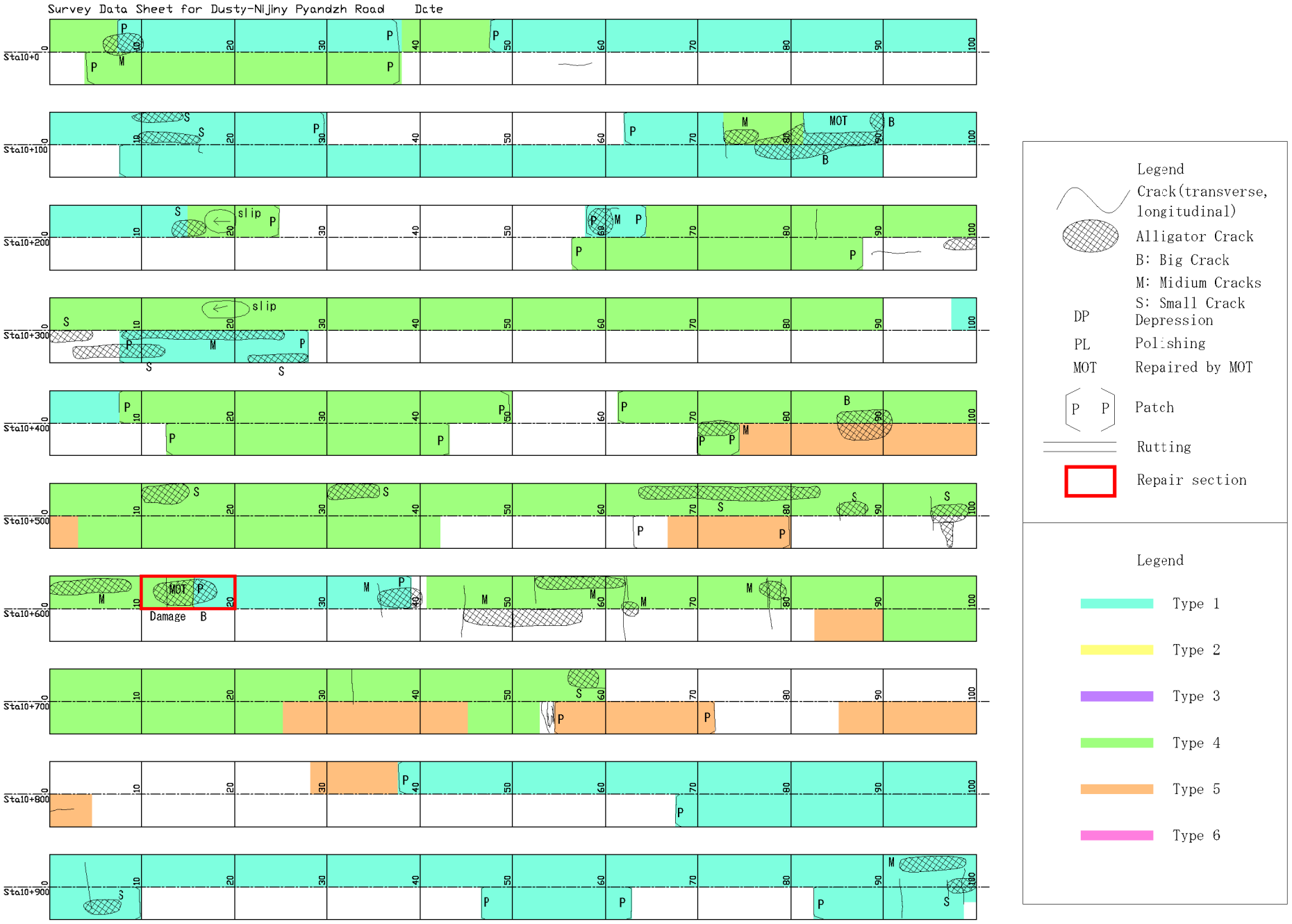
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Sta10+0
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Sta10+300
Sta10+400
Sta10+500
Sta10+600
Sta10+700
Sta10+800
Sta10+900
slip
Damage B
Legend
Crack(transverse, longitudinal)
Alligator Crack
B: Big Crack
M: Midium Cracks
S: Small Crack
DP Depression
PL Polishing
MOT Repaired by MOT
Patch
Rutting
Repair section
Legend
Type 1
Type 2
Type 3
Type 4
Type 5
Type 6


Survey Data Sheet for Dusty-Nijny Pyandzh Road Date
Stall+0
Stall+100
Stall+200
Stall+300
Stall+400
Stall+500
Stall+600
Stall+700
Stall+800
Stall+900
Legend
Crack(transverse, longitudinal)
Alligator Crack
B: Big Crack
M: Midium Cracks
S: Small Crack
DP Depression
PL Polishing
MOT Repaired by MOT
Patch
Rutting
Repair section
Legend
Type 1
Type 2
Type 3
Type 4
Type 5
Type 6


Survey Data Sheet for Dusty-Nijny Pyandzh Road Date
Sta12+0
Sta12+100
Sta12+200
Sta12+300
Sta12+400
Sta12+500
Sta12+600
Sta12+700
Sta12+800
Sta12+900
M
B
MOT
Damage
Surface roughness
Crack
Legend
Crack(transverse, longitudinal)
Alligator Crack
B: Big Crack
M: Midium Cracks
S: Small Crack
DP Depression
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MOT Repaired by MOT
Patch
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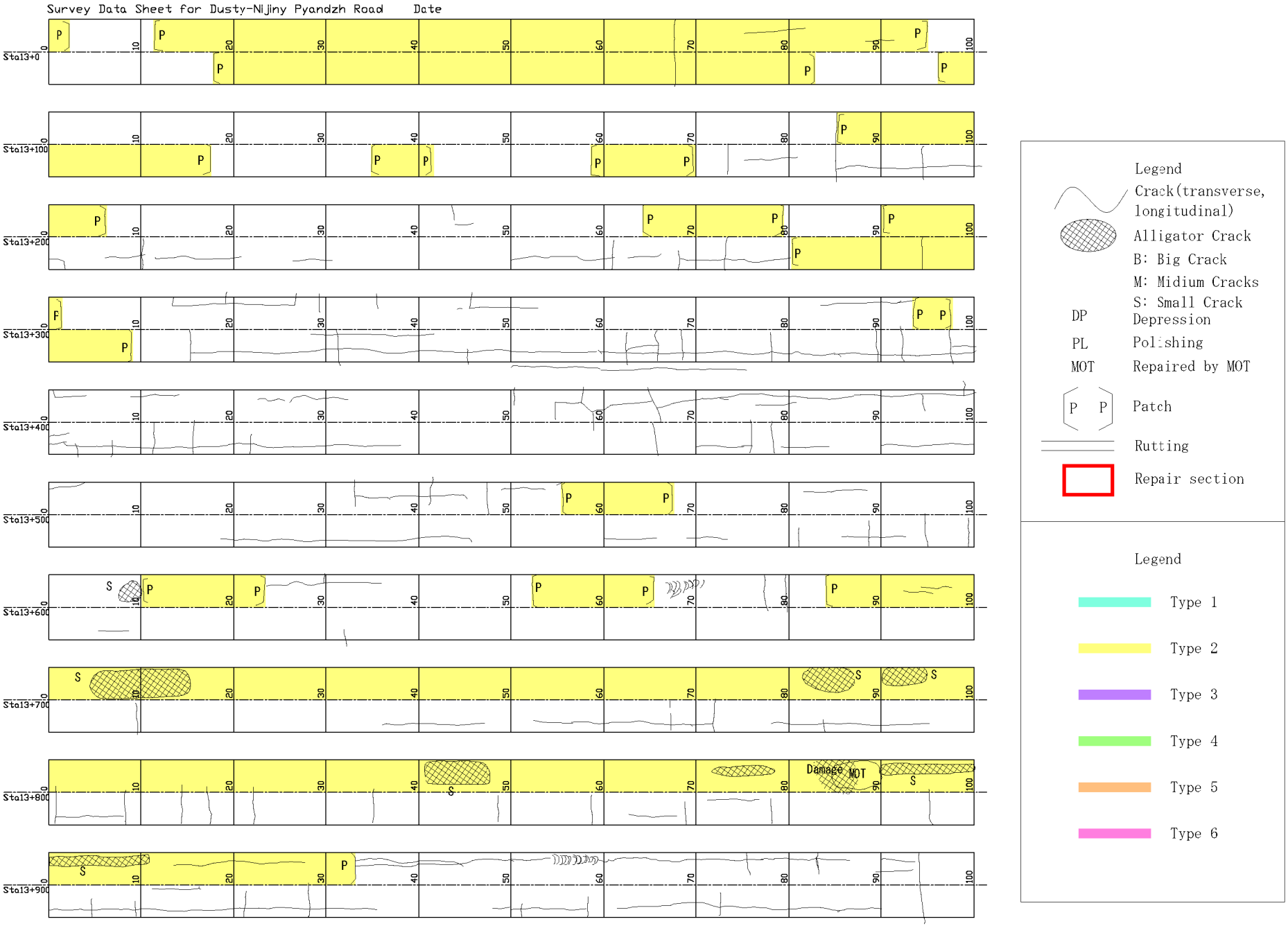
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Sta13+200
Sta13+300
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Sta13+700
Sta13+800
Sta13+900
Damage
MOT
Legend
Crack(transverse, longitudinal)
Alligator Crack
B: Big Crack
M: Midium Cracks
S: Small Crack
DP Depression
PL Polishing
MOT Repaired by MOT
Patch
Rutting
Repair section
Legend
Type 1
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Type 4
Type 5
Type 6


Survey Data Sheet for Dusty-Nijiny Pyandzh Road
Dote
Sta14+0
Sta14+100
Sta14+200
Sta14+300
Sta14+400
Sta14+500
Sta14+600
Sta14+700
Sta14+800
Sta14+900
DP
GAP 2cm
MOT
Gap
Swelled
Damage
Gap 20cm
Damage
Legend
Crack(transverse, longitudinal)
Alligator Crack
B: Big Crack
M: Midium Cracks
S: Small Crack
DP Depression
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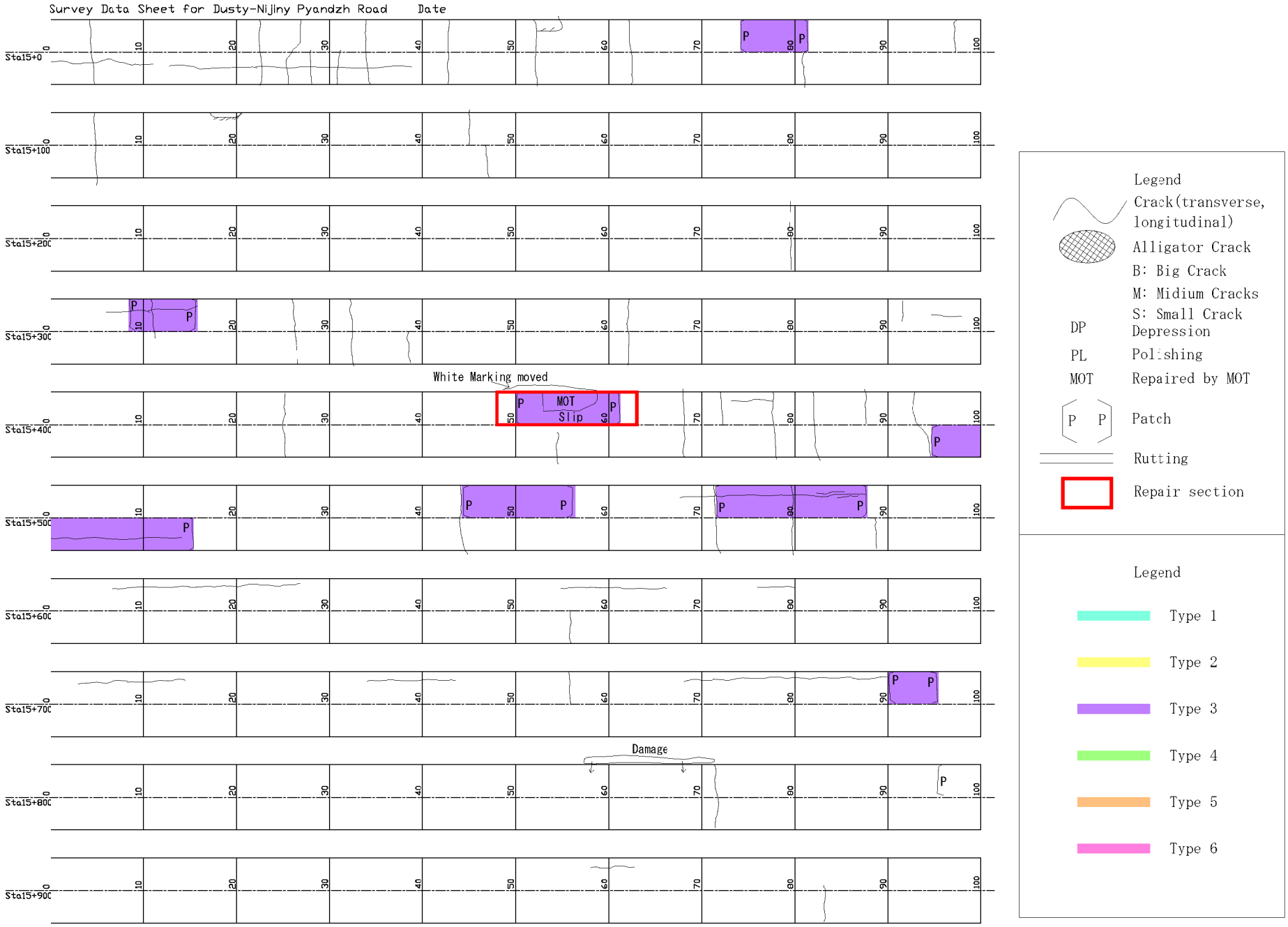
Type 6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Date
Sta15+0
Sta15+100
Sta15+200
Sta15+300
Sta15+400
Sta15+500
Sta15+600
Sta15+700
Sta15+800
Sta15+900
White Marking moved
MOT
Slip
Damage
P
Legend
Crack(transverse, longitudinal)
Alligator Crack
B: Big Crack
M: Midium Cracks
S: Small Crack
DP Depression
PL Polishing
MOT Repaired by MOT
P P Patch
Rutting
Repair section
Legend
Type 1
Type 2
Type 3
Type 4
Type 5
Type 6


Survey Data Sheet for Dusty-NIJny Pyandzh Road
Date
Sta16+0
Sta16+100
Sta16+200
Sta16+300
Sta16+400
Sta16+500
Sta16+600
Sta16+700
Sta16+800
Sta16+900
Gap
Damage
P
0
10
20
30
40
50
60
70
80
90
100
Legend
Crack(transverse, longitudinal)
Alligator Crack
B: Big Crack
M: Midium Cracks
S: Small Crack
DP Depression
PL Polishing
MOT Repaired by MOT
P P Patch
Rutting
Repair section
Legend
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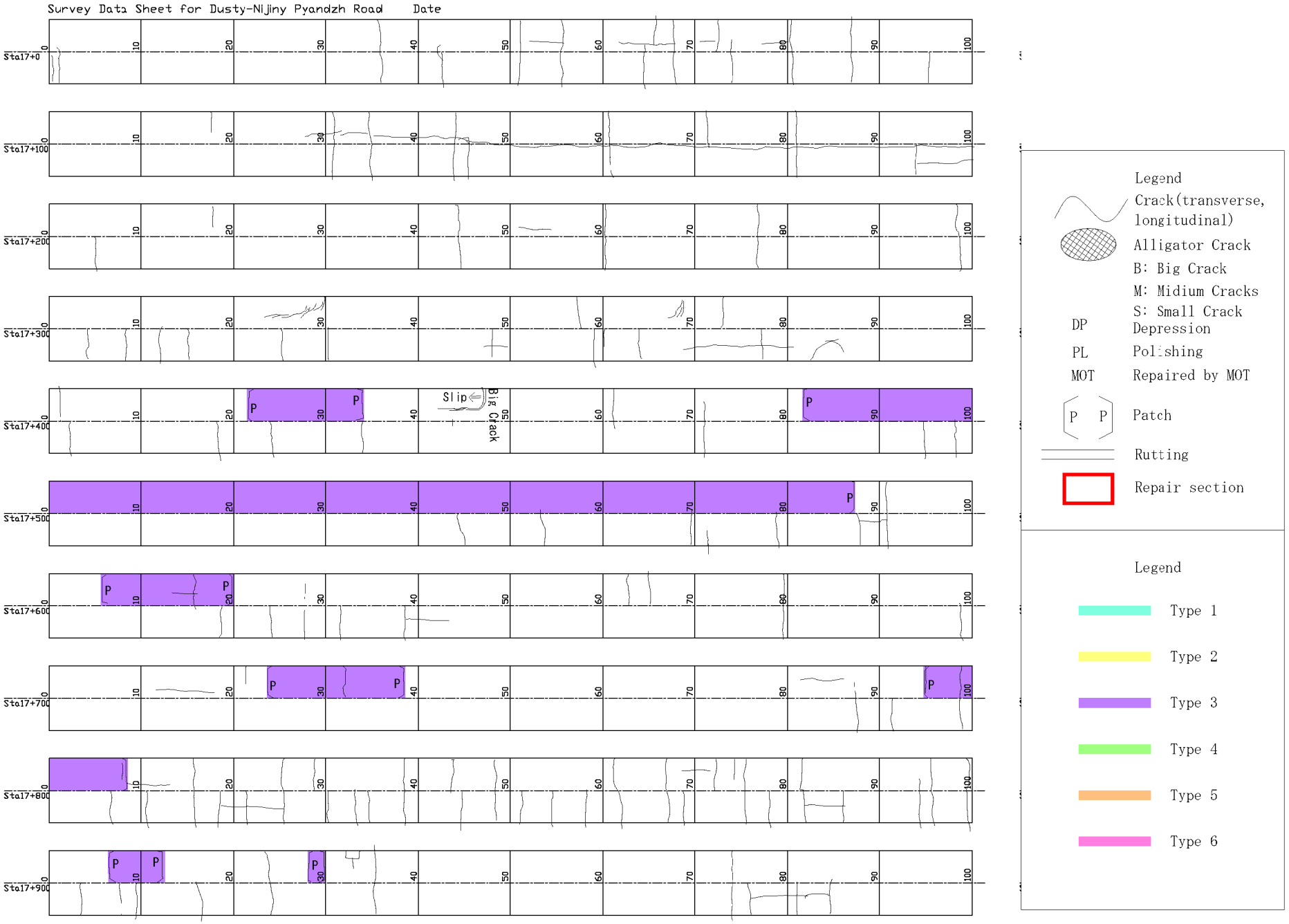
Type 5
Type 6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Sta17+300
Sta17+400
Sta17+500
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Sta17+700
Sta17+800
Sta17+900
Slip
Big Crack
P
Legend
Crack(transverse, longitudinal)
Alligator Crack
B: Big Crack
M: Midium Cracks
S: Small Crack
DP Depression
PL Polishing
MOT Repaired by MOT
P P Patch
Rutting
Repair section
Legend
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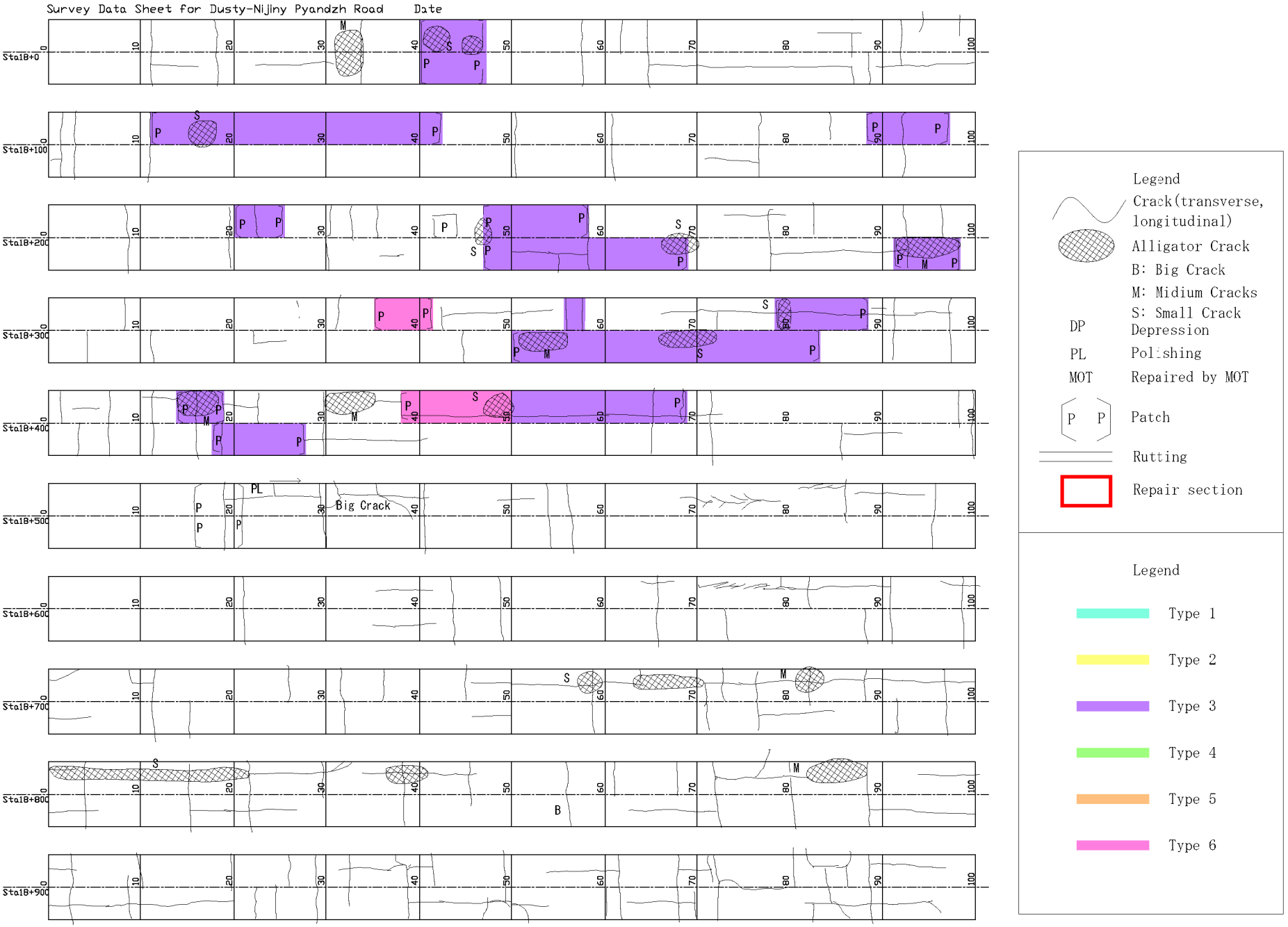
Type 5
Type 6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Date
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Sta18+200
Sta18+300
Sta18+400
Sta18+500
Sta18+600
Sta18+700
Sta18+800
Sta18+900
Big Crack
Legend
Crack(transverse, longitudinal)
Alligator Crack
B: Big Crack
M: Midium Cracks
S: Small Crack
DP Depression
PL Polishing
MOT Repaired by MOT
P P Patch
Rutting
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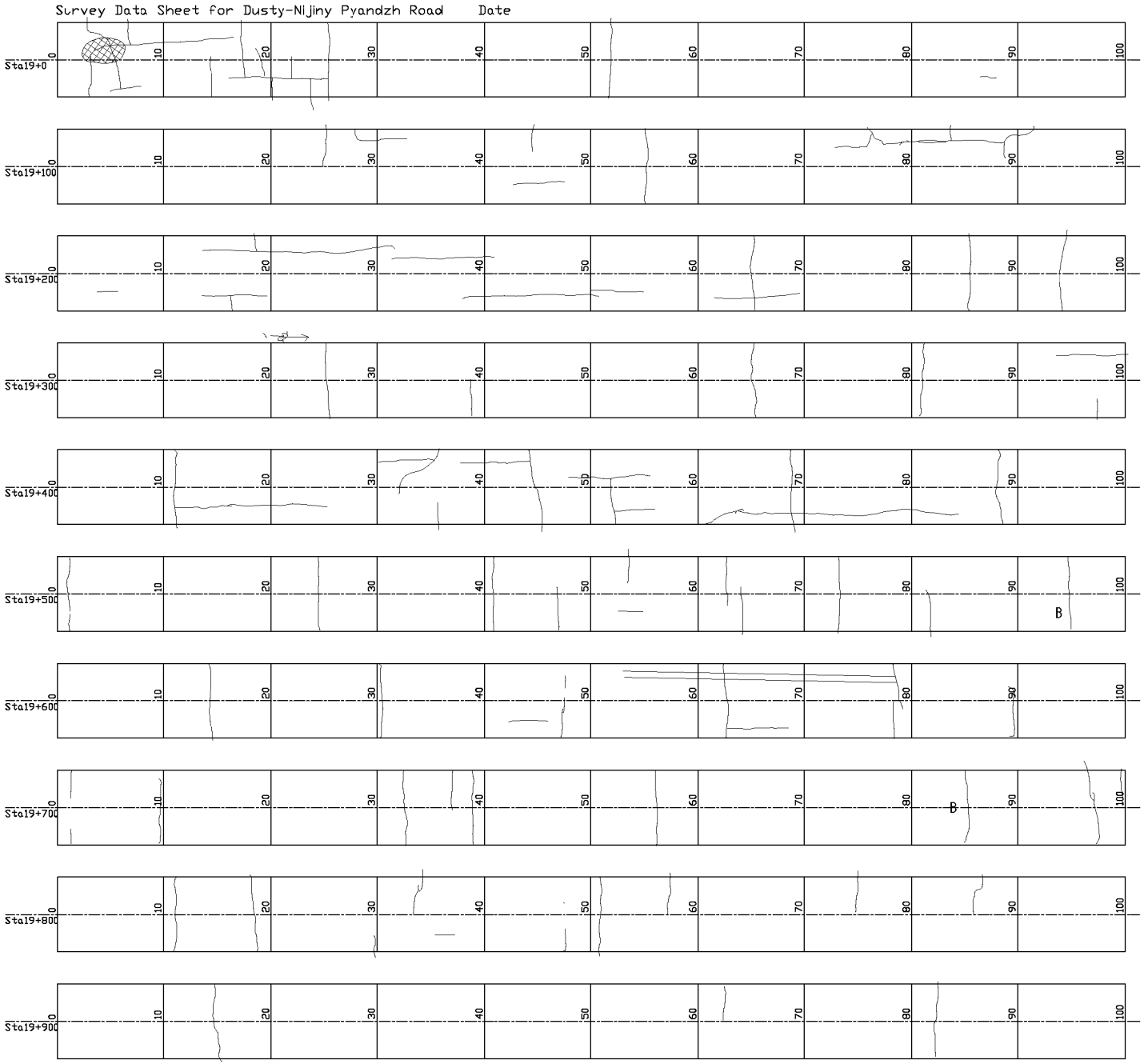
Type 6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Sta19+200
Sta19+300
Sta19+400
Sta19+500
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Sta19+900
0
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30
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60
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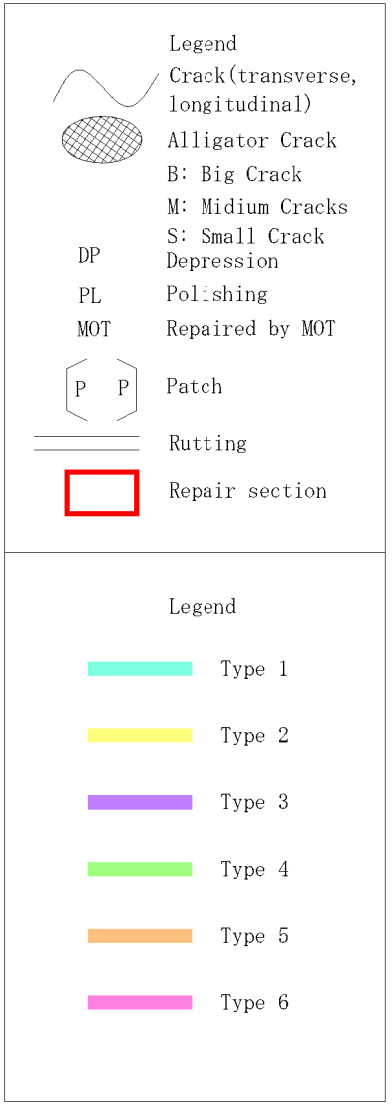
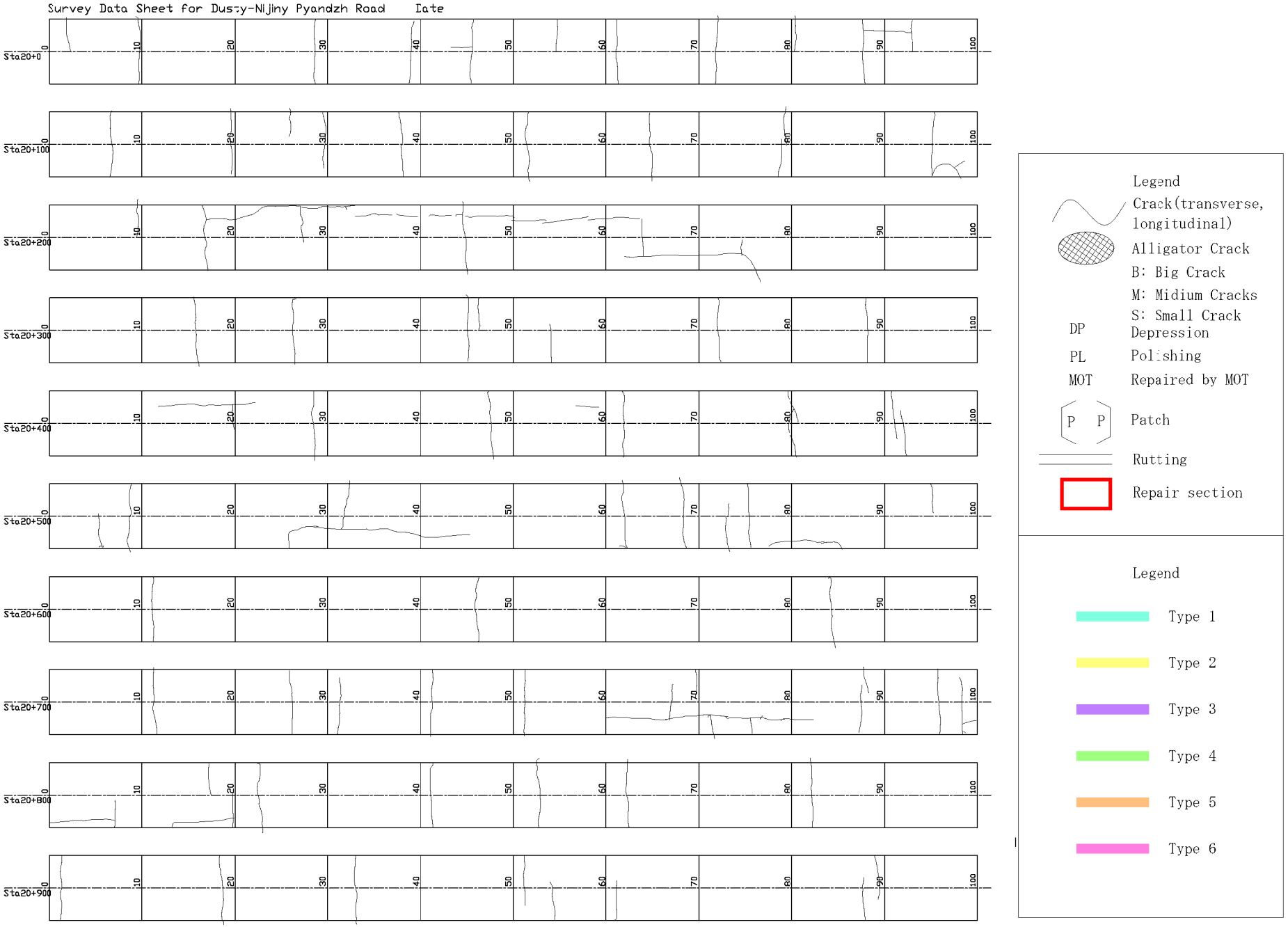
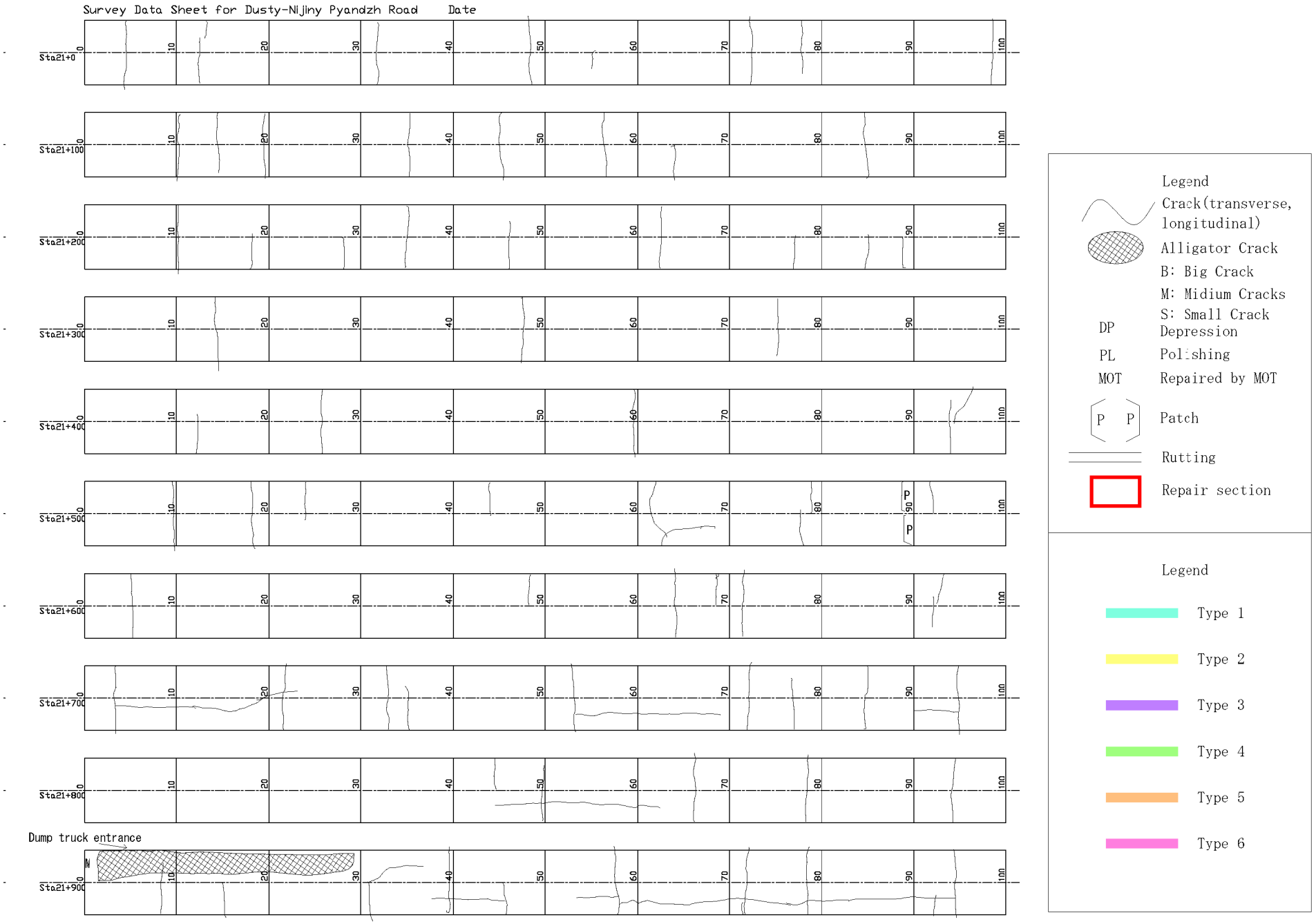
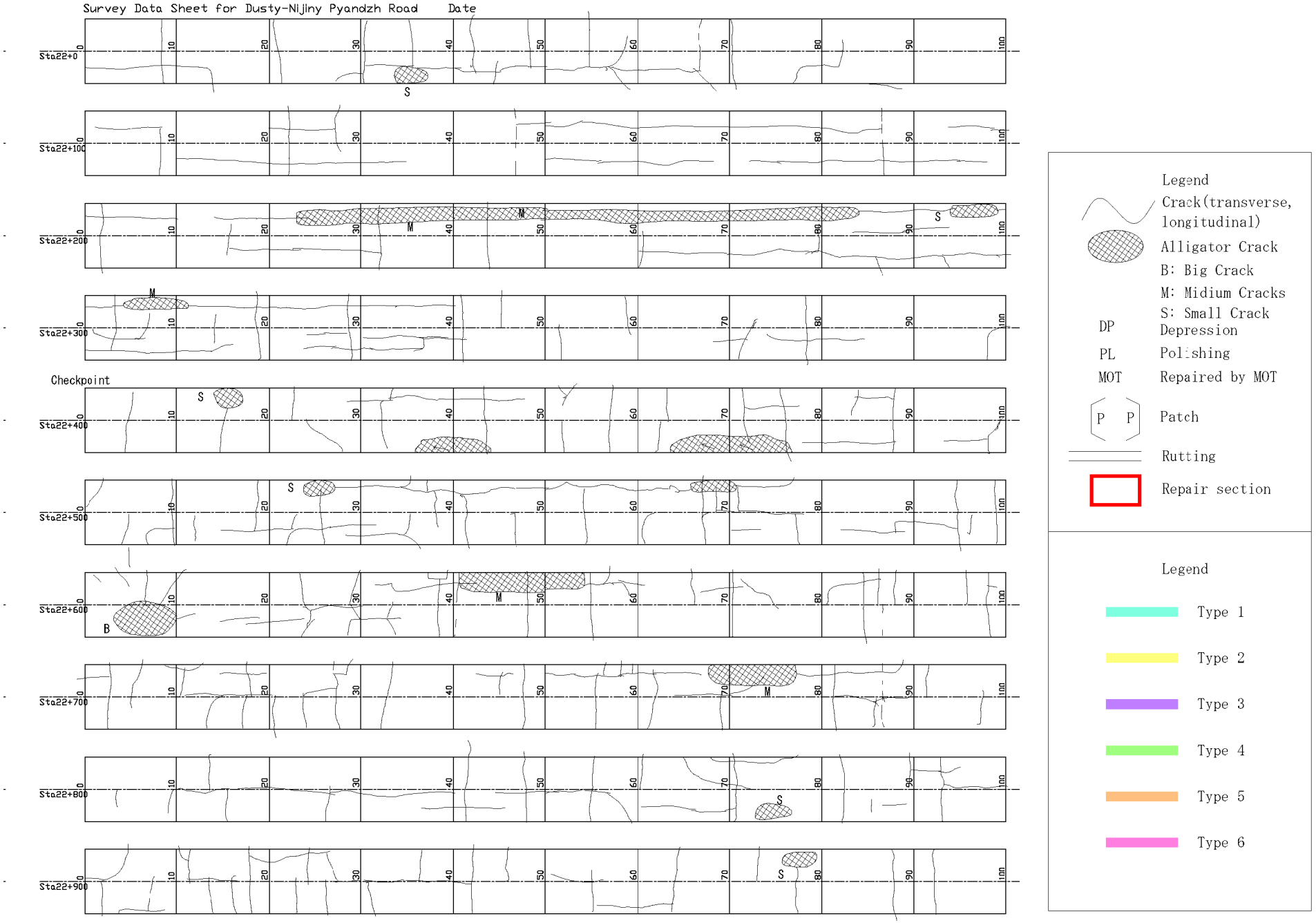
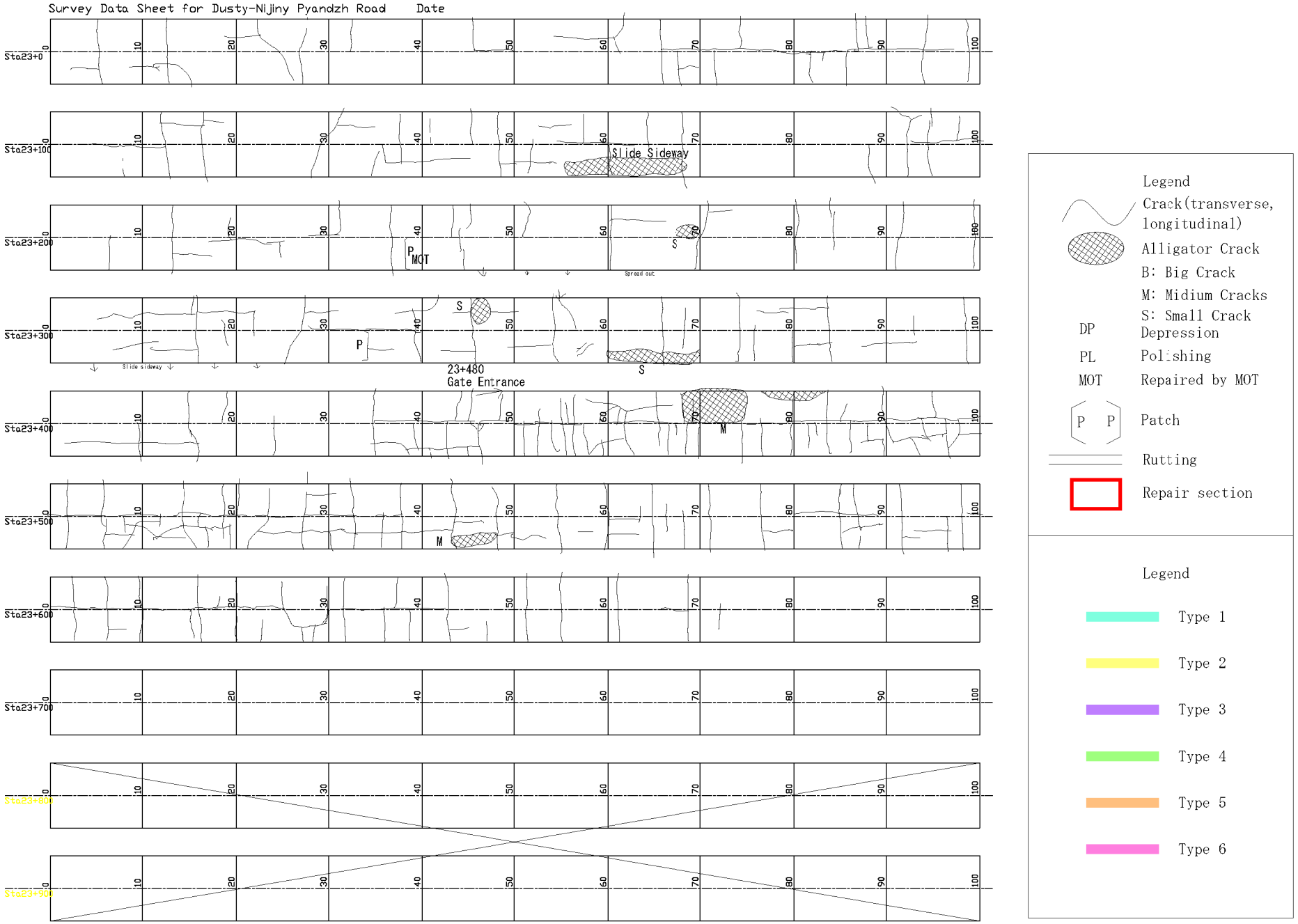
80
90
100
B
B


Legend
Crack(transverse, longitudinal)
Alligator Crack
B: Big Crack
M: Midium Cracks
S: Small Crack
DP Depression
PL Polishing
MOT Repaired by MOT
P P Patch
Rutting
Repair section
Legend
Type 1
Type 2
Type 3
Type 4
Type 5
Type 6


Survey Data Sheet for Dusty-Nijny Pyandzh Road Date
Sta20+0
Sta20+100
Sta20+200
Sta20+300
Sta20+400
Sta20+500
Sta20+600
Sta20+700
Sta20+800
Sta20+900
0
10
20
30
40
50
60
70
80
90
100
Legend
Crack(transverse, longitudinal)
Alligator Crack
B: Big Crack
M: Midium Cracks
S: Small Crack
DP Depression
PL Polishing
MOT Repaired by MOT
P P Patch
Rutting
Repair section
Legend
Type 1
Type 2
Type 3
Type 4
Type 5
Type 6


Survey Data Sheet for Dusty-Nijiny Pyandzh Road
Date
Sta21+0
Sta21+100
Sta21+200
Sta21+300
Sta21+400
Sta21+500
Sta21+600
Sta21+700
Sta21+800
Sta21+900
Dump truck entrance
M
P
P
Legend
Crack(transverse, longitudinal)
Alligator Crack
B: Big Crack
M: Midium Cracks
S: Small Crack
DP Depression
PL Polishing
MOT Repaired by MOT
P P Patch
Rutting
Repair section
Legend
Type 1
Type 2
Type 3
Type 4
Type 5
Type 6


Survey Data Sheet for Dusty-Nijiny Pyandzh Road
Date
Sta22+0
Sta22+100
Sta22+200
Sta22+300
Checkpoint
Sta22+400
Sta22+500
Sta22+600
Sta22+700
Sta22+800
Sta22+900
Legend
Crack(transverse, longitudinal)
Alligator Crack
B: Big Crack
M: Midium Cracks
S: Small Crack
DP Depression
PL Polishing
MOT Repaired by MOT
P P Patch
Rutting
Repair section
Legend
Type 1
Type 2
Type 3
Type 4
Type 5
Type 6


Survey Data Sheet for Dusty-Nijny Pyandzh Road Date
Sta23+0
Sta23+100
Slide Sideway
Sta23+200
P MOT
S
Spread out
Sta23+300
S
P
Slide sideway
23+480
Gate Entrance
S
Sta23+400
M
Sta23+500
M
Sta23+600
Sta23+700
Sta23+800
Sta23+900
Legend
Crack(transverse, longitudinal)
Alligator Crack
B: Big Crack
M: Midium Cracks
S: Small Crack
DP Depression
PL Polishing
MOT Repaired by MOT
P P Patch
Rutting
Repair section
Legend
Type 1
Type 2
Type 3
Type 4
Type 5
Type 6

Section	Length (m)	Direction	Repair Type												No Repair Section		Total Length of Each Repair Section (m)	Total of Damage Rate of Each Repair Section(%)	Total of Damage Rate(Repair + Unrepair)(%) (23,650m)
			1		2		3		4		5		6						
			Length (m)	Damage rate(%)	Length (m)	Damage rate(%)	Length (m)	Damage rate(%)	Length (m)	Damage rate(%)	Length (m)	Damage rate(%)	Length (m)	Damage rate(%)	Length (m)	Damage rate(%)			
1 (0+000 to 0+950)	950	Inbound													950.00	21.00			21.00
		Outbound													950.00	7.68			7.68
		Total													**1,900.00**	**14.34**			**14.34**
2 (0+950 to 2+350)	1,400	Inbound													1,400.00	14.36			14.36
		Outbound													1,400.00	17.79			17.79
		Total													**2,800.00**	**16.07**			**16.07**
3 (2+350 to 3+100)	750	Inbound													750.00	17.33			17.33
		Outbound													750.00	8.40			8.40
		Total													**1,500.00**	**12.87**			**12.87**
4 (3+100 to 7+000)	3,900	Inbound	890.00	13.82					920.00	6.36	260.00	4.35			1,830.00	3.44	2,070.00	8.18	6.99
		Outbound	960.00	9.79					500.00	4.40	180.00	4.72			2,260.00	5.80	1,640.00	6.30	6.18
		Total	**1,850.00**	**11.81**					**1,420.00**	**5.38**	**440.00**	**4.54**			**4,090.00**	**4.62**	**3,710.00**	**7.24**	**6.58**
5 (7+000 to 14+000)	7,000	Inbound	1,450.00	9.28	860.00	6.10			1,030.00	7.52	180.00	13.33			3,480.00	5.09	3,520.00	9.06	8.26
		Outbound	960.00	6.98	440.00	2.05			520.00	3.75	390.00	3.21			4,690.00	3.84	2,310.00	3.99	3.96
		Total	**2,410.00**	**8.13**	**1,300.00**	**4.08**			**1,550.00**	**5.64**	**570.00**	**8.27**			**8,170.00**	**4.46**	**5,830.00**	**6.53**	**6.11**
6 (14+000 to 22+000)	8,200	Inbound					870.00	3.91					60.00	10.83	7,270.00	5.80	930.00	7.37	6.85
		Outbound					250.00	6.20							7,950.00	5.01	250.00	6.20	5.60
		Total					1,120.00	5.05					**60.00**	**10.83**	**15,220.00**	**5.41**	**1,180.00**	**7.94**	**7.10**
7 (22+000 to 23+650)	1,450	Inbound													1,450.00	15.48			15.48
		Outbound													1,450.00	14.52			14.52
		Total													**2,900.00**	**15.00**			**15.00**
Total of Each Repair Type(%)			**4,260.00**	**9.82**	**1,300.00**	**4.73**	**1,120.00**	**4.42**	**2,970.00**	**5.98**	**1,010.00**	**8.42**	**60.00**	**10.83**	**36,580.00**	**7.44**	**10,720.00** (Total)	**7.45**	**7.44**

Attachment-4

Result of Axle Load Measurement

Attachment-4 Heavy Vehicle Weight Measurement Survey (Total Weight, Axle Load)／conducted on Jun. 10, 11, 20

Trailer

No	Wheel	Load	Front wheel load	Rear wheel load	Before ESAL	After ESAL	Total ESAL
1	6	18.16	1.65	3.30	0.00	0.14	0.14
2	5	20.39	2.27	4.53	0.01	0.39	0.40
3	5	20.39	2.27	4.53	0.01	0.39	0.40
4	5	24.78	2.75	5.51	0.01	0.85	0.87
5	5	31.40	3.49	6.98	0.03	2.20	2.24
6	5	16.40	1.82	3.64	0.00	0.16	0.17
7	6	19.06	1.73	3.47	0.00	0.17	0.17
8	6	19.46	1.77	3.54	0.00	0.18	0.18
9	6	27.75	2.52	5.05	0.01	0.75	0.76
10	6	21.00	1.91	3.82	0.00	0.25	0.25
11	5	36.26	4.03	8.06	0.06	3.92	3.98
12	5	28.40	3.16	6.31	0.02	1.47	1.50
13	4	34.24	4.89	9.78	0.13	6.38	6.52
14	4	34.36	4.91	9.82	0.13	6.47	6.61
15	4	33.70	4.81	9.63	0.12	5.99	6.11
16	4	34.01	4.86	9.72	0.13	6.21	6.34
17	6	35.16	3.20	6.39	0.02	1.94	1.96
18	6	35.83	3.26	6.51	0.03	2.09	2.12
19	5	37.97	4.22	8.44	0.07	4.71	4.78
20	4	36.62	5.23	10.46	0.17	8.35	8.53
21	4	34.96	4.99	9.99	0.14	6.94	7.08
22	4	47.96	6.85	13.70	0.51	24.57	25.08
23	5	32.47	3.61	7.22	0.04	2.52	2.56
24	6	37.95	3.45	6.90	0.03	2.63	2.67
25	5	18.96	2.11	4.21	0.00	0.29	0.30
Total		737.64					91.71
Average per veh		29.51					3.67

Truck

No	Wheel	Load	Front wheel load	Rear wheel load	Before ESAL	After ESAL	Total ESAL
1	4	45.02	6.43	12.86	0.40	19.08	19.48
2	4	33.63	4.80	9.61	0.12	5.94	6.06
3	4	33.24	4.75	9.50	0.12	5.67	5.79
4	4	33.18	4.74	9.48	0.12	5.63	5.75
5	4	32.47	4.64	9.28	0.11	5.16	5.27
6	4	32.00	4.57	9.14	0.10	4.87	4.97
7	4	29.72	4.25	8.49	0.08	3.62	3.70
8	4	29.47	4.21	8.42	0.07	3.50	3.58
9	4	28.00	4.00	8.00	0.06	2.85	2.91
10	4	22.49	3.21	6.43	0.02	1.19	1.21
11	3	15.30	3.06	6.12	0.02	0.65	0.67
12	3	14.80	2.96	5.92	0.02	0.57	0.59
13	4	18.32	2.62	5.23	0.01	0.52	0.53
14	4	18.10	2.59	5.17	0.01	0.50	0.51
15	4	18.05	2.58	5.16	0.01	0.49	0.50
16	4	18.02	2.57	5.15	0.01	0.49	0.50
17	4	18.00	2.57	5.14	0.01	0.49	0.50
18	4	18.00	2.57	5.14	0.01	0.49	0.50
19	4	18.00	2.57	5.14	0.01	0.49	0.50
20	4	18.00	2.57	5.14	0.01	0.49	0.50
21	4	17.46	2.49	4.99	0.01	0.43	0.44
22	4	17.34	2.48	4.95	0.01	0.42	0.43
23	4	17.24	2.46	4.93	0.01	0.41	0.42
24	4	16.93	2.42	4.84	0.01	0.38	0.39
25	4	16.72	2.39	4.78	0.01	0.36	0.37
26	4	16.66	2.38	4.76	0.01	0.36	0.37
27	4	16.60	2.37	4.74	0.01	0.35	0.36
28	4	16.55	2.36	4.73	0.01	0.35	0.36
29	4	16.55	2.36	4.73	0.01	0.35	0.36
30	4	16.54	2.36	4.73	0.01	0.35	0.35
31	4	16.44	2.35	4.70	0.01	0.34	0.35
32	4	16.42	2.35	4.69	0.01	0.34	0.34
33	4	16.42	2.35	4.69	0.01	0.34	0.34
34	4	16.39	2.34	4.68	0.01	0.34	0.34
35	4	16.39	2.34	4.68	0.01	0.34	0.34
36	4	16.24	2.32	4.64	0.01	0.32	0.33
37	4	16.21	2.32	4.63	0.01	0.32	0.33
38	4	15.90	2.27	4.54	0.01	0.30	0.30
39	4	15.39	2.20	4.40	0.01	0.26	0.27
40	4	15.39	2.20	4.40	0.01	0.26	0.27
41	4	15.09	2.16	4.31	0.01	0.24	0.25
42	4	15.09	2.16	4.31	0.01	0.24	0.25
43	4	13.90	1.99	3.97	0.00	0.17	0.18
44	5	14.48	1.61	3.22	0.00	0.10	0.10
45	4	27.60	3.94	7.89	0.06	2.69	2.75
46	4	14.22	2.03	4.06	0.00	0.19	0.19
		923.97				Total	74.78
		20.09					1.63

Attachment-5

Technical Note-1

Republic of Tajikistan

Ex-Post Situation Survey
for the Project for the Improvement of
Dusty-Nizhniy Pyandzh Road

Technical Data-1

June 2014

Japan International Cooperation Agency
CTI Engineering International Co., Ltd.

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1. First Survey Result in Tajikistan

1.1 Confirmation of Damage Condition

The damage condition of the whole target roads has been grasped from the inventory survey. See the table of the inventory file 1. As a result, the damage has been classified as the following.

- Transverse crack(cross section direction)
- Longitudinal crack(Profile direction)
- Alligator crack（Record in 3 steps as Big/Medium/Small）
- Damaged by the sliding of the AS pavement
- Crescent-shaped gaps/cracks considered to be the initial stage of the sliding

Damage condition of the each section and its characteristics are as in the attachment-1.

1.2 Survey for the Grasp of the Damage Factor

In order to grasp the damage factors, the confirmation of the subgrade, cement stabilized base at the severe damage location and lesser location had been conducted. Also the physical tests of the collected samplings are conducted if required. The details are as followings.

① Test date: 6th May, 2014

Test location: Sta. 12+607 (shoulder of the out-bound lane) good road surface condition section

Pavement Structure			Strength Test		Remark
Structure	Design	Measure	Design	Measure value	
AS thickness	3cm	3cm	－	－	
Sub course	15cm	15cm	30	Cement stabilized base course top CBR: 300,578,590	Material: Sand + pebble Collection of sample
Subgrade	－	30cm	5.9	Subgrade CBR: 15,9,12	Clay: yellow Collection of sample
	－	－	5.9	Road Top－50cmCBR: 28,9,13	Clay: dark brown Collection of sample

② Test date: 9th May, 2014

Test location: Sta. 6+352 (Shoulder of out-bound lane) good road surface condition section

Pavement Structure			Strength Test		Remark
Structure	Design	Measure	Design	Measure value	
AS thickness	3cm	3cm	－	－	－
Base course	15cm	15cm	30	Cement stabilized base course top CBR: 118,128,118	Material: Sand + pebble Collection of sample
Subgrade	－	40cm	8.7	Sub-grade top CBR: 12,19,12	Clay: yellow Collection of sample
				Road top－50cm CBR: 7,9,13	
		62cm	8.7		Base course of old road: sand mixed pebble
				Road top－110cmCBR：31	Subgrade of old road: sand Collection of sample

Rutting depth: 1.3cm, no underground water

③ Test date: 9th May 2014

Test location: Sta.4+480 (in-bound lane) damage section.

Pavement Structure			Strength Test		Remark
Structure	Design	Measure	Design	Measure value	
As thickness	5cm	5cm	—	—	—
Base course	25cm	13cm	30	Cement stabilized base course CBR: 118,26,21	Material: Sand + pebble Collection of sample
		9cm	30	Cement stabilized sub-base course CBR: 10,10,10	Material: clay(yellow) Collection of sample
Existing As pavement		10cm	—	—	—
Subgrade	—	—	8.7	Road－46cm CBR: 80,112,112	Base course of old road: sand mixed boulder Collection of sample

④ Test date: 10th May, 2014

Test location: Sta. 2+416(in-bound lane) damage section

Pavement Structure			Strength Test		Remark
Structure	Design	Measure	Design	Measure value	
As thickness	10cm	8cm	—	—	Collection of sample
Base course	—	9cm	—	—	Material: gravel
	35cm	12cm	30	Cement stabilized base course Base course top CBR: 118,112,128	Material: sand + pebble Collection of sample
		18cm	30	Cement stabilized sub-base course Road top-29cm CBR: 23,63,49	Material: sand + pebble
Subgrade	—	—	3	Road top-46cm CBR: 21,21,21	Sand

Rutting depth of carriageway: middle lane side 0.8cm、shoulder side 3.6cm

Middle lane side 0.6cm、shoulder side 3.9cm

⑤ Test date: 10th May, 2014

Test location: Sta. 2+425 (out-bound shoulder) damage section

Pavement Structure			Strength Test		Remark
Structure	Design	Measure	Design	Measure value	
As thickness	3cm	4.5cm	—	—	—
Base course	15cm	12cm	30	Cement stabilized base course Base course top CBR: 26,23,43,34	Material: sand + pebble
Subgrade	—	40cm	3	Subgrade top CBR: 12,13,10	Clay: yellow(fill)
		55cm	3	Road top -110cm CBR: 6,6	Sand(mixed with dust)

No underground water (-110cm from the road surface)

⑥ Test date: 10th May, 2014

Test location: Sta. 15+458(in-bound lane) (pavement sliding) section

Pavement Structure			Strength Test		Remark
Structure	Design	Measure	Design	Measure value	
As	10cm	10cm	—	—	Grooving process according

thickness					to the repair record but cannot confirm
Base course	30cm	Not measured	30	Cement stabilized base course Base course top CBR: too hard to measure	Material: sand + pebble

⑦ Test date: 10th May, 2014

Test location: Sta. 5+030(middle of lane) damage section

Pavement Structure			Strength Test		Remark
Structure	Design	Measure	Design	Measure value	
As thickness	5cm	5cm	—	—	—
Base course	25cm	16.5cm	30	Cement stabilized base course Base course top CBR: 21,31,34	Material: sand + Pebble
		3.5cm	30	Cement stabilized sub-base course Top of 3.5cm CBR: 13,17,36	Material: Clay(yellow) Collection of sample
Existing As pavement		—	—	—	—

⑧ Test date:12th May, 2014

Test location: Sta. 1+317(middle lane) damage section

Pavement Structure			Strength Test		Remark
Structure	Design	Measure	Design	Measure value	
As thickness	8cm	8cm	—	—	—
Base course	30cm	15.0cm	30	Cement stabilized base course Top CBR: error, error, 566%	Material: sand +pebble Collection of sample
		15.0cm	30	Cement stabilized sub-base	Material: sand + pebble
Subgrade		27cm	5.2	Top CBR: 17,19,19	Clay: dark brown
		—	5.2	Top CBR: 60,67,52	Clay: red Collection of sample

⑨ Test date: 12th May, 2014

Test location: Sta. 5+028 (Middle of lane) good section (next to damage section)

Pavement Structure			Strength Test		Remark
Structure	Design	Measure	Design	Measure value	
As thickness	5cm	5cm	—	—	—
Base course	25cm	17.5cm	30	Cement stabilized base course Top of base course CBR: 195%, 209%, error	Material: sand + pebble
		4.0cm	30	Cement stabilized sub-base	Material: clay (yellow)

The CBR value above was measured by using the Simple Soil Strength Tester.

1.3 Traffic Volume Survey

The traffic volume survey was conducted near the Sta.2+400 and Sta. 3+300 for two days on May 8th, 9th .The result is as below.

Sta.2+400

	To Dushanbe	To Afghanistan	Total (per two days)	Total (per one day)
Car	3,993	3,700	7,693	3,846
Pick-up	2	3	5	2
Bus/Mini Bus	128	219	347	173
Truck	160	186	346	173
Trailer	122	104	226	113
Total	4,405	4,212	8,617	4,307

Sta.3+300

	To Dushanbe	To Afghanistan	Total (per two days)	Total (per one day)
Car	1,842	1,941	3,783	1,891
Pick-up	18	14	32	16
Bus/Mini Bus	30	36	66	33
Truck	166	114	280	140
Trailer	196	95	291	145
Total	2,252	2,200	4,452	2,225

1.4 Axle Load Survey

Installation of the easy Vehicle Weight Measure Device since 2011 in front of the gate at the border with Afghanistan to measure the over load of large vehicles. The truck scale had been placed since 2014 and the measurement is conducting 24 hours. Nevertheless, the measurement of the vehicle weight was started in 2006.

Truck Scale Placed in front of the Border Gate

Vehicles Waiting for the Night Passing

Currently, there is a load limit restriction carrying on the road MD9 (Dushanbe-Kurgan Tyube lower Pianj border). According to the hearing survey at the weight measurement administration office, there is a measure to unload overweight vehicle.

Load Limit on MD9

Period	All seasons (except summer)	Summer(May to August/ 10AM to 8PM) ※At day which the temperature is over 25℃
Total Load	< 40tonnes	
Axle Load	2 axles: 7.2tonnes to less than 10.8tonnes 3axles: 9.6tonnes to less than 13.5tonnes	Axle load: < 6tonnes

Vehicles are waiting near the gate of Afghanistan side at the border till night and the heavy vehicles are normally travelling even at daytime from Tajikistan side at the present. The vehicles which are waiting for the night travelling are usually loading with cement from the Afghanistan side. Fuel and agriculture products were transported from Tajikistan. The transportation from Afghanistan is much more than the transportation from Tajikistan.

Furthermore, the survey was conducted for 24 hours. As a result, the load limit as described above is abiding until now. However, it was mentioned in the defect liability inspection report that the overload vehicles of about 70tonnes were passing through the target road.

The results of vehicle weight measurement (total weight, axle number) are shown in the attachment-2.

1.5 Material Procurement

Procurement survey had been done for the materials required for the urgent repair.

Crusher Run (Rumi Quarry)

Crusher run has been produced from the river gravel in Rumi village 30km north of the target road at the start point by the private company.

The crusher run produced has only size dimension of 5mm×15mm, 5mm×20mm.

The production volume is 300t~400t／days possible to produce year round. The price is as following.

Price of Crusher Run

Material	Price(m3)	Remark
5mm×15mm	80Somoni	Transportation fee of 25 Somoni/km is calculated.
5mm×20mm	60Somoni	Possess 3 dump trucks which can load up to 16m3 each.

Plant

Aggregate

Crusher Run（Jirikuru quarry）

Crusher run has been produced from the river gravel along the river 14km south west of Rumi village 30km north of the target road at the start point by the private company. The crushing plant was bought from the World Kaihatsu Kogyo which was subcontracted from Dai Nippon Construction by the private company.

The product of crusher run has 3 types of size dimension of 0mm to 5mm、0mm to 15mm、0mm to 25m. Size of 40mm is available only by order. The product volume is 100t to 120t per hour and the production is possible year round. The prices are as following.

Price of the Crusher Run

Material	Price(m3)	Remark
0mm to 5mm	45Somoni	Pick-up unit price is excluding the transportation fee.
0mm to 15mm	45Somoni	
0mm to 25mm	35Somoni	

Plant-1

Plant-2

Collection of Aggregate

Straight Asphalt

Straight Asphalt can be procured from the Qumsangir Salosa company which is near Dusti city of the target road.

Construction Equipment / Plant

It has been confirmed that the Rohid Tajik Company owns the following construction equipment / plant.

List of Equipment / Plant owned by Rohid Tajik Company

Name of Equipment / Plant	Specifications
Asphalt Plant	1260 ton / day
Milling Machine	120 ton / hr
Asphalt finisher	
Macadam Roller	16 ton
Tire Roller	13 ton
Small Roller	4 ton
Motor Grader	

1.6 The Budget of the Qumsangir Road Maintenance Office (SEHM)

The budget and the expense for the road maintenance from 2011 to 2013 of 3 years is 260,222Somoni (or 5,200,000¥).

1.7 Soil Test Result at MOT

Table of Soil Test Results in Tajikistan (MOT)

Sta	Component	Depth(from pavement)	CBR (%)	PL,LL,PI	Moisture content (%)	Usage
12+607	Subgrade	-30cm	11.9	NP	11.9	
		-50cm	16.7	NP	10.9	
6+352	Subgrade	-50cm	11.4	32.4, 20.8, 11.6	11.8	
		-110cm	19.59	NP	4.0	
4+480	Subgrade	-46cm	19.59	21.8, 17.2, 4.6	6.5	
2+425	Subgrade	-50cm	10.3	NP	15.7	
5+030	Cement stabilized sub-base	Upper layer		NP	5.7	
		Lower layer		32.7, 20.3, 12.4	12.5	
1+317	Subgrade	-70cm	18.9	NP	4.5	

Note NP: Non-Plastic

Comparison of Clegg Hummer and CBR Value

Test Location		Clegg Hummer	CBR (%)
12+607	-30cm	12(15,9,12)	11.9
	-50cm	16.6(28,9,13)	16.7
6+352	-50cm	16.6(28,9,13)	11.4
	-110cm	31(31)	19.59
4+480	-46cm	101(80,112,112)	19.59
2+425	-50cm	11.6(12,13,10)	10.3
1+317	-70cm	62(67,67,52)	18.9

2. The Differences of the Traffic Load

2.1 Traffic Load (W_{18}) of Dusti-Nizhniy Pyandzh Road

Traffic load of the approach road of Nizhniy Pyandzh Bridge (open to the public in spring 2005) which is located at the end of the project has been adopted for this project.

Traffic road condition of this project

Day traffic volume	1,000vehicles per day
Rate of mixed heavy vehicles	7%→1,000×7%=70vehicles per day
Equivalent Single Axle Load (ESAL)(18kip) of heavy vehicle	0.931
Service period (10 years) ESAL	70/2×0.931×365day×10years =118,940

2.2 Comparison of the Traffic Load (W_{18}) within the Kurgan Tyube-Dusti Road

Traffic Load Comparison within the Kurgan Tyube - Dusti Road

Day traffic volume	Kurgan Tyube city	9,671vehicles per day
	Kurgan Tyube - Rumi	5,740vehicles per day
	Rumi – Dusti	6,920vehicles per day
Service period(10 years) ESAL	Kurgan Tyube city	20,400,000(※176 times)
	Kurgan Tyube - Rumi	16,500,000(※139 times)
	Rumi – Dusti	20,100,000(※169 times)

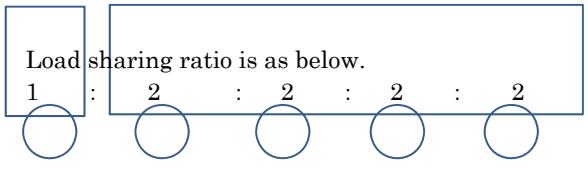
※ / 118,940

2.3 Traffic Load Prediction from the Current Traffic Volume

2.3.1 Estimation of Equivalent Single Axle Load (ESAL)(18kip) of Trailer

The ESAL values of trailer and truck (18kip) were calculated by using the result of axle load survey in June 10th, 11th, 2014 as per the attachment-2. The target vehicles of this survey were the vehicles with freight cargo, thus the ESAL values of trailer and truck without freight cargo were computed based on the 70% of the average of the vehicle's weight from the axle load survey as follows.

Vehicle weight 29.5ton×70%=20.6ton

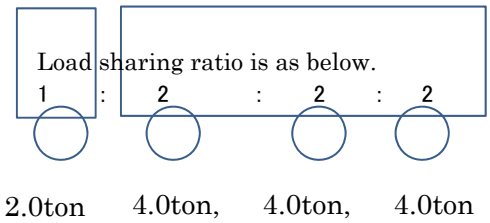


2.3ton 4.6ton, 4.6ton, 4.6ton, 4.6ton

ESAL value of trailer without much cargo

: $(2.3/8.1)^4 + (4.6/8.1)^4 \times 4 = 0.423$

Vehicle weight 20ton × 70%=14ton



ESAL value of truck without much load

: $(2.0/8.1)^4 + (4.0/8.1)^4 \times 3 = 0.182$

2.3.2 Estimation of ESAL value (18kip)

ESAL values (18kip) from 2009 to 2018 are estimated based on the traffic survey on 8th and 9th May, 2014 and the economic growth rate per year computed by the World Bank. The ESAL values (18kip) computed in the attachment-2 are used for the half of the traffic volume and the ESAL values (18kip) computed in 2.3.1 are used for another half of the traffic volume.

Predicted ESAL Value from Year 2009 to Year 2018

	Economic Grow Rate (%)	Day Traffic Volume(Heavy Vehicle)	Annual Traffic Volume(Heavy Vehicle)	Truck Mixed Rate (0.634)	Trailer Mixed Rate(0.366)
2009	3.9	208	75,815	48,067	27,748
2010	6.5	216	78,722	49,941	28,831
2011	7.4	230	83,892	53,188	30,704
2012	7.5	247	90,100	57,123	32,977
2013	7.4	265	96,858	61,408	35,450
2014	6.2	285	104,025	65,952	38,073
2015	6.2	303	110,475	70,041	40,434
2016	6.2	321	117,324	74,383	42,941
2017	6.2	341	124,598	78,995	45,603
2018	6.2	363	132,323	83,893	48,430
Sub total			1,014,181	642,991	371,190
				×1.63/2/2	×3.67/2/2
				×0.182/2/2	×0.423/2/2
Total ESAL	1,342,190(11.3times/ original plan)			582,550	759,640

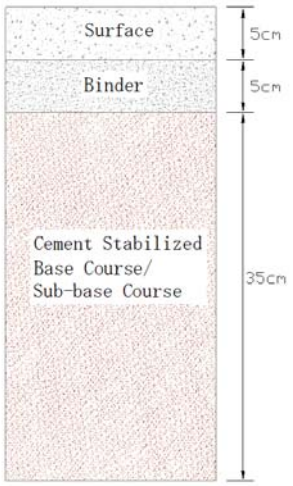
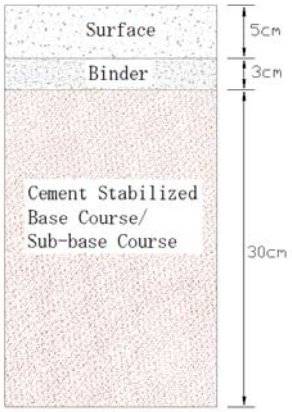
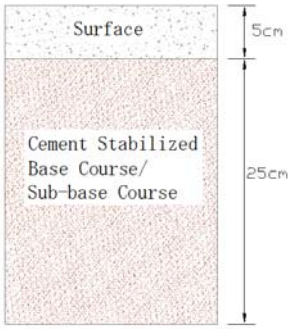
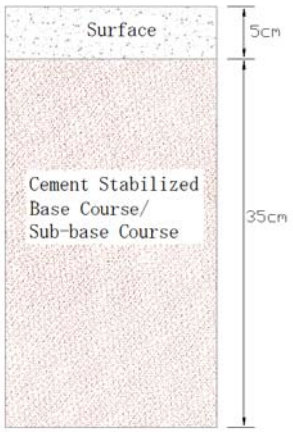
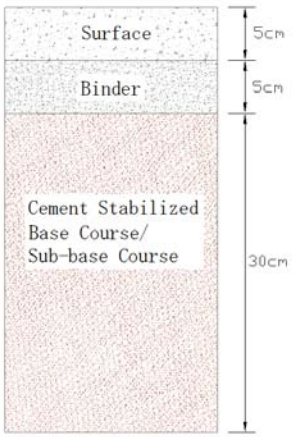
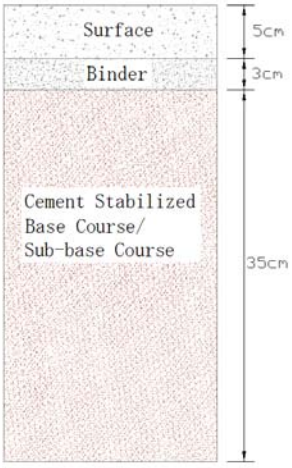
3. Pavement Evaluation

3.1 Current Condition of the Pavement Structure

Initial Required Pavement Structure Number (SN)

	1,3	2	4	5	6	7
Accumulated 18kip Equivalent Single Axle Load loading number(W18)	118,940					
Standard Deviation（Z0）	-0.841					
Standard Error	0.45					
Performance Service Index ΔPSI	1.7					
Mp	4,500	7,800	13,050	8,850	5,700	6,150
CBR	3.0	5.2	8.7	5.9	3.8	4.1
Required Structural Number(SN)	2.755	2.288	1.819	2.121	2.515	2.442

Pavement Structures

		
Section1,3	Section2	Section4
		
Section5	Section6	Section7

Layer Coefficient of the Pavement

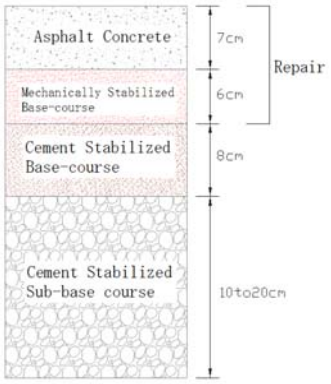
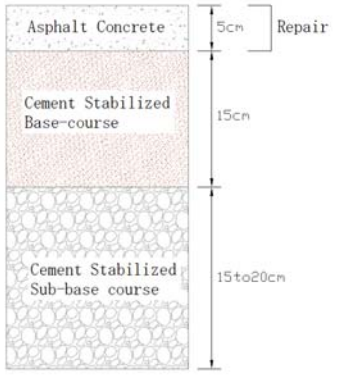
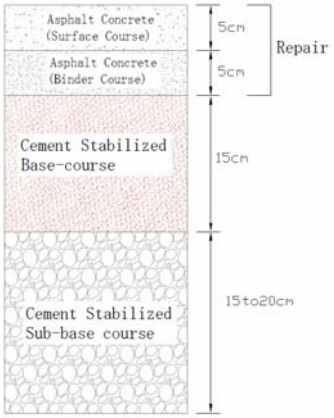
Pavement material	Layer Coefficient
Asphalt Surface Course	0.39
Bituminous Stabilized Sub-base	0.30
Cement Stabilized Sub-base	0.108
Granular Upper Sub-base(CBR=80)	0.135
Granular Lower Sub-base(CBR=30)	0.108

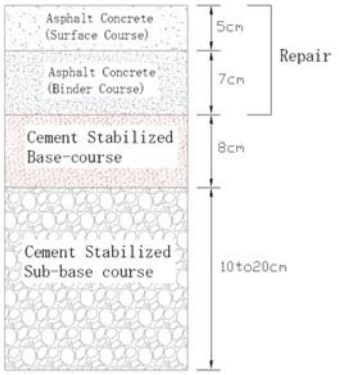
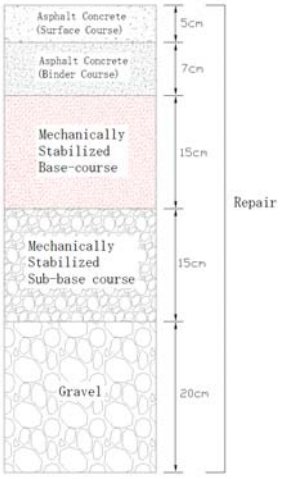
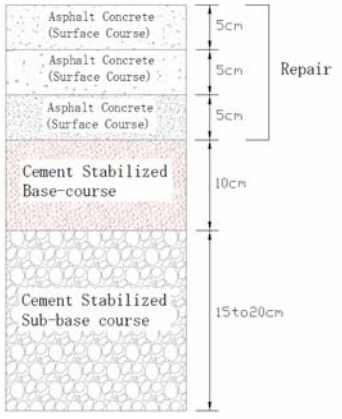
Pavement Structure Number

	Required Pavement Structure Number(SN)	Own Pavement Structure Number(SN)	Check
Section – 1,3	2.755	2.846	OK
Section – 2	2.288	2.398	OK
Section – 4	1.819	1.831	OK
Section – 5	2.121	2.256	OK
Section – 6	2.515	2.634	OK
Section – 7	2.442	2.610	OK

After the construction completed based on the initial design, the defects had been found during the defect liability period. The repair was done based on the following types.

Repair Types during the Defect Liability Period

		
Type-1	Type-2	Type-3

		
Type-4	Type-5	Type-6

3.2 Pavement Life Prediction from the SN Value and the Current Traffic Volume

The ESAL is calculated from the CBR of subgrade and Own SN of each section. The year achieved (design period) of ESAL value is calculated from the current traffic volume as below. Most of the design period of each section and type is less than 5 years.

Pavement Life Prediction from the SN Value and the Current Traffic Volume

Pavement type &SN Value / Type of Subgrade		Unrepair	Type-1	Type-2	Type-3	Type-4	Type-5	Type-6
Section1,3 CBR:3.0	SN value	2.85	2.69	2.47	2.85	3.00	3.72	3.40
	ESAL Value	146	103	62	146	198	735	423
	Service Period	2 years	1 year	1 year	2 years	2 years	7 years	4 years
Section 2 CBR:5.2	SN value	2.40	2.39	2.17	2.55	2.70	3.72	3.10
	ESAL Value	186	181	102	267	377	2,634	867
	Service Period	2 years	2 years	1 year	3 years	4 years	16years	7 years
Section 4 CBR:8.7	SN value	1.83	2.05	1.83	2.21	2.36	3.72	3.19
	ESAL Value	123	239	123	374	554	8,692	3,400
	Service Period	2 years	3 years	2 years	4 years	5 years	31 years	19 years
Section 5 CBR:5.9	SN value	2.26	2.48	2.26	2.63	2.79	3.72	3.19
	ESAL Value	174	303	174	431	616	3,531	1,381
	Service Period	2 years	3 years	2 years	4 years	6 years	19 years	10 years
Section 6 CBR:3.8	SN value	2.63	2.48	2.26	2.63	2.79	3.72	3.19
	ESAL Value	155	109	63	155	222	1,272	498
	Service Period	2 years	1 year	1 year	2 years	3 years	10 years	5 years
Section 7 CBR:4.1	SN value	2.61	2.61	2.38	2.76	2.91	3.72	3.32
	ESAL Value	177	177	102	248	341	1,518	756
	Service Period	2 years	3 years	1 year	3 years	4 years	11 years	7 years

Note) ESAL value (×1000)

3.3 The Difference between the Design Pavement Strength and the Current Pavement Strength

Based on the trial digging of the cement stabilized sub-base at two locations Sta.4+480 and Sta.5+029 of the first survey, the followings are confirmed:

- The design strength of the cement stabilized sand + boulder at the damage section is not secured. The condition of loosen due to the pavement damage has been confirmed
- The moisture content of cement stabilized lower sub-base layer is high and clayey. The cement stabilized sub-base course is divided into 2 layers which are sandy and gravel base course and clayey sub-base course. The strength of the entire base course seems to be not enough.

Cement Stabilized Base course of Sand + Gravel

Cement Stabilized Sub-base of Clay

The followings are confirmed in MOT laboratory.

Comparison of the Upper Sub-base and Lower Sub-base Course Layer

	Upper Sub-base Course	Lower Sub-base course
PL, LL, PI	Non plastic	32.7, 20.3, 12.4
Moisture Content	5.7	12.5
Fine（<0.075mm）	<5%	>20%

The base course is of sandy soil, where the sub base-course is having highly PL 32.7% and classified as silt. The moisture content is high and the fine grain is more than 20%.

The subgrade is extremely firm at the existing AS pavement. The average 3 times of clegg hummer is over 100%. Thus, the damage at these two locations seemed to be caused by the heavy traffic load and the stagnated water on the existing AS pavement penetrated from the damaged surface.

However, the causes of the damages could not be concluded because there are still many things to clarify

such as the impact of the thin clayey sub-base course to entire pavement and the variation of the quality of the cement stabilized base-course.

From the hearing survey, upper sub-base course and the lower sub-base course material were taken from the same borrow pit (Sta. 13). The cause for the large percentage of the fine particle mixed in the sub-base layer were unclear whether during the construction the fine particle were mixed in the sub-base course or the unevenness of the quality of the borrow pit.

3.4 Excessive Traffic Load in the Past

There were a report of the trailer full loaded with cement having total weight of 69.3 ton (axle load 13.86 ton) were passing through the target road after the completion of road construction in the defect liability inspection report in 2013. The ESAL value of the trailer in the past in Chapter 2.3.2 is only 3.67 but the ESAL value of axle load 13.86ton was 42.8 which is by far higher than the current value. This is one factor to accelerate the damage of the road surface.

3.5 Conclusion

The main cause of the damages on the target road seems to be by the increased traffic volume (11 times of designed ESAL value).

It was also confirmed that the cement stabilized sub-base didn't attain the design strength. The deterioration of the sub-base seems to be caused by the seepage water from cracks caused by the excessive increased traffic volume. However, the impact of this deteriorated clayey sub-base cannot be so big since the thickness of the sub-base is very thin.

Further, CBR value of base-course on the good section exceeds 3 times of design (30%) and the lengthening of the service period can be expected. The prevention of the seepage water from the cracks is very important for the maintenance.

4. Urgent Repair of the Damaged Sections

4.1 Selection of the Repair Location (Section with traffic safety problem at Grade Section and Flat Section)

Grade Section

	Start Point (Sta)	End point (Sta)	Lane	Length	Area	Usage
1	14+420	14+460	Both sides	40m	280.0m2	
2	15+448	15+463	North side	15m	52.5m2	
Total					332.5m2	US10,000～US46,000 (US3,000 ～ US14,000 /100m^2)

Flat Section

	Start Point (Sta)	End Point (Sta)	Lane	Length	Area	
1	4+475	4+508	North side	33m	115.5m2	
2	5+023	5+036	Both sides	13m	91.0m2	
3	6+895	6+912	North side	17m	59.5m2	
4	9+204	9+216	North side	12m	42.0m2	
5	10+610	10+620	North side	10m	35.0m2	
6	11+860	11+870	North side	10m	35.0m2	
7	12+050	12+060	South side	10m	35.0m2	
Total					413m2	US12,390～US41,300 (US3,000～US10,000 /100m^2)

4.2 Current Condition of the Selected Locations (Damage condition, Pavement Structure, Survey Result are summarized in the table)

Grade Section

	No	Location (Start) (End)	Section	Components	Condition
Grade Location	1	14+420 14+460	6	10cm(AS Concrete) 30cm(Sub-base)	Asphalt pavement is sliding significantly though the condition under the sub-base is firm.
	2	15+448 15+463			
Flat Location	1	4+475 4+508	4	5cm(AS Concrete) 25cm(Sub-base)	Surface is drastically deformed along with the alligator crack. Cement stabilized sub-base is spouting out which interrupts the traffic.
	2	5+023 5+036			
	3	6+895 6+912			Surface is drastically deformed along with the alligator crack which interrupts the traffic. The deformation is expected to be drastic in future.
	4	9+204 9+216	5	5cm(AS Concrete) 35cm(Sub-base)	
	5	10+610 10+620			

	6	11+860 11+870			
	7	12+050 12+060			

4.3 Examination of the Permanent Repair Cross Section

(Large scale repair)

The urgent repair locations are selected from the section4, 5, 6. and the pavement cross sections of the 3 sections are examined. To satisfy the required SN which was calculated from the ESAL (10 years) in Chapter 2.3.2, it is necessary to add the AS binder course of 13cm to 15 cm.

		Section4 (CBR: 8.7%)		Section5 (CBR: 5.9%)		Section6 (CBR: 3.8%)	
		Thickness(inch)	SN	Thickness(inch)	SN	Thickness(inch)	SN
AS Concrete surface course	0.390	1.97(5cm)	0.768	1.97(5cm)	0.768	1.97(5cm)	0.768
AS Concrete binder course	0.300	5.12(13cm) (additional)	1.535	5.12(13cm) (additional)	1.535	7.87(20cm) (15cm additional)	2.362
Sub-base	0.108	4.72(12cm)	0.510	8.66(22cm)	0.935	5.91(15cm)	0.638
Total			2.813> 2.734		3.238> 3.175		3.768> 3.752

(Overlay)

The overlay thickness was designed by using the ESAL value of 15 years from 2009 and by considering the remaining SN of the present pavement cross section. However, the damage of the lower sub-base which is not caused by the traffic volume factors shall repair separately.

	Economic Grow Rate (%)	Day Traffic Volume(Heavy Vehicle)	Annual Traffic Volume(Heavy Vehicle)	Truck Mixed Rate(0.634)	Trailer Mixed Rate(0.366)
Subtotal from Year 2009 to Year 2018			1,014,181	642,991	371,190
2019	6.2	385	140,527	89,094	51,433
2020	6.2	409	149,240	94,618	54,622
2021	6.2	434	158,493	100,484	58,008
2022	6.2	461	168,319	106,714	61,605
2023	6.2	490	178,755	113,331	65,424
Subtotal				1,147,233	662,283
			Axle load survey	×1.63 / 2 / 2	×3.67 / 2 / 2
			Other	×0.182 / 2 / 2	×0.423 / 2 / 2
Total of ESAL from year 2009 to year 2023 2,494,755				1,039,393	1,355,362

	Section 1,3	Section 2	Section 4	Section 5	Section 6	Section 7
CBR	3.0	5.2	8.7	5.9	3.8	4.1
Required	4.501	3.688	3.030	3,516	4.139	4.026

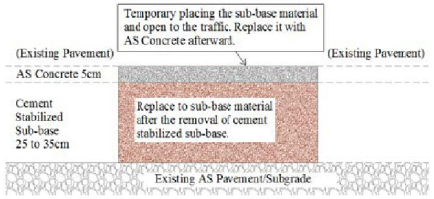
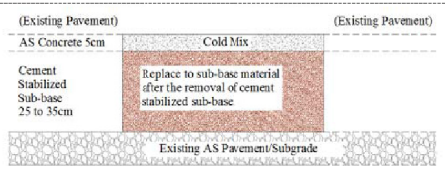
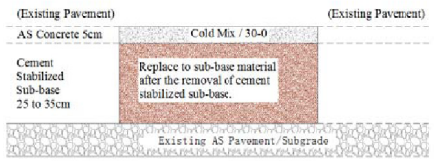
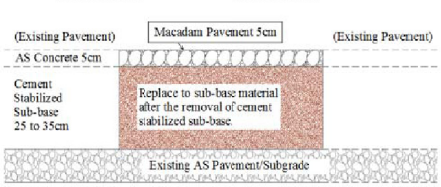
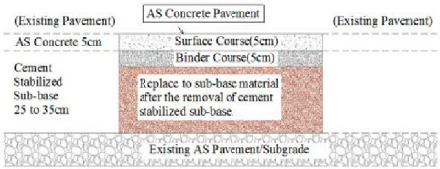
SN						
Having SN	2.846	2.398	1.831	2.256	2.634	2.610
Insufficient SN	1.636	1.290	1.199	1.260	1.505	1.416
Required AS thickness	10.8cm (11cm)	8.4cm (9cm)	7.8cm (8cm)	8.2cm (9cm)	9.8cm (10cm)	9.2cm (10cm)

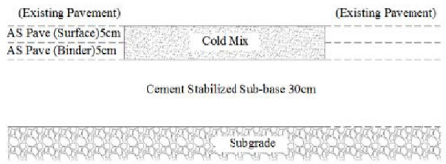
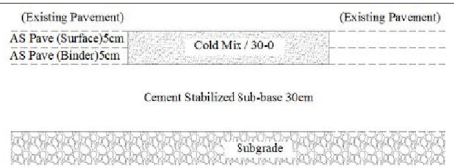
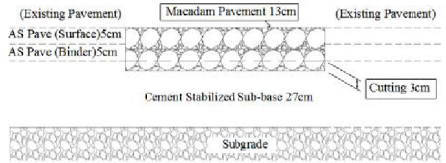
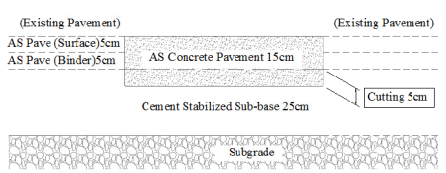
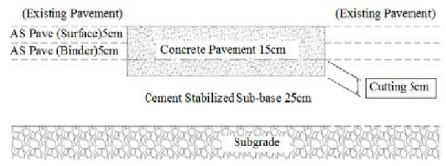
4.4 Examination of the Repair Method

The procurement of material in Tajikistan and the possible repair method had been examined. The urgent repair method and permanent repair method was not clearly classified but the low durability method (urgent repair) to the high durability method (permanent repair) are lining up in order from up to bottom.

A plan of using the hot mixture material was adopting since it was confirmed to be produced in Dushanbe. The road planers are possible to be procured in Dushanbe. It is necessary to examine the AS material for the possibility of usage of modified material, possibility of the procurement of straight AS with hard penetration and the usage of gap grade.

Table of Counter Measures

	Damage type	Location	No.	Durability	Service Period	Measurement	Cost (/100m2)	Method	Construction method	Material (per 100m2)	Machine	Notes	Issue/Valuation
Flat section	Repair Large scale	7 loc. 413m3	1	D	0.3 ~ 0.5		US$ 3,000 (M)2,000 (E)500 (L)500	Sub-base temporary rehab method	After removing the cement sub-base, backfill sub-base material till the head of pavement. Open to the traffic, level the surface by filling the settlement location with sub-base material. Continue until the settlement is not occurring and replace the surface when the AS is secured.	Sub-base material 40cm3	Concrete cutter, hand guide roller	Continue supplying the material after opening to the traffic.	Necessary to reconstruct the surface layer earlier. The lowest price but time consuming.
			2	C	0.5 ~ 1.0		US$ 4,500 (M)3,000 (E)1,000 (L)500	Replacement of sub-base + Cold mixture pavement(5cm	Remove cement sub-base, backfill it till the head of the sub-base and compact it. Construct the surface with cold mixture pavement.	Cold mixture 11.5t Tack coat material 50 l	Concrete cutter Mixer(pug mill or continuity) AS finisher Tire roller Macadam roller Hand guide roller	Binder volume Particle size of the mixture Examine the finished thickness	Question of the durability of the cold mixture material.
			3	C'	0.8 ~ 1.5		US$ 4,700 (M)3,200 (E)1,000 (L)500	Replacement of sub-base + Cold mixture pavement(30-0)pavement(5cm)	Remove cement sub-base, compact the backfill till the head of sub-base. Construct the surface with cold mixture (30-0) pavement.	Crusher run 30-0 13.5 m³ Cold mixture 11.5t Tack coat material 50 l	Concrete cutter Dump truck Motor grader Mixer(pug mill or continuity) AS finisher Tire roller Macadam roller Hand guide roller	Compaction of sub-base Binder volume Particle size of the mixture Examine the finished thickness The particle size of the crusher run must be continuous size	Expect the durability since the aggregate is including.
			4	B	1.5 ~ 2.0		US$ 5,000 (M)3,200 (E)1,000 (L)800	Replacement of sub-base + Permeable macadam pavement (5cm)	Remove cement sub-base, compact the backfill well till the head of sub-base head. Construct the surface with the permeable macadam pavement (5cm).	Crush run 30-20 5 0 m³ Crusher run10-5 2 0 m³ Crusher run 5-2.5 1 0 m³ Binder 750 kg (Straight AS)	Concrete cutter Macadam roller (Tire roller) (Hand guide roller) Binder spray machine (Distributor) (Engine sprayer)	It is necessary to do training one week for the crusher run spreading. Single size of the crusher run is required.	Expect the durability to some degree. Preparation of spreading machine and method of heating the binder are ok?
			5	A	5		US$ 10,000 (M)7,000 (E)2,500 (L)500	Replacement of sub-base + Hot AS pavement	Remove cement sub-base, compact backfill well till the depth of -10cm from the head of pavement head. Construct the surface with AS(10cm).	Hot AS mixture(5cm) 12 ton Tack coat material 50 l	Concrete cutter AS finisher Macadam roller Tire roller Hand guide roller Rake	Mechanical leveling Manual leveling Method to prevent sliding of the mixture	Method to procure the AS. Expect the most durability.
	Alligator crack	Same as the attached				Asphalt overlay 8cm to 11cm(see 4.3)		Hot Mix Asphalt Pavement					
	Crack Small scale	Same as the attached				sealing							

Grade section	Repair Large scale	2loc. 332.5m2	1	C	0.5 ～ 1.0		US$ 3,000 (M)2,300 (E) 500 (L) 200	Cold mixture pavement(cm) method	Construct the bare surface location with cold mixture pavement.	Cold mixture 11.5t Tack coat material 50 l	Concrete cutter Mixer (pug mill or continuity) AS finisher Tire roller Macadam roller Hand guide roller	Binder volume Particle size of the mixture	Question of the durability of the cold mixture. Require the check of finished thickness. No counter measure for sliding
			2	C'	0.8 ～ 1.5		US$ 3,300 (M)2,600 (E) 500 (L) 200	Cold mixture(30-0)pavement(5cm)	Construct the bare surface location with cold mixture pavement (30-0).	Crusher run 30-0 13.5 m³ Cold mixture 11.5t Tack coat material 50 l	Concrete cutter Dump truck Motor grader Mixer (pug mill or continuity) AS finisher Tire roller Macadam roller Hand guide roller	Binder volume particle size for the mixture examine the finished thickness Particle size of crusher run must be continuous particle size.	Expect the durability since the aggregate is including. No counter measure for sliding.
			3	B	1.5 ～ 2.0		US$ 7,000 (M)2,500 (E)2,000 (L) 500	Surface removal＋Permeable macadam pavement (13cm)	Cut the surface 3cm as a measure to prevent sliding. Construct the surface with permeable macadam pavement (13cm).	Crusher run 30-20 15.0 m³ Crusher run 10-5 5.0 m³ Crusher run 5-2.5 2.5 m³ Binder 2,000 kg (Straight Asphalt)	Concrete cutter Road planer Macadam roller (Tire roller) (Tire roller) (Hand guide roller) (Binder spray machine) (Distributor) (Engine sprayer)	Require one week to do training for the crusher run spreading. Single size of crusher run is necessary.	Expect the non-sliding from the surface cutting Preparation of spreading machine and method of heating the binder are ok? Expect the durability to some degree.
			4	A	5		US$ 14,000 (M)8,500 (E)2,000 (L) 500	Surface removal＋hot AS pavement	Cut the surface 5cm to prevent sliding and secure the thickness of the pavement. Construct the surface with hot AS pavement.	Hot asphalt mixture(5cm) 12 ton Tack coat material 50 l	Concrete cutter Road planer AS finisher Macadam roller Tire roller Hand guide roller Rake	Mechanical leveling Manual leveling Method to prevent sliding of the mixture	Expect the non-sliding from the surface cutting Method to procure the AS. Expect the durability.
			5	A	5		US$ 9,500 (M)2,000 (E)2,500 (L)2,000	Surface removal＋Cement concrete pavement(15)	Cut the surface 5cm to prevent sliding and secure the thickness of the pavement. Construct the surface with cement concrete pavement	Cement concrete mixture 20.8 m³	Concrete cutter Road planer Concrete mixer Mixture truck (one wheel) Scope prod	Security of curing time and pavement method is required	Expect the non-sliding from the surface cutting Secure the durability by concrete pavement.

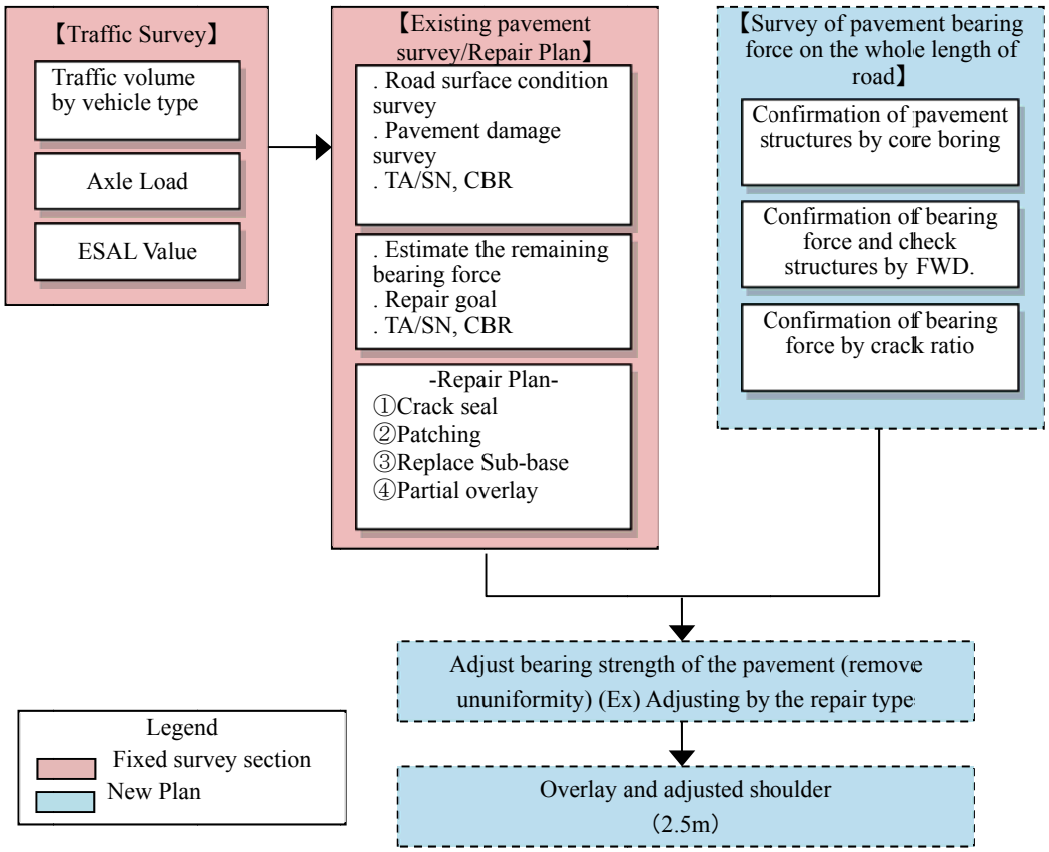
Note) Durability : A to E/ high to low

(M): (Material), (E): (Equipment), (L): (Labor)

5. Future Repair

For the future repair, the initial design traffic volume and the current traffic volume which is confirmed from the survey are having a big different volume. Clay lump are found in the cement stabilized sub-base, giving notice that the layer thickness and its strength are not in conformity and was not reached its design strength. Thus, it is necessary to examine the remaining bearing force of the existing road.

However, checking the remaining bearing force of the whole target roads in the survey are limit so as it is necessary to plan according to the below method.



6. Attachment Data

Attachment 1: Pavement Inventory

Attachment 2: Result of Vehicle Weight Measurement

Attachment-6

Record of Meeting about the Selection of the Urgent Repair Work

Minutes of Discussion for the Second Survey

Project Name : Ex-Post Situation Survey for the Project for the Improvement of Dusty-Nizhniy Pyandzh Road

Participants	MOT	Mr. Olim Yatimov	Head of Department on Cooperation with foreign investment, Ministry of Transport, Republic of Tajikistan
	Survey Team	Mr. Furuki Moriyasu :	Road Planning / Design / Construction
		Mr. Miura Minoru:	Chief Engineer / Road Design
		Mr. Noda Yoshihisa :	Road Design / Pavement Survey II
		Mr. Oguro Koichi ;	Pavement Construction
	JICA Tajikistan Office	Ms. Murakami Masayo	Project Formulation Adviser
Date, Time	July 01, 2014 16:00～17:00		
Venue	MOT Conference Room		

The contents of the discussion on the Technical Data-1 are as follows.

Survey Team	Survey Team explained the causes of defects, traffic volume and axle load survey results, several types of urgent repair method and the necessary expenses to MOT which have been prepared in accordance with the MOD concluded on May 7th, 2014 between First Deputy Minister and Mr. Kenshiro TANAKA / JICA,
MOT	MOT expressed appreciation for the Survey Team's effort and accepted the proposal in general. MOT will select the proper urgent repair methods in consultation with First Deputy Minister. Regarding the maintenance budget, they must consult with the Minister. MOT asked the timing of implementation of urgent repair works to the Survey Team.
Survey Team	The Survey Team answered that the repair works are supposed to be implemented in August 2014 in accordance with the MOD.
MOT	The maintenance budget for the urgent repair works is not allocated in the MOT budget for 2014. However, they will consider the issue of budget from MOT budget for 2014. If not, the maintenance budget for the urgent repair works is to be allocated in the MOT budget for 2015. The fiscal year in Tajikistan starts on January 1st.

Survey Team	The Survey Team requested that the MOT inform JICA as soon as possible in case MOT cannot prepare the budget from MOT budget for 2014 because the third mission is scheduled in August.
MOT	MOT promised to have contact with JICA continuously.

Dushanbe, July 3, 2014

Mr. Minoru Miura
Chief Engineer / Road Design of Survey Team

Attachment-7

Letters of Request for the Selection of Repair Method

CTI Engineering International Co., Ltd.
Consulting Engineers
Tachibana Annex Building, 2-25-14 Kameido, Koto-ku, Tokyo 136-0071 Japan
TEL: +81-3-3638-2586, FAX: +81-3-3638-2620

Date: 22th July 2014
Our Ref. No. :CTII/MOT/001

Mr. Sherali Gangalzoda,
First Deputy Minister, Ministry of Transport, Republic of Tajikistan

Project: Ex-Post Situation Survey for the Project for the Improvement of Dusty-Nizhniy Pyandze Road

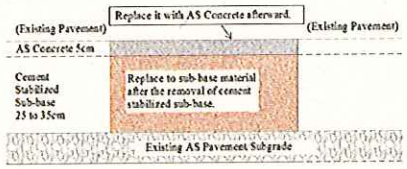
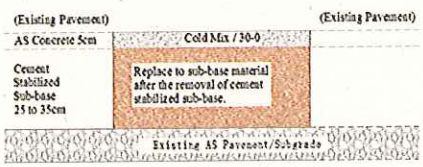
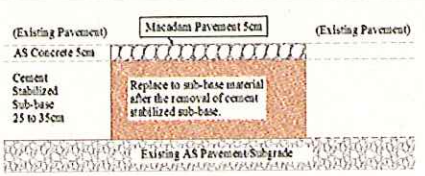
Subject: Necessary Budget for Respective Repair Type

Dear Sir,

We are pleased to propose and share following estimations of costs for respective repair type for the sections that require urgent repair works, which has been reported in the Technical Data-1 Report. (The unit costs in the tables are based on our market price survey.)

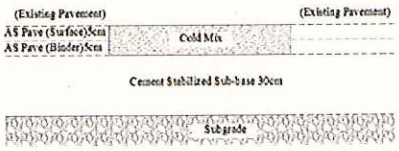
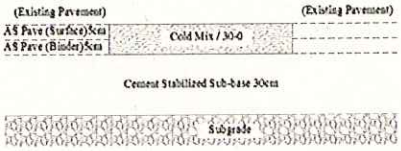
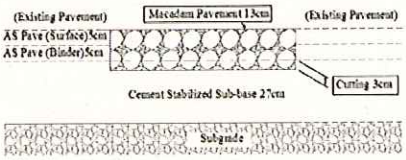
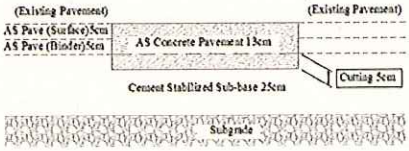
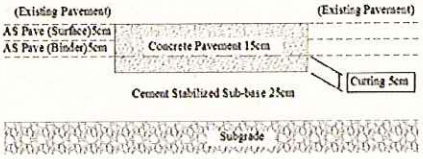
In this connection, you are kindly requested to estimate and ensure your necessary budget for the urgent repair works referring to our proposal and inform us of the result.

Table-1 Flat Sections (Sta. 0 - Sta. 14+140) / 413.0m^2

No	Type of Measurement	Repair Work Procedure	Propose Section	Unit Price (USD/100m^2)	Amount (USD)
1	Sub-base Temporary Rehab Method	1. To remove existing asphalt pavement and cement stabilized sub-base 2. To backfill granular material till the top 3. To open to the traffic 4. To replace top 5cm with asphalt concrete pavement in the future		3,000 (M)2,000, (E)500, (L)500	12,390
2	Replacement of Sub-base & Cold Asphalt pavement Method (5cm)	1. To remove existing asphalt pavement and cement stabilized sub-base 2. To backfill granular material till the top of base-course 3. To construct cold asphalt pavement		4,500 (M)3,000, (E)1,000, (L)500	18,585
3	Replacement of Sub-base & Cold Asphalt Pavement (30-0) Method (5cm)	1. To remove asphalt pavement and cement stabilized sub-base 2. To backfill granular material till the top of base-course 3. To construct cold asphalt mixed with gravel(30-0)		4,700 (M)3,200, (E)1,000, (L)500	19,411
4	Replacement of Sub-base & Penetration Macadam Pavement Method (5cm)	1. To remove asphalt pavement and cement stabilized sub-base 2. To backfill granular material till the top of base-course 3. To construct penetration macadam pavement (5cm)		5,000 (M)3,200, (E)1,000, (L)800	20,650
5	Replacement of Sub-base & Hot Asphalt Pavement Method (10cm)	1. To remove asphalt pavement and cement stabilized sub-base 2. To backfill granular material till the top of base-course 3. To construct hot asphalt concrete pavement (10cm)		10,000 (M)7,000, (E)2,500, (L)500	41,300

Note) (M):Material, (E):Equipment, (L):Labor

Table-2 Steep Sections (Sta. 14+140 - Sta.23+700) / 332.5m^2

No	Type of Measurement	Repair Work Procedure	Proposed Section	Unit Price (USD/100m^2)	Amount (USD)
1	Cold Asphalt Pavement Method (5cm)	1. To fill widely cracked and/or uneven asphalt pavement with cold asphalt material to make the surface flat		3,000 (M)2,300, (E)500, (L)200	9,975
2	Cold Asphalt (30-0) Pavement Method (5cm)	1. To fill the widely cracked and/or uneven asphalt pavement with cold asphalt material mixed with gravel(30-0) to make the surface flat		3,300 (M)2,600, (E)500, (L)200	10,973
3	Surface Removal & Penetration Macadam Pavement Method (13cm)	1. To remove the slipped asphalt pavement 2. To mill the cement stabilized base-course 3cm from the surface 3. To construct penetration macadam pavement (13cm)		7,000 (M)2,500, (E)4,000, (L)500	23,275
4	Surface Removal & Hot Asphalt Concrete Pavement Method (15cm)	1. To remove the slipped asphalt pavement 2. To mill the cement stabilized base-course 5cm from the surface 3. To construct hot asphalt concrete pavement (15cm)		14,000 (M)8,500, (E)5,000, (L)500	46,550
5	Surface Removal & Cement Concrete Pavement Method (15cm)	1. To remove the slipped asphalt pavement 2. To mill the cement stabilized base-course 5cm from the surface 3. To construct concrete pavement (15cm)		9,500 (M)2,000, (E)5,500, (L)2,000	31,588

Note) (M):Material, (E):Equipment, (L):Labor

Your kind understanding on the above would be highly appreciated.

Very truly yours,

Minoru MIURA
Chief Engineer / Road Design of Survey Team

c.c.: JICA Tajikistan Office
Attachment: Technical Data-1 Report

Attachment-8

Table of Result of Soil Test

Table of Execution of Soil Tests

No.	Sta.	Location	Surface condition	Pavement structure	Thickness		Test laboratory	Depth	MDD	OMC	CBR	Clegg Hummer	PL	LL	PI	Classification	Water content	Particle size distribution (silt)	Cement volume	Permeable coefficient	Remark
					Design	Measurement															
					cm	cm			g/cm^3	%	%	%	%	%	%		%	%	%	cm/s	
1	1+317	Carriageway	Huge alligator crack	Upper/lower base	30	30						Impossible									
				Subgrade	-	-	MOT	-0.7	1.810	10.8	18.9	59.7	NP	NP	NP		4.5	70.8			
2	2+416	Carriageway	Huge alligator crack	AS Surface	10	8						119									
				Base course	35	39															
				Subgrade	-	-						21									
3	2+425	Shoulder	Carriageway allogator crack	Base	15	12						31									
				Subgrade	-	-	MOT	-0.5	1.815	10.2	10.3	11.6	NP	NP	NP		15.7	48.9			
4	4+476	Carriageway	Huge alligator crack	Upper base	15	13	Road laboratory					24	NP	NP	NP	SF		24.1	Impossible		
				Lower base	10	9	Road laboratory					10	37.4	18.1	19.3	GF		36.0	Impossible		
				Subgrade	-	-	MOT	-0.46	1.927	8.7	19.6	101	NP	NP	NP		6.5	81.9			
5	5+028	Carriageway	Good part by side of alligator crack	Upper base	15	17.5						Impossible									
				Lower base	10	4.0						18									
6	5+029	Carriageway	Huge alligator crack	Upper base	15	16.5	MOT					28.7	NP	NP	NP		5.7	4.16			Additional tests at Road laboratory afterward
				Lower base	10	3.5	MOT					22	32.7	20.3	12.4		12.5	22.6			
	5+029	Carriageway	Huge alligator crack	Upper base	15	16.5	Road laboratory					28.7	NP	NP	NP	GF		16.2	Impossible		
				Lower base	10	3.5	Road laboratory					22	37.2	17.8	19.4	GF		37.1	Impossible		
				Lower base	-	-	Center												16.6		
7	6+352	Shoulder	Good	Base	15	15						Impossible									
				Subgrade	-	-	MOT	-0.5	1.817	11.8	11.4	16.6	32.4	20.8	11.6		11.8	40.6			
					-	-		-1.1	1.997	6.4	19.6	31	NP	NP	NP		4.0	17.2			
8	6+904	Carriageway	Type-4 Repair/Defect	Upper/lower base	18	18						28.7									
				Subgrade	-	-	MOT	-0.4	1.875	10.6	18.9	11	25.8	19.4	6.4		10.6	43.6			
9	9+960	Carriageway	Good	Upper/lower base	25	25						Impossible									
				Subgrade	-	33						21									
10	12+607	Shoulder	Good	Base	15	15															
				Subgrade	-	-	MOT	-0.3	1.879	7.7	11.9	12	NP	NP	NP		11.9	23.9			
					-	-		-0.5	1.926	10.4	16.7	16.6	NP	NP	NP		10.9	60.9			
11	5+029	Shoulder		-	-	-	Road laboratory													1.44E-05	
12	STA22	Borrow pit		Specimen-2	-	-	Road laboratory						48.0	22.9	25.1	Fm		66.2			
14	STA22	Borrow pit		Specimen-1	-	-	Road laboratory						85.3	29.1	56.2		3.6	40.5			
				Specimen-2	-	-	Road laboratory						54	25.7	28.3		4.3	22.3			
15	STA13			Specimen-4	-	-	Road laboratory						NP	NP	-		0.1	4.4			

Road laboratory: Road Laboratory Center: Material Test Center SF : Fine particle mix sand GF : Fine particle mix gravel Fn MDD : Max dry density OMC:Optimum moisture