2016

Ministry of Transport
Republic of Tajikistan

PAVEMENT INSPECTION GUIDELINE

Japan International Cooperation Agency

FOREWORD

Pavement Inspection Guideline was prepared through *The Project for Improvement of Road Maintenance in the Republic of Tajikistan (October 2013 to November 2016)* implemented by Japan International Cooperation Agency (JICA), under collaborative works with Ministry of Transport (MOT), Republic of Tajikistan. This guideline provides a guidance on pavement inspection recommended considering to important lessons and experience learnt through a series of trainings conducted during the project. It aims to introduce IRI (international roughness index) to evaluate pavement condition and to support MOT's policy of pavement repair from the reactive maintenance to the preventive maintenance. This guideline is intended for road sector workers involved in the repair and maintenance as well as a comprehensive manual to assist in educational efforts pertaining to pavement maintenance.

October, 2016

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Minister of Transport, Republic of Tajikistan

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1. Introduction

In the Republic of Tajikistan, the Annual Road Inspection is conducted by order of Ministry of Transport for international roads, national roads and railway crossing to monitor conformity of traffic safety by the commission jointly with MOT, SETM, SEHM and Traffic Police. Defects identified in the inspection are reported to the relevant authorities as maintenance order. Apart from this, road condition is monitored by the SEHM maintenance team in a daily basis.

The authority of road such as MOT, SETM and SEHM has a responsibility to provide to the road users good service through the year. Maintenance work is the one of most important work with no doubt.

The systematic maintenance with regular inspection preventive repair is effective to enhance the life period of the pavement (Figure 1). This cycle contributes to minimize the maintenance work load as well as maintenance cost.

This guideline introduces a pavement inspection methodology using IRI (international roughness index) and visual inspection. This guideline is prepared for the road authorities to facilitate the systematic management performance for the pavement maintenance.

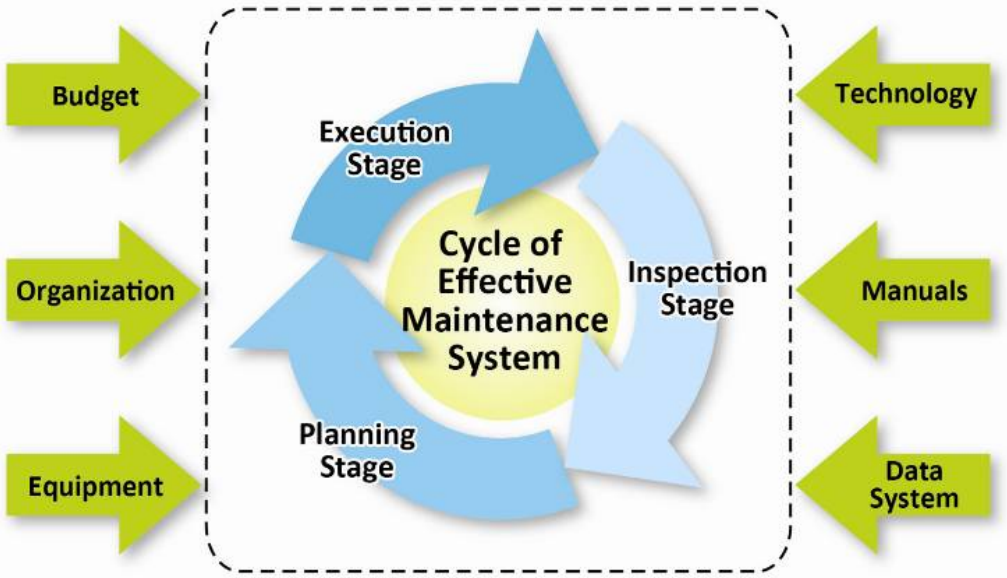
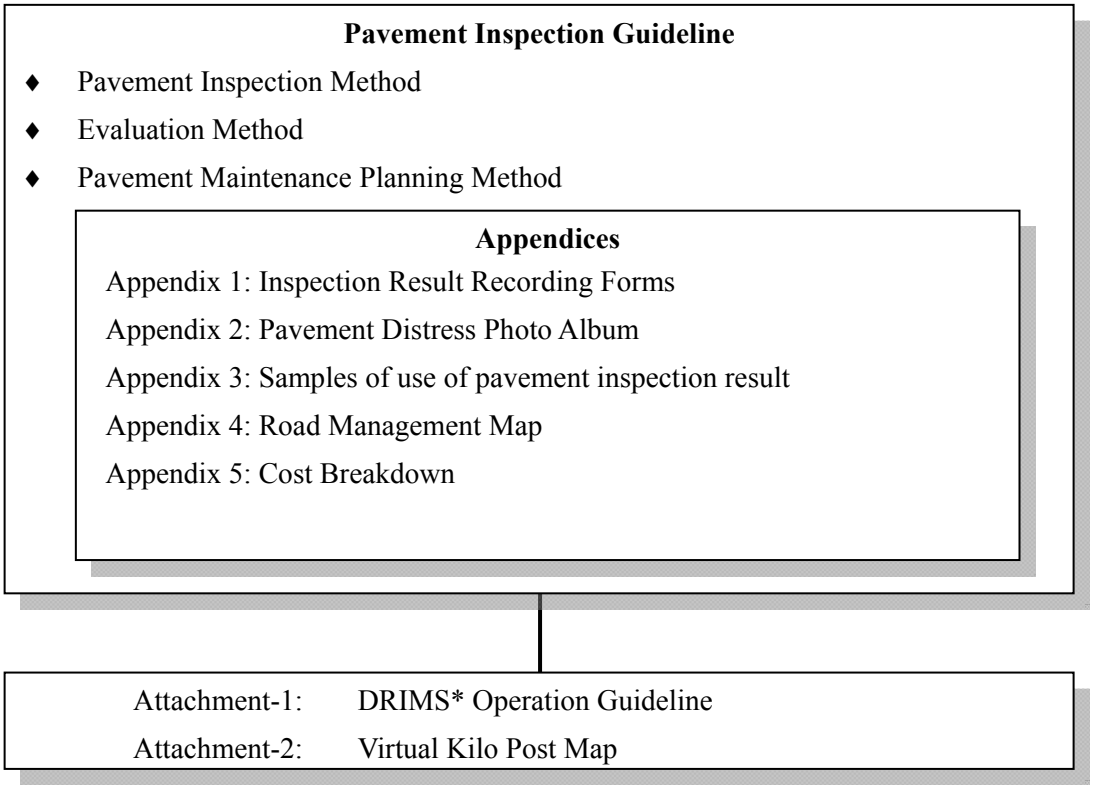


Figure 1 Road Maintenance Cycle

2. Structure of Guideline

Structure of this Guideline is shown in Figure 2.



Note: Since DRIMS Operation Guideline is focused on operating specific devices, it is separately attached with this Guideline.

* DRIMS: Dynamic Response Intelligent Monitoring System

Figure 2 Structure of Guideline

3. Purpose of Pavement Inspection

Pavement Inspection has the following four (4) purposes;

1. **To obtain** required information promptly from the site for maintain smooth and safe traffic by adequate maintenance.
2. **To know** the pavement surface condition and identify the portion requiring maintenance
3. **To find** locations of serious potholes in order to prevent accident of the road user and third party.
4. **To evaluate** severity of the distress of the pavement, to prioritize the repair plan and to select the most urgent section to repair.

4. Pavement Inspection Flow

The steps of the pavement inspection are illustrated in the following flow chart.

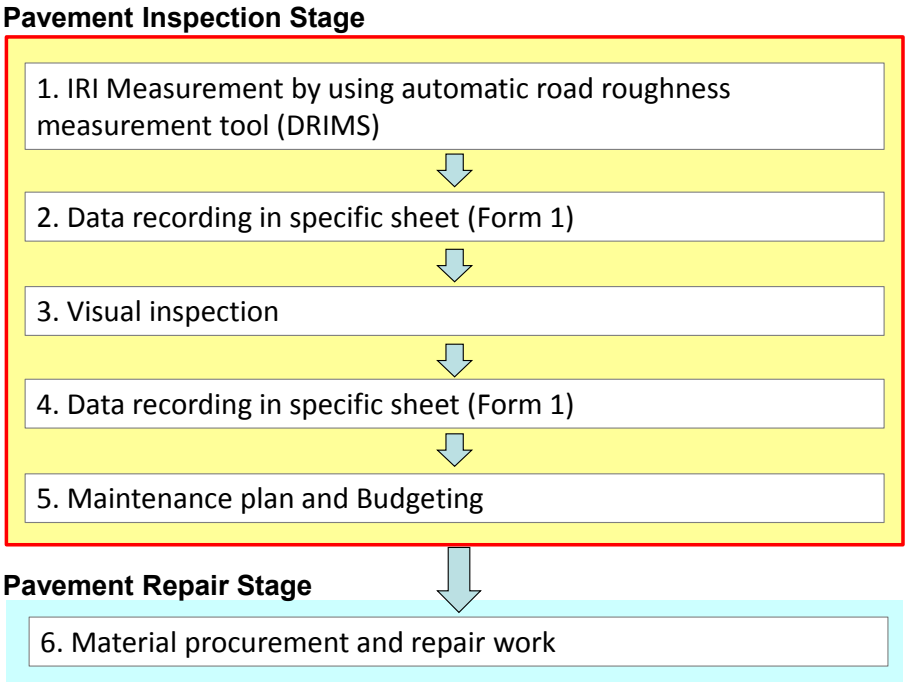


Figure 3 Pavement Inspection Flow

5. Methodology of the Pavement Inspection

5.1 Objective of Pavement Inspection

Objective of the pavement inspection is to evaluate condition quantitatively. The result must be enough objective for judgment of urgency of repair, forecast of development of the defect and study of cause of the defect.

The most important types of defects witch mostly concerns to service of pavement (life, road safety and drivers comfort etc.,) are crack, rutting, smoothness and potholes of the pavement. In order to efficiently monitor such pavement defect, pavement inspection should follow a standard inspection procedure introduced in ***section 5.3.***

Table 1 shows typical pavement defect and inspection method.

Table 1 Typical Pavement Defect and Inspection Method

Inspection item	Method	Type of pavement defect				
		Crack		Rutting	Smoothness	Pothole
		Linier	Alligator			
IRI	Devise (ex.DRIMS)	△	○	△	◎	○
Crack	Visual	◎	◎	◎	△	–
Pothole	Visual	–	–	–	△	◎

◎ : most applicable, ○ : applicable, △ : less applicable

5.2 [STEP 1] IRI Measurement

Step 1 is the screening survey of the road by IRI (International Roughness Index).

IRI shows ride comfort as explained in Figure 4.

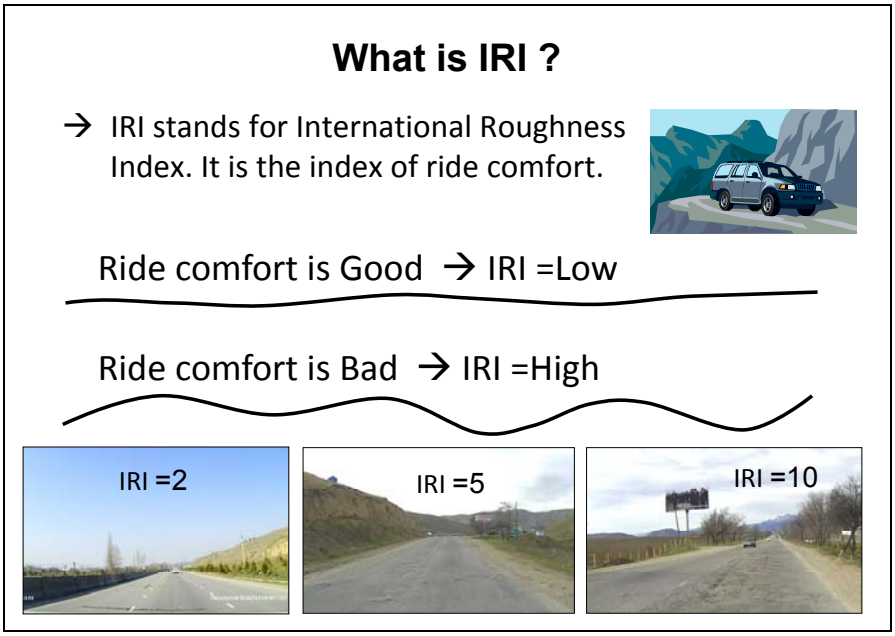


Figure 4 Explanation of IRI

Relation between IRI value and pavement condition is summarized in Table 2. For more information, refer to Table 4 .

Table 2 IRI and Pavement Condition

Condition	IRI	Remark
Very Good	0 - 3	
Good	3 – 5	
Sufficient	5 – 7	
Bad	7 – 10	
Very Bad	More than 10	Rough Section

IRI can be measured by using specific tools called DRIMS (Dynamic Response Intelligent System) as described in Figure 5. For detailed information to operate DRIMS, refer to ***Attachment-1 DRIMS Operation Guideline.***

Justification of use of DRIMS is mentioned in Table 12

The inspector shall record the information into a specific recording sheet called 'Form 1'. How to fill the information is explained in ***5.4 [STEP 3] Encoding the Inspection* Results into Form 1** .

Measured data is summarized into specific data Sheet (Form 1) as described in Table 13.

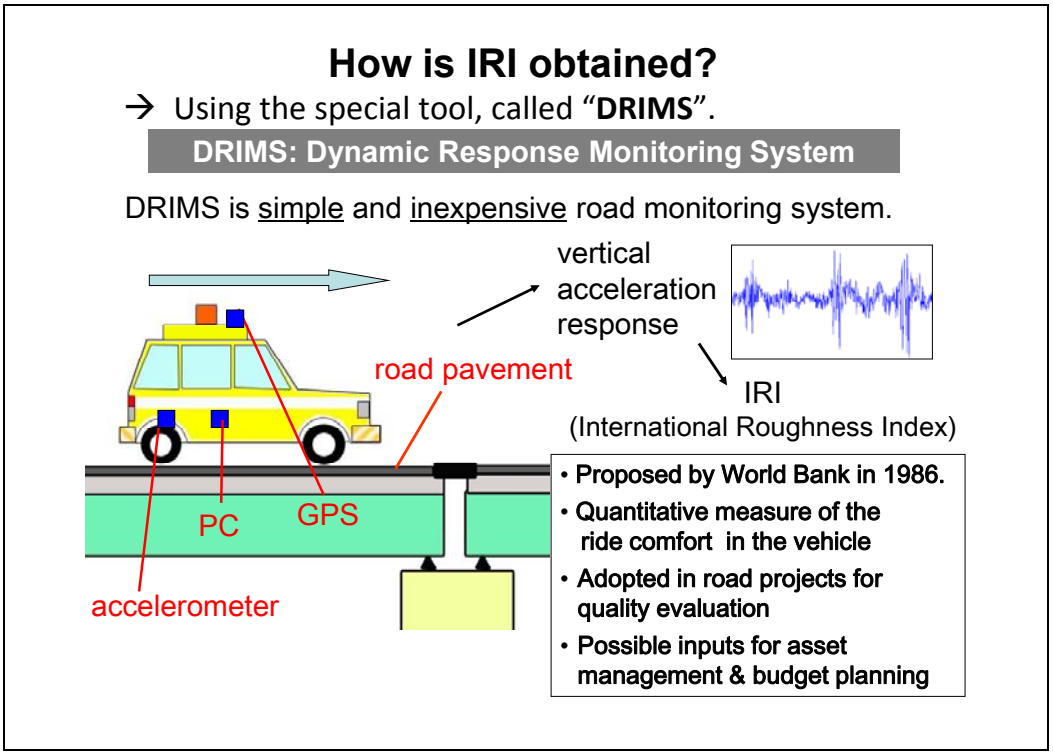


Figure 5 General Outline on IRI Measurement

Once IRI is obtained, smoothness of the pavement can be evaluated by average IRI and an index called Rough Section. Rough Section is defined as below.

Table 3 Definition of Rough Section

Average IRI	Average of IRI to total length
Rough Section Ratio (%)	The percentage of Rough Section Length to measured road. *Rough Section is defined as the length of which IRI is 10 or more.

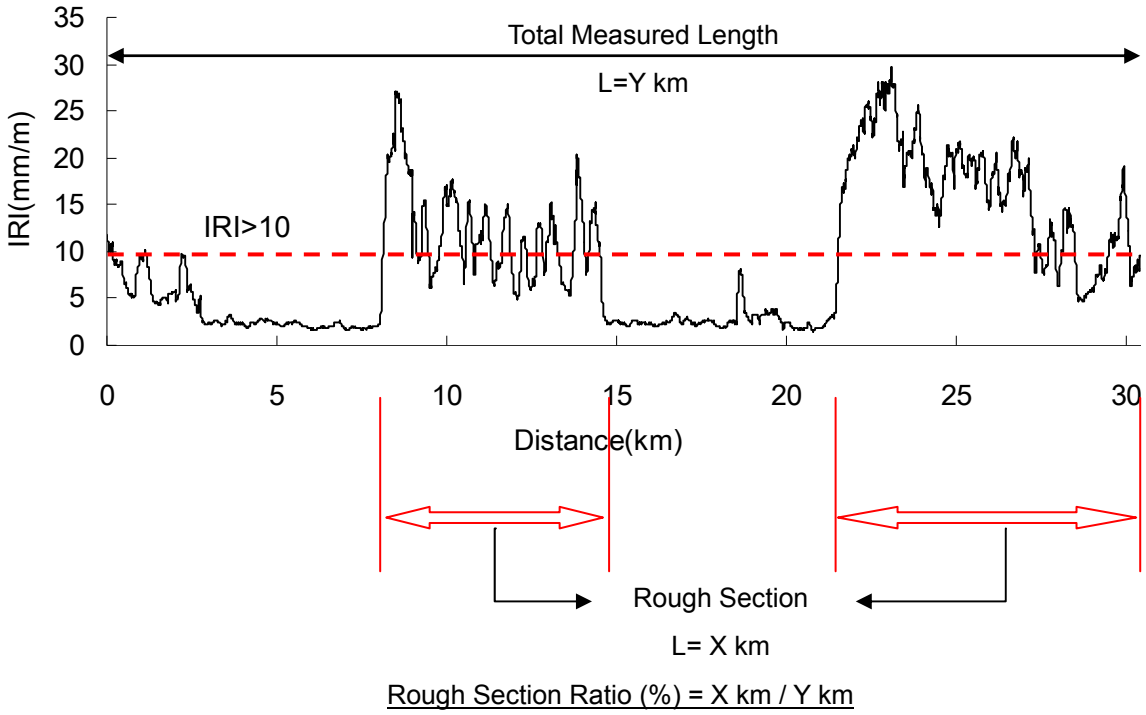


Figure 6 Rough Section

Apart from pavement evaluation by IRI, RRI (Repair Requirement Index) is introduced to represent pavement condition. RRI is a more accurate index which is considered not only IRI but also visual inspection result (refer to ***6*** for more explanation).

The average IRI and Rough Section Ratio can be integrated into the road list as shown in Table 5 in order to easily understand pavement condition.

Table 4　Relation between IRI and Road Surface Condition

IRI	Typical Photograph	
	General	Detail
0～3		
3～5		
5～7		
7～10		
10<		
12～15		
15～20		
20～		

Table 5 Road List (proposed) (Add No.23, No.24 for Road Condition by IRI)

Name of road (start to end)	Length	including					Traffic volume				Bridge(unit/m.2)							Pipe (ед м.2)				Road condition	
		Category	Paved	Mixed bitumen with gravel and	not mixed	Soil	Total	including			Total	RC	steel		wooded	Loading	Norm of loading	Total	including			IRI ave	Damage ratio
								vehicles	bus	trucks			Total	hanign					RC	steel	concrete		
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**
1. SEHM Bohtar																							
National road-053 p/a around Kurgan-tube (0-12,4) км	12,4	111(0-12,4)	12,4				7800	7090	10	720	2/34	2/34				Н-30	Г-7	25/619	24/607	1/12			
National road-054 p/a K-tube-Vakhsh(0-13,8)	13,8	1У (0-13,8)	13,8				3020	2600	2	418	3/88	2/40	1/48			Н-30	Г-7	16/348	16/348				
Total	**26,2**		**26,2**								**5/122**	**4/74**	**1/48**					**41/967**	**40/955**	**1/12**			
2 SEHM Jomi																							
National road-043 p/a Rudaki-Yovon-Jomi-Uyali (75-107)км	32	111(75-107)	32				3010	2600	4	406	16/301	16/301				Н-30	Г-8	17/245	17/245				

5.3 [STEP 2] Visual Inspection

Step 2 is to carry out visual inspection which aims to collect and record detailed structural condition of the pavement visually. The visual inspection shall be conducted shown as below, after completion of IRI survey.

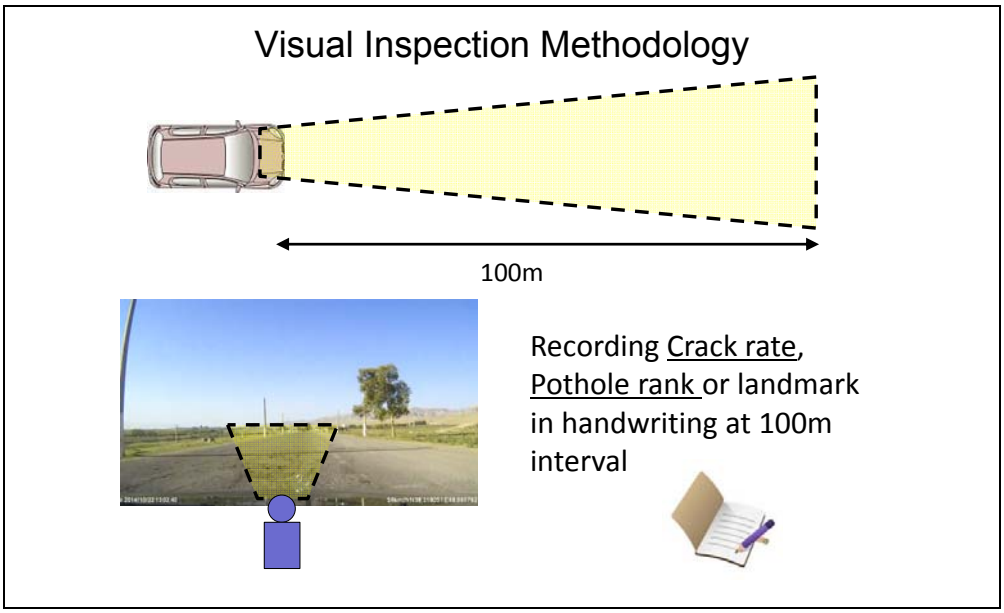


Figure 7 General Outline on Visual Inspection

The visual inspection aims to identify pavement repair requirements from the structural condition. The pavement will be judged from 1) surface crack and 2) pothole.

Table 6 and Table 7 show a standard evaluation rank for surface crack and pothole respectively. Examples of crack rate are shown in Table 8.

All surveyed information shall be recorded in the Form 1.

Table 6 Standard Crack Rate

Crack Rate	Typical Condition
0%	**New Pavement**
1% to 30%	**Hair Crack**
30 % to 50%	**Partial Crack** ¨Longitudinal Cracks ¨Traverse Cracks
50% to 70%	**Jointed partial Crack** ¨Longitudinal crack and traverse crack joint and covers all surface
70% to 100%	**Dense Alligator Cracks** ¨Agitator crack smaller than 0.5x0.5m covers whole surface

Table 7 Standard Pothole Rank

Pothole Rank	Condition	Criteria
A	No Pothole	No pothole neither no repair patching
B	Few Potholes	1 to 5 potholes or patching per 100m
C	Several Potholes	5 to 20 potholes or patching per 100m
D	Many Potholes	More than 20 potholes or patching per 100m

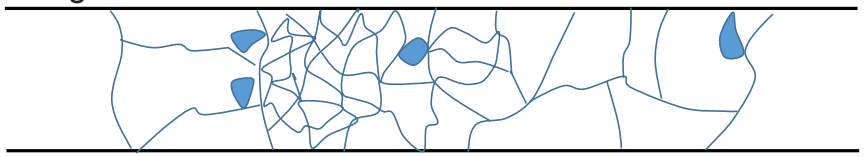
The value α and β are the adjustment factors of the IRI for calculation of Repair Requirement Index.

As a reference, the relation between actual condition in Tajikistan and crack ratio and photos are shown in Table 8 and Table 9.

Table 8 Example of Standard Crack Rate

Crack Rate	Condition	Photo
0%	**New Pavement**	
1% to 50%	**Partial Crack** ♦ Longitudinal Cracks ♦ Traverse Cracks	
50% to 70%	**Jointed partial Crack** ♦ Longitudinal crack and traverse crack joint and covers all surface	
70% to 100%	**Dense Agitator Cracks** ♦ Agitator crack smaller than 0.5x0.5m covers whole surface	

Table 9 Surface Condition and Repair Requirement

Surface Condition	Description	Repair Requirement	Crack Rate	Pothole Rank
First stage Large cracks occurred. 	Small cracks start developing. No significant negative effect to drivers comfort, road safety and road side environment. Small scale maintenance required.	Low - crack sealing	0-30%	A No Pothole
The second stage Crack is generated between the large cracks. 	Cracks are starting to expand. Driving speed lower, noise from tires increasing.	Middle - crack sealing - patching	30 % to 50%	B Few Potholes
Third stage Crack is subdivided, and pothole occurs. 	Road surface is covered by cracks. Pavement is already over design life. Strong negative impact to traffic safety. Negative environment impact due to noise and vibration.	High - patching - overlay	50% to 70% 70% to 100%	C Several Potholes D Many Potholes

In Japan, more detailed crack rate is calculated by the coverage of the area of 0.5m rectangular grid traversed by cracks as shown in Figure 8. In case there are more than two (2) cracks in the grid, crack rate is counted as 100%. If only one (1) crack is in the grid, it is counted as 65%.

Summary of all grids will be total of crack rate of the surveyed length. In detailed survey, this may be studied from surface photo (see samples in Table 10).

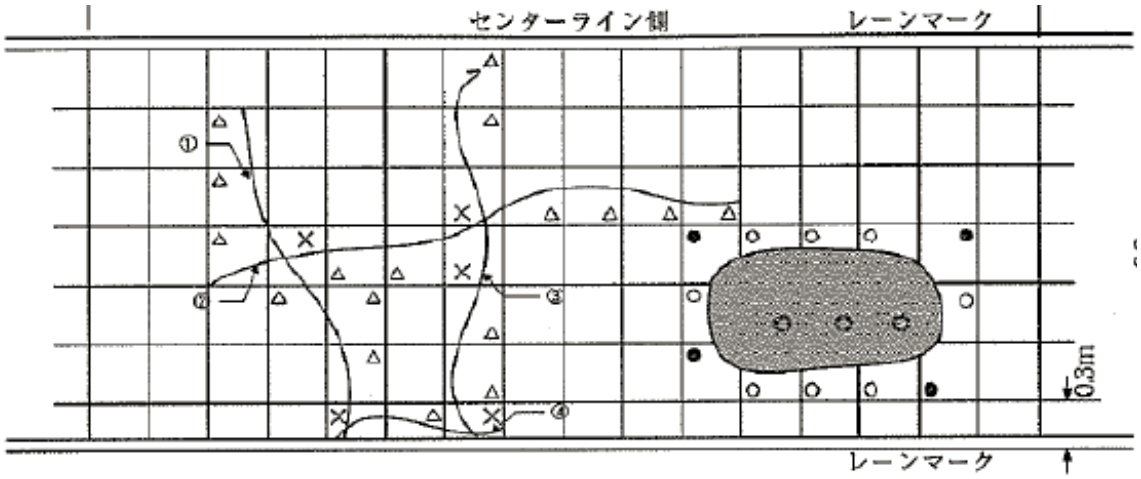
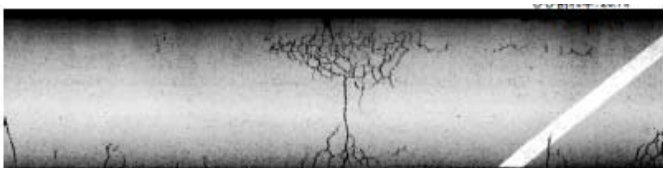
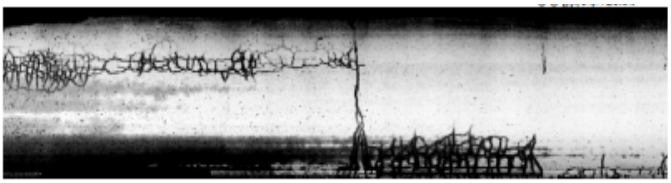
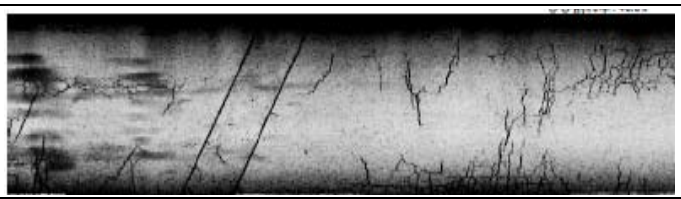


Figure 8 Detailed Crack Rate Evaluation Method

Table 10 Example of Crack Rate

%	Sample photograph of surface crack captured by special camera
10%	
20%	
30%	
40%	

5.4 [STEP 3] Encoding the Inspection Results into Form 1

(1) Data Integration

At the Step 3 stage, both IRI measurement result and visual inspection result are integrated into Form1.

Table 11 Data Integration

Methodology	IRI Measurement	Visual Inspection
Purpose	To measure IRI	To inspect road deterioration
Inspection Result	IRI value	Crack rate, Pothole rank
Data Integration	All inspection results are summarized in the specific form, called "**Form 1**".	

Collected data shall be input indicated below.

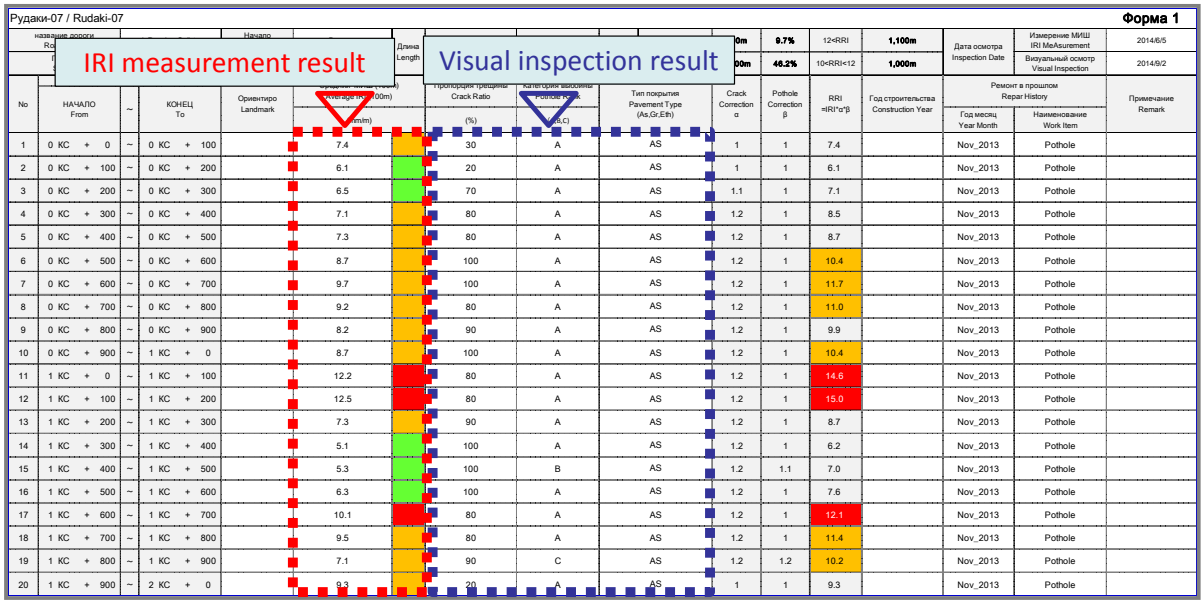


Figure 9 Data Input Area

(2) Explanation of Form1

Table 12 Explanation of Data Sheet Form 1

Item	Description
(1) Head Items	
□ Road Name	Road Name
□ Responsible SEHM	Name of SEHM
□ Starting point and end point	Put name of village of start point and end point of the road
□ Length	Survey road length (automatically calculated)
□ Average IRI	Average of IRI (normally mechanically measured and calculated) *This figure will be shared to the Road List
□ Rough Section Length and Ratio (%) evaluated by IRI	The percentage of Rough Section Length defined by IRI to measured road.
□ Rough Section Length and Ratio (%) evaluated by RRI	The Rough Section Length defined by RRI to measured road.
□ Date of Inspection	IRI measurement and visual inspection date
(2) Detail Items	
□ Kilo Post	Start Point and End Point (KP ※ Section length can be decided between land mark, pavement type etc, one section is 100m
□ Landmark	Landmark to find the KP (ex. Shop, building etc.,)
□ Average IRI	Average IRI at 100m interval
□ Crack Ratio (%)	Assumed crack rate observed from vehicle (See Table 8)
□ Pothole Rank (or Length of IRI>10)	Evaluation by visual observation in accordance with number of Potholes A: no pothole B: 1-5nos/100m C: 5-20nos/100m D: more than 20nos/100m
□ Pavement Type	AS pavement, Gravel Pavement, Earth pavement, Others (concrete pavement)
□ Crack Rate Coefficient	α (Refer to Chapter 6)
□ Pothole Rank Coefficient	β (Refer to Chapter 6)
□ RRI	RRI = IRI x α x β (Refer to Chapter 6)
□ Construction Year Month	Constructed Year is recorded.
□ Repair history	Repair work year and month or work items are recorded.
□ Remark	Snow falls, frequent accident point, land slide etc.,

Table 13 Pavement Inspection Data Sheet (Form 1)

Рудаки-01 / Rudaki-01 ③ ④ ⑤ ⑥ ⑦ ⑧ Форма 1

① название дороги Road Name	Душане-Кугантюбе	Начало Starting Point	Корвон	Длина Length	23,900m	Средний МИШ Average IRI	3.9	МИШ > 10	200m	0.8%	12<ИПР	100m	Дата осмотра Inspection Date	Измерение МИШ IRI MeAsurement	2015/5/15
② ГУСАД SEHM	Рудаки	Конец Ending Point	пост Фахробод					МИШ > 7	600m	2.5%	10<ИПР<12	200m		Визуальный осмотр Visual Inspection	2015/8/10

No	Раздел (КС) ⑨ НАЧАЛО From	~	КОНЕЦ To	⑩ Ориентиро Landmark	Средний МИШ (100m) Average IRI (100m) ⑪ (mm/m)		Пропорция трещины Crack Ratio ⑫ (%)	Категория выбоины Pothole Rank ⑬ (A,B,C)	⑭ Тип покрытия Pavement Type (As,Gr,Eth)	⑮ Коэф.трещин α Crack Correction α	⑯ Коэф.выбоин β Pothole Correction β	⑰ ИПР =МИШ*α*β RRI =IRI*α*β	⑱ Год строительства Construction Year	⑲ Ремонт в прошлом Repar History Год месяц Year Month	Наименование Work Item	⑳ Примечание Remark
121	12 КС + 0	~	12 КС + 100		8.1		30	A	As	1	1	8.1				
122	12 КС + 100	~	12 КС + 200		8.4		80	A	As	1.2	1	10.1				
123	12 КС + 200	~	12 КС + 300		5.5		70	A	As	1.1	1	6.1				
124	12 КС + 300	~	12 КС + 400		5.4		70	A	As	1.1	1	5.9				
125	12 КС + 400	~	12 КС + 500		5.2		70	A	As	1.1	1	5.7				
126	12 КС + 500	~	12 КС + 600		4.9		60	A	As	1.1	1	5.4				
127	12 КС + 600	~	12 КС + 700		4.8		70	A	As	1.1	1	5.3				
128	12 КС + 700	~	12 КС + 800		4.5		60	A	As	1.1	1	4.9				
129	12 КС + 800	~	12 КС + 900		5.7		60	A	As	1.1	1	6.3				
130	12 КС + 900	~	13 КС + 0		11.3		50	A	As	1	1	11.3				
131	13 КС + 0	~	13 КС + 100		12.3		50	A	As	1	1	12.3				
132	13 КС + 100	~	13 КС + 200		8.7		70	A	As	1.1	1	9.6				
133	13 КС + 200	~	13 КС + 300		6.9		70	A	As	1.1	1	7.6				
134	13 КС + 300	~	13 КС + 400		5.8		70	A	As	1.1	1	6.4				
135	13 КС + 400	~	13 КС + 500		4.3		80	A	As	1.2	1	5.1				
136	13 КС + 500	~	13 КС + 600		4.4		70	A	As	1.1	1	4.9				
137	13 КС + 600	~	13 КС + 700		4.2		60	A	As	1.1	1	4.7				
138	13 КС + 700	~	13 КС + 800		3.3		70	A	As	1.1	1	3.6				
139	13 КС + 800	~	13 КС + 900		3.2		80	A	As	1.2	1	3.8				
140	13 КС + 900	~	14 КС + 0		3.7		80	A	As	1.2	1	4.5				

(3) Importance of Start Point, End Point and Landmark

In order to conduct accurate pavement inspection, it is important to identify exact locations of observed irregularities. The start point, the end point and landmarks that provide locational information help inspection engineers to identify the correct repair location to repair. The Form 1 and Virtual Kilo-Post Map attached with ***Attachment - 2 Virtual Kilo Post Map*** was prepared for actual use in the jurisdiction under Gissar SETM and Kurgan Tyube SETM (as sample).

Table 14 Landmarks to be Locational Information

			
Kilo Post		Building	Gate

(4) Update of Form 1

Form 1 is the basic information of present pavement condition. Form 1 shall annually be prepared by conducting of IRI survey and visual inspection in spring (April to May). However, the Form 1 should be updated regularly when the road maintenance engineer finds out any changes on the pavement such as newly-occurred defects or maintained sections. Keeping such record is the 1st duty of the maintenance engineer.

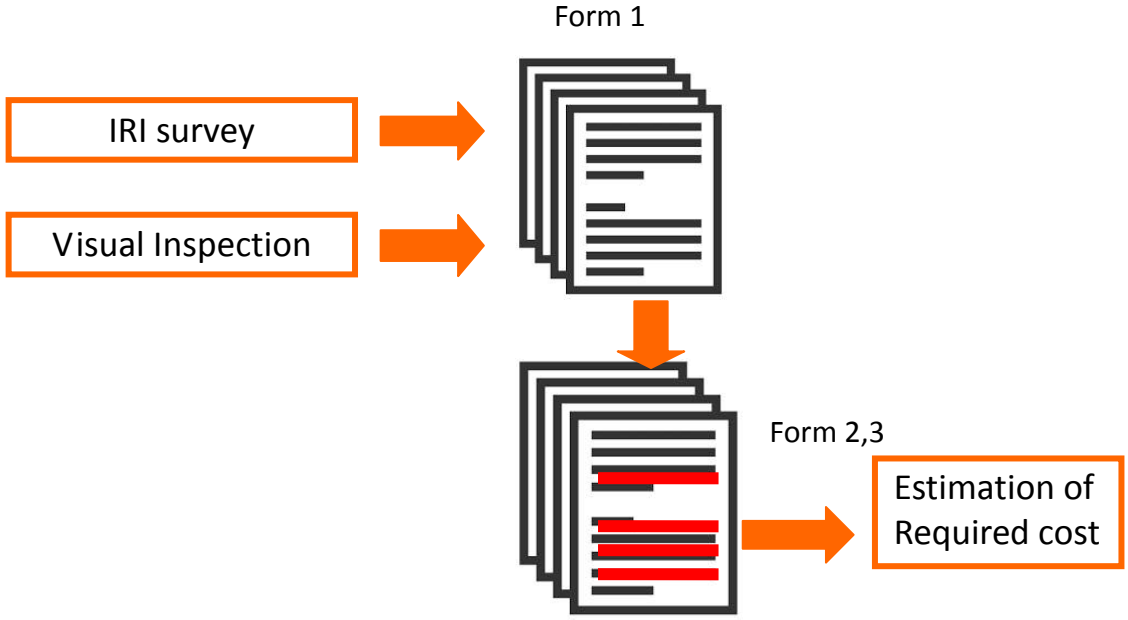


Figure 10 Update of Form 1

5.5 [STEP 4] Cost Estimation for Prioritized Maintenance Section (Form 2 and Form 3)

Step 4 is to estimate the required cost for repair of the identified section. Form 2 and Form 3 will be used for this step.

Based on Form 1, serious damaged section (RRI>10) shall be selected and listed in Form 2 by road. Estimated quantity (in m^2) is assumed in the Form and required rough cost will be calculated by using standard unit price (SOM/m^2) prepared in this Guideline (see 10). For this estimation, repair method shall be selected either overlay or patching. For patching required quantity need to consider actual work volume such as 5%, 10% of the total surface area. Total required repair cost will be summarized by Form 2.

Form 3 is to summarize the required cost by each SEHM.

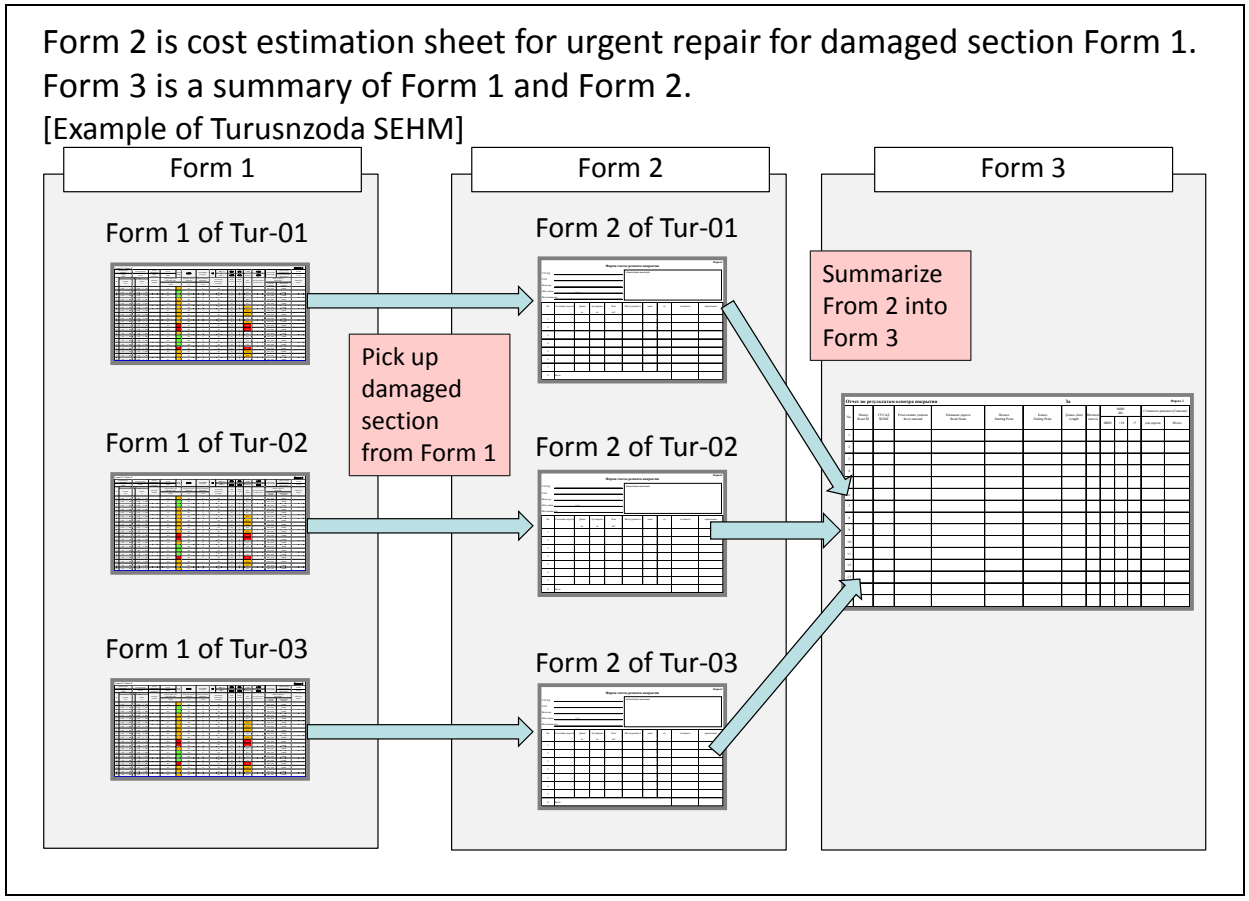


Figure 11 Relations of Forms

5.6 [STEP 5] Pavement Maintenance Plan

Pavement maintenance plan is developed by using pavement inspection result.

For developing the realistic plan, elements as listed below must be considered.

- Available budget and funds
- Number of qualified staffs
- Available machines and spare parts

- Institutional arrangements
- Management capability

Especially, availability of maintenance budget largely affects planning.

Development of maintenance plan is the one of the efficient ways to use such limited budget.

Hereinafter, standard methodology for pavement maintenance plan is shown focusing on following topics;

- Evaluation of Pavement Condition
- Prioritization for Road Maintenance
- Standard Repair Method and Cost Estimation
- Conduct of Pavement Inspection

6 Evaluation of Pavement Condition

6.1 General

The objective of evaluation is to identify the location requires pavement repair and its severity. Pavement condition should be evaluated considering both 1) surface smoothness (IRI) and 2) structural condition (crack rate and pothole rank).

In order to evaluate urgency of the pavement maintenance, RRI (Repair Requirement Index) calculate from IRI, crack ratio and pothole rank is introduced in this chapter.

6.2 Repair Requirement Index

The Repair Requirement Index (RRI) is computed from following equation;

$$RRI = IRI \times \alpha \times \beta$$

Where,

IRI : International Roughness Index

α : Crack Rate Coefficient

β : Pothole Rank Coefficient

In case that there is no data of visual inspection (crack rate and pothole rank) , input α=1.0 and β=1.0. This means, single value from IRI can be used for rough evaluation of the pavement condition.

Table 15 Repair Requirement Index

Repair Requirement Index (RRI)	0 – 5	5 to 7	7 to 10	10 to 12		More than 12
Requirement of Repair	Small	Medium	Routine	Urgent		Very urgent
Pavement condition	New	Within life time	Near life time	Over life time		Over life time
Typical surface condition	Very smooth	Sufficiently smooth	Bad	Bad, mostly covered by crack		Bad, mostly covered by deep pothole
Driving condition	Very high	High	Moderate	Moderate		Less than 30km/h
Methodology	Monitoring	Crack sealing	Crack sealing	Patching	Overlay	Overlay

6.3 Crack rate coefficient and pothole rank coefficient

Crack rate coefficient and pothole rank coefficient is to be referred from Table 16 and Table 17.

Table 16 Standard Pothole Rank

Pothole Rank	Condition	Criteria	**α**
A	No Pothole	No pothole neither no repair patching	**1.0**
B	Few Potholes	1 to 5 potholes or patching per 100m	**1.0**
C	Several Potholes	5 to 20 potholes or patching per 100m	**1.1**
D	Many Potholes	More than 20 potholes or patching per 100m	**1.2**

Table 17 Standard Crack Rate

Crack Rate	Typical Condition	**β**
0% to 30 %	**New Pavement**	**1.0**
30 % to 50%	**Partial Crack** ¨Longitudinal Cracks ¨Traverse Cracks	**1.0**
50% to 70%	**Jointed partial Crack** ¨Longitudinal crack and traverse crack joint and covers all surface	**1.1**
70% to 100%	**Dense Alligator Cracks** ¨Agitator crack smaller than 0.5x0.5m covers whole surface	**1.2**

7 Prioritization for Road Maintenance

7.1 Criteria for Prioritization

Pavement maintenance priority can be set by consideration of a large vehicle traffic volume and a current pavement condition as shown in Table 13.

This matrix classifies the road into four (4) different groups according to the priority.

Table 18 Group and Maintenance Priority

Priority	Group	Maintenance Schedule	Budget Allocation Priority
1	Group 1	This Year	Highest
2	Group 2	Next Fiscal Year	2nd Highest
3	Group 3	In 3～5 years	Less Priority
4	Group 4	In 5～10 years	Less Priority

7.2 Things to be Considered

The actual section for repair work must be selected considering following site condition;

1. Roadside land use
2. Environmental impact
3. Road alignment
4. Traffic speed
5. Traffic accident history
6. Other strategic reasons

Table 19 Pavement Maintenance Priority Matrix

Traffic Volume	Example	RRI	Repair Requirement Index				
			More than 12	12-10	10 to 7	7 to 5	Less than 5
			Very Urgent	Urgent	Routine	Routine	Monitoring
		corresponding VSN10-78 score	0	3	4	4	5
More than 25000	Dushanbe-Krugan Tyube (in Gissar)	International	Group1				
25000 - 7000	Dushanbe- Tursanzoda Dushanbe -Krugan Tyube (in KT)			Group2			
7000-3000	Vahdat - Romi Dusty - Nz Pianzi				Group3		
3000-1000	Chormagzak Yovon Kurgan Tyube- Dangara						
Less than 1000	Uzun - Jilkur Zardolu - Naizirak	National/ Local				Group4	

8 Standard Repair Method and Cost Estimation

8.1 Standard Selection of Repair Method

Standard selection flow for pavement repair method is show in Figure 12.

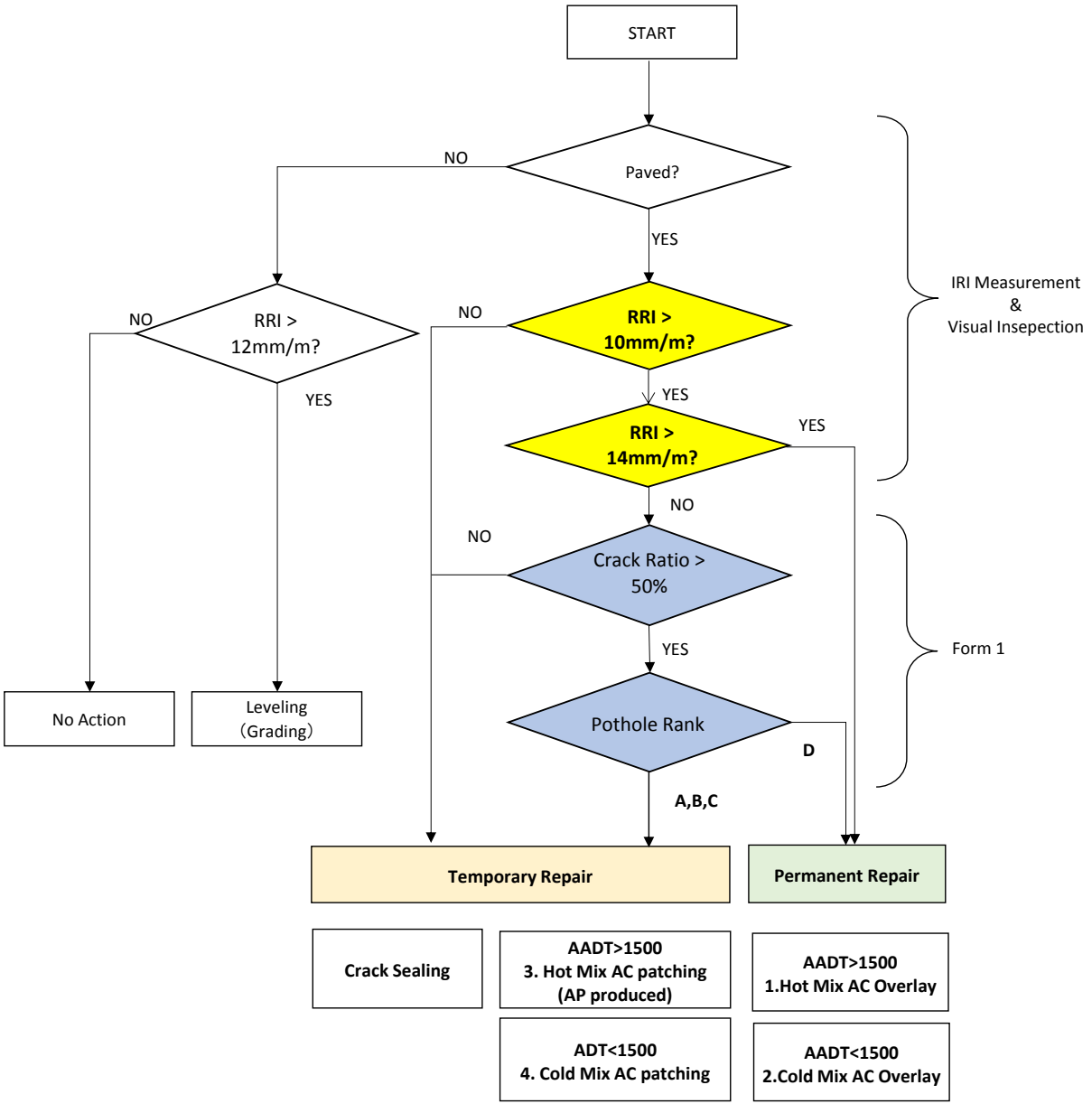


Figure 12 Selection of Pavement Maintenance

8.2 Estimation of Required Cost for Maintenance

For preliminary cost estimation for pavement maintenance, unit price shown in Table 20 is to be used. Breakdown of the unit cost is in Appendix 5.

Table 20 Unit Price of Pavement Repair Work

No	Repair method	Specification	Unit	Unit Price	Remark
1	Hot mix AC overlay	60/90, force account	Somoni/m2 (t=50mm)	43	AP produced including transport 100km
			Somoni/ton	342	
2	Cold mix AC overlay	70/130, force account	Somoni/m2 (t=50mm)	32	AP produced including transport 100km
			Somoni/ton	256	
3	Cold mix AC patching (AP produced)	70/130, force account	Somoni/m2 (t=50mm)	31	AP produced including transport 100km
			Somoni/ton	251	
4	Cold mix AC patching (Manual produced)	70/130, force account	Somoni/m2 (t=50mm)	24	Manual produced at SEHM (including transport 100km)
			Somoni/ton	193	

As of 2016 April

9 Conduct of Pavement Inspection

9.1 Inspection Team

Following team members and assignments are recommended for pavement inspection.

Table 21 Inspection Team

Position	Assignment
1. Team leader	● Overall management of inspection, schedule making, data analysis and management.
2. IRI measurement devise (ex.DRIMS) operator	● To set DRIMS to a vehicle ● To measure IRI ● To manage surveyed data ● To instruct beginning point and end point of the survey road.
3. Visual Inspector	● To judge crack rate and pothole rank
4. Recorder	● To record inspection result to Form 1
5. Driver	● To drive inspection vehicle, keep distance

9.2 Requirement of Skill and Knowledge

Table 22 shows the requirement of skill and knowledge for the team members.

Table 22 Requirement of Skill and Knowledge

Position	Requirement
1. Team leader	● Senior engineer class ● Management skill, experience of road maintenance and construction ● PC skill
2. Devise operator	● Sufficient knowledge and experience to operate devise. ● Training and calibration of the devise
3. Visual Inspector	● Sufficient knowledge and experience to judge crack rate and pothole rank ● Visual inspection training course (ex. JICA training)
4. Recorder	● Basic knowledge of IRI and Visual Inspection
5. Driver	● Understanding of the inspection objectives and able to drive with respect*.

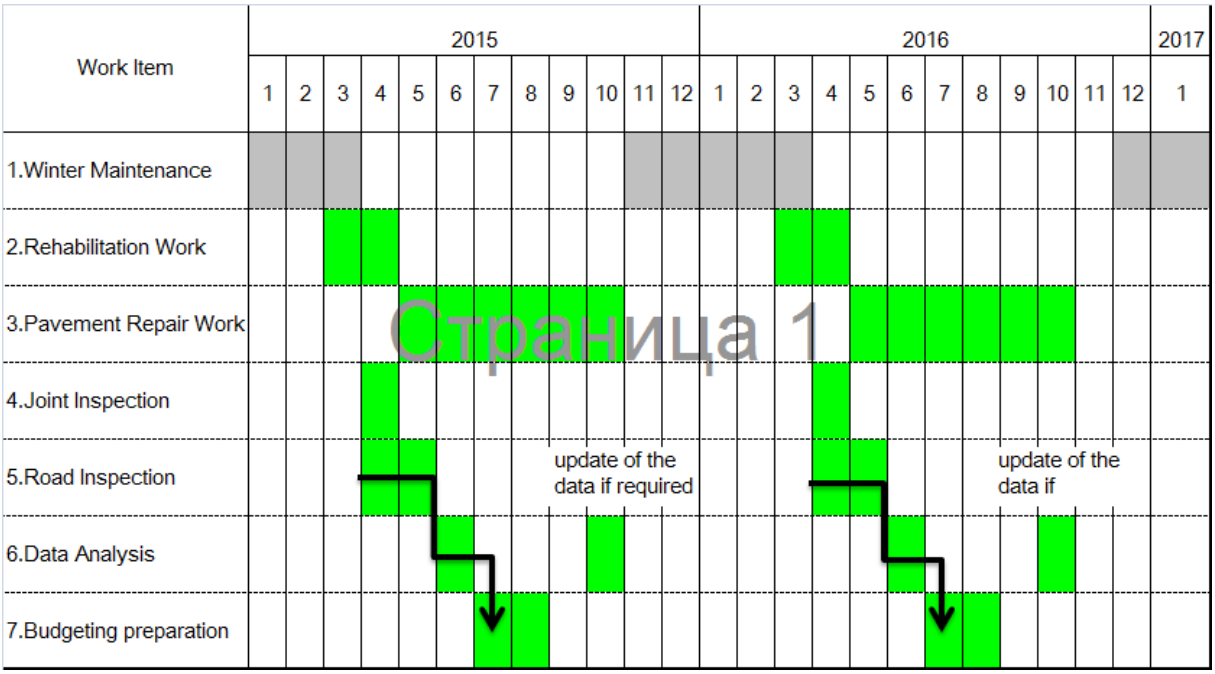
** For inspection purpose, the inspection vehicle needs to drive on damaged section of the road. Otherwise the inspection result does not reflect actual condition. The drive must understand the objective correctly and drive his vehicle.*

9.3 Pavement Inspection Schedule

Pavement inspection shall be conducted from April and completed by end of May.

Based on the survey data, maintenance plan for the next fiscal year shall be developed.

Table 23 Standard Schedule of Pavement Inspection



10 Required Cost for Pavement Inspection

For conducting IRI survey by using DRIMS, average cost per km is shown in Table 24. For cost estimation, not only fuel cost necessary for measured length but also the cost for returning to the original point as well as daily allowances should be considered.

Breakdown of the unit cost is in Appendix 5.

Table 24 Unit Price of Pavement Inspection

Item	Specification	Unit Cost
Pavement inspection	● IRI survey by DRIMS ● Visual Inspection	1.1~1.3 Somoni / km

11 Application of the Pavement Inspection Result to the Annual Road Safety Inspection

Annual Road Safety Inspection is conducted annually to check the road facility to secure the safety of the road traffic together with Ministry of Transport and Police Department. The result is evaluated in accordance with VSN10-87.

Pavement Inspection result can use to this Annual Road Safety Inspection as shown below;

Table 25 Evaluation items in VSN10-87 and use of Pavement Inspection Result

Evaluation Item (VSN 10-87)	Application
1. Pavement with coating 1.1 Improved type 1.2 Crushed Stone, gravel, ground and improved pavement	Applicable Average IRI for evaluation of the surface condition * the surface condition of the winter season should collect by interview to SEHM（Table 26 Evaluation **of VSN10-87 Item by IRI (Draft)**）
2. Road bed and drainage	Not applicable
3. Artificial Construction	Not applicable
4. Road Safety Equipment	Not applicable
5. Road Facility (plant, bus stop etc.,)	Not applicable

Table 26 Evaluation of VSN10-87 Item by IRI (Draft)

Road element	List of defects			
	(5)	(4)	(3)	(0)
1	2	3	4	5
1. Pavement with coating: 1.1 Improved type	No defects No snow cover on pavement; icy roads filling with deicing agents in estimated date agreed with traffic police	Surface scaling, surface roughness, lack of sanding in places of bitumen spreading; unfilled joints and cracks with mastic Snow on pavement, filling with deicing agents in estimated date agreed with traffic police	Flaking, holes, shift, wheel tracking; edge failure of road way, slab edge and curb; unfilled joints and cracks with mastic, hollow spots, surface roughness because of breakdown in process of hollow spots elimination, garbage on roadway Packed snow filling with deicing agents in estimated date agreed with traffic police	Hollow spots, gaps; water stagnation, foreign objects on roadway, which could be a cause of emergency situation in the absence of relevant road signs Packed snow and ice haven't filled with deicing agents in estimated date agreed with traffic police
Average IRI	**0-3**	**3-7**	**7-10**	**>10**
	No defects	**Cracks observed**	**Pothole observed**	**Pothole and settlement (difficult to drive safely)**
1.2 Crushed stone, ground and improved pavement	No defects Flat packed snow is up to 5sm or black ice, filling with deicing agents in estimated date agreed with traffic police	Separate damages of cross section Flat packed snow is more 5sm, filling with deicing agents in estimated date agreed with traffic police	Flaking, wheel tracking, comb, water stagnation on roadway, presence of non-cohesive crushed stone or gravel, garbage, flaking of pavement. Soft snow is no more 20sm.	Hollow spots, water stagnation on roadway, foreign objects which could be a cause of emergency situation in the absence of relevant road signs Packed snow and ice haven't filled with deicing agents in estimated date agreed with traffic police
Average IRI	**0-7**	**7-10**	**10-15**	**>15**
	No defect	**Damage outside of the carriage way**	**Corrugated**	**Pothole and water stagnation**

12 Use of DRIMS for IRI Measurement

12.1 Classification of IRI Data Collection Methods

The IRI was first presented by the World Bank Technical Paper Number 46, which suggested grouping various measuring methods into four classes, based on the ability of equipment providing IRI measurement and calculation results. The classification of methods is shown in Table 27.

Table 27 Classification of Measuring Methods

Equipment Class	Description	Accuracy	Cost	Operational Performance
Class I: Precision Profiles 	This class represents the highest standards of accuracy for measurement of IRI. A Class 1 method requires that the longitudinal profile of a wheeltrack be measured (as a series of accurate elevation points closely-spaced along the travelled wheelpath) as a basis for calculating the IRI value.	High	High	Low
Class II: Other Profilometer Methods 	This class includes all other methods in which profile is measured as the basis for direct computation of the IRI , but which are not capable of the accuracy required for a Class 1 measurement.	High	Moderate	Middle
Class III: IRI Estimates from Correlations → ***DRIMS*** 	This class includes other roughness measuring instruments capable of generating a roughness numeric reasonably correlated to the IRI. The measures obtained can be used to estimate IRI through regression equations if a correlation experiment is performed.	Middle	Low	High
Class IV: Subjective Ratings	There are situations in which a roughness data base is needed, but high accuracy is not essential, or cannot be afforded. Still, it is desirable to relate the measures to the IRI scale. In those cases, a subjective evaluation involving either a ride experience on the road or a visual inspection could be used.	Low	Low	High

12.2 Use of DRIMS for IRI Measurement

DRIMS is an innovative IRI measuring equipment developed by a group of transport engineering academicians in Japan. The achievement has led to a private Japanese firm to introduce the technology in Japan and in the world. DRIMS has been introduced since 2008 in countries such as Kyrgyz, Kenya,

South Sudan, Cambodia, Vietnam, Myanmar and the Philippines.

The JICA Experts Team proposed the use of DRIMS under the project and has had a successful record of obtaining IRI measurement data for international roads and republican roads in Tajikistan.

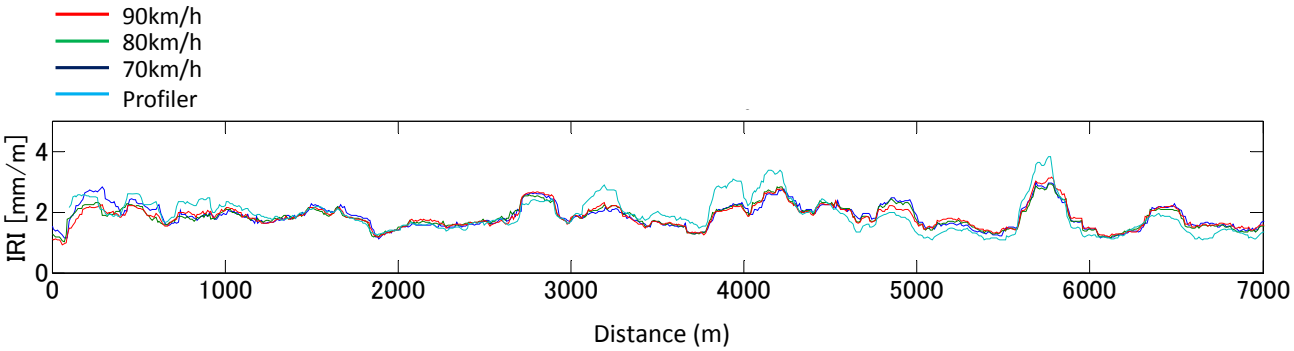


Figure 13 Comparison between IRI Estimated by DRIMS and Measure by Road Profiler

Table 28 Performance Summary

Performance	Value
Repeatability	< 0.5mm/m
Accuracy	< 1.0mm/m at good condition roads
Measurement vehicle	Not limited to specific one
Drive speeds	30-110km/h
Distance per day	500-1000km/day

12.3 DRIMS Future Outlook

DRIMS would be further applied to several oversea projects undertaken by JICA. In addition, DRIMS in projects financed by the World Bank is scheduled to be evaluated in the near future. DRIMS are planned to be evaluated against accuracy of road profilers using standardized tests at Public Works Research Center, Japan within 2016.

12.4 DRIMS Contact

Jip Techno Science Corporation is the Japanese supplier of DRIMS, under the support of University of Tokyo. For inquiries or information on DRIMS, contact the following. Please note that DRIMS covers software, accelerometer, DAQ and GPS only. Lap top computers are not included.

Department in Charge	Tokyo Technical Sales Department Infrastructure solutions Division
Email Address	drims_project@cm.jip-ts.co.jp

Appendix 1

Inspection Result Recording Forms

Form 1: Pavement Inspection Form

Form 2: Pavement Repair Cost Estimation Form

Form 3: Inspection Result Report Form

название дороги:

Форма 1

название дороги Road Name		Начало Starting Point		Длина Length		Средний МИШ Average IRI		МИШ > 10			12<ИПР		Дата осмотра Inspection Date	Измерение МИШ IRI MeAsurement	
ГУСАД SEHM		Конец Ending Point						МИШ > 7			10<ИПР<12			Визуальный осмотр Visual Inspection	

No	Раздел (КС) НАЧАЛО From	~	КОНЕЦ To	Ориентиро Landmark	Средний МИШ (100m) Average IRI (100m) (mm/m)		Пропорция трещины Crack Ratio (%)	Категория выбоины Pothole Rank (A,B,C)	Тип покрытия Pavement Type (As,Gr,Eth)	Коеф.трещин α Crack Correction α	Коеф.выбоин β Pothole Correction β	ИПР =МИШ*α*β RRI =IRI*α*β	Год строительства Construction Year	Ремонт в прошлом Repar History Год месяц Year Month	Наименование Work Item	Примечание Remark
1	0 KC + 0	~	0 KC + 100													
2	0 KC + 100	~	0 KC + 200													
3	0 KC + 200	~	0 KC + 300													
4	0 KC + 300	~	0 KC + 400													
5	0 KC + 400	~	0 KC + 500													
6	0 KC + 500	~	0 KC + 600													
7	0 KC + 600	~	0 KC + 700													
8	0 KC + 700	~	0 KC + 800													
9	0 KC + 800	~	0 KC + 900													
10	0 KC + 900	~	1 KC + 0													
11	1 KC + 0	~	1 KC + 100													
12	1 KC + 100	~	1 KC + 200													
13	1 KC + 200	~	1 KC + 300													
14	1 KC + 300	~	1 KC + 400													
15	1 KC + 400	~	1 KC + 500													
16	1 KC + 500	~	1 KC + 600													
17	1 KC + 600	~	1 KC + 700													
18	1 KC + 700	~	1 KC + 800													
19	1 KC + 800	~	1 KC + 900													
20	1 KC + 900	~	2 KC + 0													

Форма сметы ремонта покрытия

ГУСАД
SEHM _____

УАХ
SETM _____

Назв.дор
Road Name _____

Общ.длина
Total length _____ км

Интенсивность
Traffic Volume _____

Коментария инженера
Comment from Maintenance Engineer

No	Состояние дороги Road condition	Длина Length (m)	Ср.ширина Average width (m)	К-во Quantity (m2)	Метод ремонта Repair Method	Цена Unit	Ед Unit Rate	Стоимость (Сомони) Cost (Somoni) = (7) x (8)	Примечание Remark
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1									
2									
3									
4									
5									
6									
7									
8	Всего Total								

Калькуляция стоимости ремонта **As of/ на** Форма3

No.	Раками рох Road ID	МДНРА SEHM	Рохи ахмият доштаи Int or national	Номгуи роххо Road Name	Саршавии рох Starting Point	Нуктаи охир. Ending Point	Дарозии рох. (km) Length	Traffic Volume	ИПР RRI			Стоимость (Сомони) Cost (Somoni)	
									Средний Average	>10	>7	per road/за дорогу	Total/Итого
1													
2													
3													
4													
5													
6													
7													
8													
9													
10													
11													
12													
13													
14													
15													
						Байнал International		**Ave.**				**Grand Total**	
						Чумхури National		**сред**				**Всего**	

Appendix 2

Pavement Distress Photo Album

DEFINITION OF DEFECT	**Urgency: Very High**	
Item: Paved Roads (Bitumen)	**Sub-Item: Surface**	**Defect: Alligator Cracking**

Alligator Cracking

Alligator cracking is a series of interconnecting cracks creating interconnected patterns. The cracks start at the bottom of asphalt surface and propagate to the surface, initially as one or more longitudinal parallel cracks. After repeated traffic loading, the cracks interconnect, forming many‐sided, sharp angled pieces that resemble chicken wire or the skin of an alligator. Alligator Cracking occurs normally only in areas subjected to repeated traffic loading, such as wheel paths.

Possible Causes: Alligator Cracking

- Inadequate pavement thickness.
- Low modulus base.
- Brittle base or wearing course (e.g. cemented aged).
- Fatigue failure of asphalt pavement due to repeated traffic loading.

Effect (if neglected):

- Allows water to enter the pavement causing softening and weakening of the pavement and layers.
- This may cause early failure of the pavement.
- If severe, cause uneven ride for the motorist and may reduce traffic speed.

Inspection Method:

- Quantification of length.

Inspection Tools:

- Tape,
- Camera.

DEFINITION OF DEFECT	**Urgency: Small**	
Item: Paved Roads (Bitumen)	**Sub-Item: Surface**	**Defect: Transverse Cracking**

Transverse Cracking

Transverse cracks run perpendicular to the direction of traffic flow. Transverse cracks can start at the curb or shoulder, be contained in only one lane, or extend completely across the roadway. These cracks can also start in the middle of a lane or at the centerline.

Possible Causes:

- Reflection of shrinkage crack or joint in underlying base(common with Portland cement concrete or cemented materials).
- Construction joint or shrinkage crack (due to low temperatures or bitumen hardening) in asphalt surfacing.
- Structural failure of Portland cement concrete base.

Effect (if neglected):

- Allows water to enter the pavement causing softening and weakening of the pavement and layers.
- This may cause early failure of the pavement.
- If severe, cause uneven ride for the motorist and may reduce traffic speed.

Inspection Method:

- Quantification of length.

Inspection Tools:

- Tape,
- Camera.

DEFINITION OF DEFECT	**Urgency : Small**	
Item: Paved Roads (Bitumen)	**Sub-Item: Surface**	**Defect: Longitudinal Cracking**

Longitudinal Cracking

Longitudinal cracks occur parallel to the direction of traffic flow. Longitudinal cracks can occur along the centerline, in mid‐lane, in the wheel tracks and along the edge. Cracks can be relatively short in length or run the entire length of a pavement section.

Longitudinal Cracking

Reflection of shrinkage crack or joint in underlying base (common with Portland cement)

- Concrete, cemented base of asphalt surfacing.
- Poorly constructed paving lane joint in asphalt surfacing.
- Daily temperatures cycle or asphalt hardening.

Effect (if neglected):

- Allows water to enter the pavement causing softening and weakening of the pavement and layers.
- This may cause early failure of the pavement.
- If severe, cause uneven ride for the motorist and may reduce traffic speed.

Inspection Method:

- Quantification of length.

Inspection Tools:

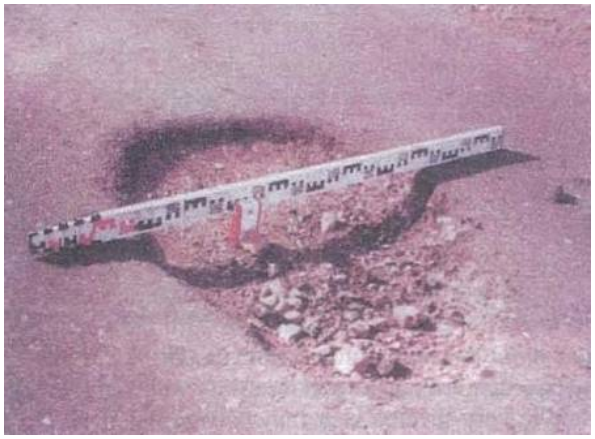
- Tape,
- Camera.

DEFINITION OF DEFECT	**Urgency: High**	
Item: Paved Roads (Bitumen)	**Sub-Item: Surface**	**Defect: Pothole**

Pothole

A defect on the surface of the paved (bitumen) roads.

Potholes are small bowl –shaped depressions on the pavement surface/base course, usually less than one meter in diameter. They generally have sharp edges and vertical sides near the top of the hole. Their growth is accelerated by free water collecting inside the hole. Potholes are reproduced when traffic abrades small pieces of pavement surface. The pavement then continues to disintegrate because of poor surface quality, weak spots in the base or sub grade, or because of severe alligator cracking. Most potholes are due to structurally related distress, and should not be confused with raveling and weathering. When holes are created by high-severity alligator cracking, they should be identified as potholes.



Possible Causes: Pothole

- Asphalt content too low,
- Excessive heating of asphalt,
- Poor quality mixtures,
- Lack of compaction allowing ingress of water.
- Excessive axle loads,
- Mechanical damage to the road due to poor reinstatement of roads after services installations,
- Injury to pavement,
- Spills or leakages.

Effect (if neglected):

- Allows water to enter the pavement causing softening and weakening of the pavement and lower layers, his may cause early failure of the pavement,
- If left unrepaired, damage can rapidly expand,
- Can create poor rides quality for motorist and may reduce traffic.

Inspection Method:

- Quantification of length, width, depth and number of potholes

Inspection Tools:

- Tape,
- Camera.

DEFINITION OF DEFECT	**Urgency: High**	
Item: Paved Roads (Bitumen)	**Sub-Item: Surface**	**Defect: Rutting/Deformation**

Rutting/Deformation

Rutting is characterized by longitudinal depressions in the pavement surface that ccur in the wheel paths of a roadway.

Possible Causes:

- Inadequate pavement thickness,
- Inadequate compaction in surfacing or base,
- Inadequate strength (stability) in surfacing or base,
- Excessive bitumen in mix,
- Excessive axle loads.

Effect (if neglected):

- If water is able to penetrate into the body of the pavement, there will be a rapid increase in the degree of rutting, which often leads to cracking and the breaking up of the pavement, if excessive, can reduce serviceability and reduce vehicle travel speeds and in very severe cases, may be an accident risk.

Inspection Method:

- •Quantification of average depth.

Inspection Tools:

- Tape,
- Camera.

DEFINITION OF DEFECT	**Urgency : High**	
Item: Paved Roads (Bitumen)	**Sub-Item: Surface**	**Defect: Frost Heaving**

Frost Heaving

- Frost heaving is characterized by longitudinal depressions in the pavement surface.
- Asphalt surface is more strongly cooled than other natural surface especially when snow is removed from the suface.
- The defrection is caused by the ice lenz in the soil.

Possible Causes:

- High grand water level
- Water contents in the base course or road bed frozen and push pavement surface which caused surface defection.
- Loss of the bearing force by melting ice in the pavement
- High water contents in the base course

Effect (if neglected):

- Surface deflection
- Loss of bearing force of the pavement
- Destruction of the pavement

Inspection Method:

- Visual Inspection

Inspection Tools:

- Visual Inspection
- Camera.

DEFINITION OF DEFECT		**Urgency : Low**
Item: Paved Roads (Bitumen)	**Sub-Item: Surface**	**Defect: Thermal Crack/ Low Temperature Crack**

Thermal Crack/ Low Temperature Crack

- Cracks caused by shrinkage of the asphalt mixture by low temprature. It is observed in the cold weather area.
- Traverse crack at the equal interval of 10m to 20m is observed.

Possible Causes:

- Shrinkage of the asphalt mixture by low Temperature
- Insufficient pavement thickness

Effect (if neglected):

- This crack is normally limited only surface course but required treatment such as sealing of the crack to avoid penetration of water.
- Monitoring regular inspection is recommended.

Inspection Method:

- Visual Inspection

Inspection Tools:

- Visual Inspection
- Camera.

DEFINITION OF DEFECT	**Urgency: Middle**	
Item: Paved Roads (Bitumen)	**Sub-Item: Surface**	**Defect: Reflection Crack**

Reflection Crack

- Crack due to existing crack of the under layer structure of the pavement such as joint of base course, crack of the cement stabilized course etc.,
- Crack of the asphalt pavement which is paved over the old concrete pavement. Cracks of under layed concrete pavement cause the cracks
- Cracks found on the overlay pavement which is constructuted on the surface without sufficient remedy of the defects such as potholes.

Possible Causes:

- Crack of underneath layer
- Possible by underground structures (pipe culvert etc.,)

Effect (if neglected):

- Crack expand to larger defects such as pothole

Inspection Method:

- Visual Inspection

Inspection Tools:

- Visual Inspection
- Camera.

DEFINITION OF DEFECT		**Urgency : High**
Item: Paved Roads (Bitumen)	**Sub-Item: Surface**	**Defect: Uneven settlement**

Uneven Settlement

- Normally longitudinal crack along the road at the border of embankment and cut cause of settlement of embankment.
- Also observed at the concret structure due to unsifficient compaction.

Possible Causes:

- Difference of bearing force between cut and embankment
- Insufficient compaction at small area
- Loss of bearing force by penetrating of rain water into base course
- Consolidation

Effect (if neglected):

- Possible to cause large scale slope failure

Inspection Method:

- Visual Inspection

Inspection Tools:

- Visual Inspection
- Camera.

DEFINITION OF DEFECT		**Urgency : Small**
Item: Paved Roads (Bitumen)	**Sub-Item: Surface**	**Defect: Corrugation**

Corrugation

- Plastic deformation of the surface with waving at small pitch on the longitudinal direction
- The deformation disturbs confortablity of the drivers by giving vibration.

Possible Causes:

- Loss of the stability of asphalt mixture at high temperature
- Insufficient construction of prime coat and tack coat
- Excessive moisture in the base course and air void in the asphalt mixture
- It may be caused by breaking and vibration by the vehicle passing.

Effect (if neglected):

- Loss of conformability of drive
- Slide of surface layer, extend to the potholes

Inspection Method:

- Visual Inspection

Inspection Tools:

- Visual Inspection
- Camera.

DEFINITION OF DEFECT		**Urgency: Very High**
Item: Paved Roads (Bitumen)	**Sub-Item: Surface**	**Defect: Heaving/ Shoving**

Heaving/ Shoving

Usually heaving/shoving occurs on either side of the wheel tracks. The irregularities are associated with deformation and subsidence.

Possible Cause

- Ingress of water: reduced bearing capacity of the pavement.
- Materials: of poor quality.
- Workmanship: insufficient compaction.
- Traffic: passage of vehicles which are too heavy for the pavement structure

Effect (if neglected):

- Forcing up of weak materials as deformation occurs.
- Progressive disintegration of the pavement.

Inspection Method:

- Scaling of length.

Inspection Tools:

- Tape,
- Camera

DEFINITION OF DEFECT	**Urgency : Low**	
Item: Paved Roads (Bitumen)	**Sub-Item: Surface**	**Defect: Stripping/fretting**

Stripping/fretting

Stripping/fretting is the wearing away of the pavement surface caused by the dislodging of aggregate particle and loss of asphalt binder. This generally indicates that the asphalt binder has hardened significantly. Loss of coarse aggregate of a sprayed seal that leaves the binder exposed to tire contact can happen bit by bit, or over a localized area.

Possible Cause

- Low binder content,
- Poor binder to stone adhesion (dirty aggregate, ineffective pre‐coating with adhesion agent or wet stone,
- Ageing or absorption of binder,
- Stone deterioration,
- Inadequate rolling before opening of seal to traffic,
- I incorrect bleeding of binder,
- Poor workmanship.

Effect (if neglected):

- Progressive breaking away of chippings resulting in surfacing becoming more slippery and more permeable.

Inspection Method:

- Quantification of length.

Inspection Tools:

- Tape,
- Camera.

DEFINITION OF DEFECT	**Urgency : Low**	
Item: Paved Roads (Bitumen)	**Sub-Item: Surface**	**Defect: Bleeding**

Bleeding

Bleeding is a film of bituminous material that covers the pavement surface and which creates a shiny, glass like appearance. It occurs when asphalt fills the void of the mix during hot weather and then migrates to the pavement surface.

Possible Cause

- Excessive application of binder with respect to stone size.
- Excessive prime coat incorporated into the seal
- Excessive binder in underlying surface (patches or flushed area)
- Prime seal covered before volatiles in primer binder evaporated.

Effect (if neglected):

- Road surface becomes slippery and hazardous to traffic,
- Separation and breaking away of surface layer due to traffic.

Inspection Method:

- Quantification of length.

Inspection Tools:

- Nil

DEFINITION OF DEFECT		**Urgency : Low**
Item: Paved Roads (Bitumen)	**Sub-Item: Surface**	**Defect: Polishing**

Polishing

- The condition of the surface with loss of slip resistance due to corse aggregate and mortal is polished by vehicle

Possible Causes:

- Use of aggregate with insufficient flakiness
- Excessive friction to the road surface by large vehicles (especially at curves)

Effect (if neglected):

- Loss of slip resistance
- Extend to pothole

Inspection Method:

- Visual Inspection

Inspection Tools:

- Visual Inspection
- Camera.

DEFINITION OF DEFECT		**Urgency: High**
Item: Paved Roads (Bitumen)	**Sub-Item: Surface**	**Defect: Delaminate of binder, Slipping**

Delaminate of binder, Slipping

- Surface course is delaminated due to the sharing stress between layers.

Possible Causes:

- Insufficient joint between pavement layers.
- Water penetration into the pavement layers.
- Excessive tack coat or insufficient tack coat
- Excessive difference of the elasticity between layers.

Effect (if neglected):

- May grow rapidly to the large defect
- Large deflection of the surface

Inspection Method:

- Visual Inspection

Inspection Tools:

- Visual Inspection
- Camera.

DEFINITION OF DEFECT		**Urgency : Middle**
Item: Paved Roads (Bitumen)	**Sub-Item: Surface**	**Defect: Edge Damage**

Edge Damage

Edge damage is a difference in elevation between the pavement edge and the shoulder and occurs along the edge of the pavement.

Possible Cause

- Shoulder wears (formation of step),
- Erosion by water,
- Insufficient compaction at edges of bituminous pavement.
- Road too narrow,
- Excessive axle loads.

Effect (if neglected):

- Rapid deterioration during rainy season,
- Traffic will worsen defect.

Inspection Method:

- Quantification of % of length and average depth.

Inspection Tools:

- Tape

DEFINITION OF DEFECT	**Urgency : Low**	
Item: Paved Roads (Bitumen)	**Sub-Item: Surface**	**Defect: Waving**

Waving

Undulations in road surface of a wavelength longer than corrugations.

Possible Cause

- Poor quality material,
- Variation in compaction and bearing capacity of lower layers,
- Poor quality or lack of prime coat or tack coat,
- Material not suited to temperature range.

Effect (if neglected):

- In hot weather, surface stripping can occur,
- Poor ride quality for motorists.

Inspection Method:

- Defect ranking

Inspection Tools:

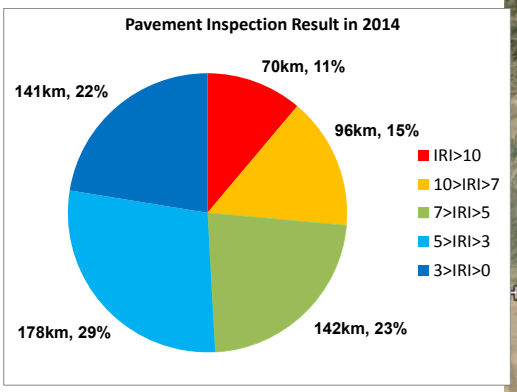
- Nil

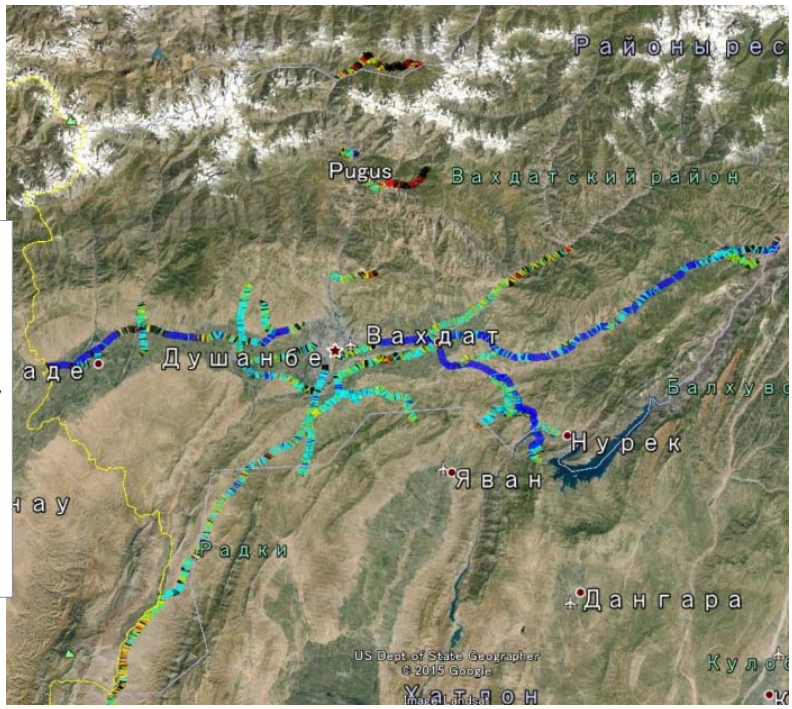
Appendix 3

Samples of Pavement Inspection Results

IRI MEASUREMENT RESULT 2014 IN GISSAR SETM

IRI Value	Road Condition	
3.0<		Excellent
3.0 to 4.99		Good
5.0 to 6.99		Fair
7.0 to 10.0		Poor
>10.0		Bad
NaN or white No.		Out of Speed Range



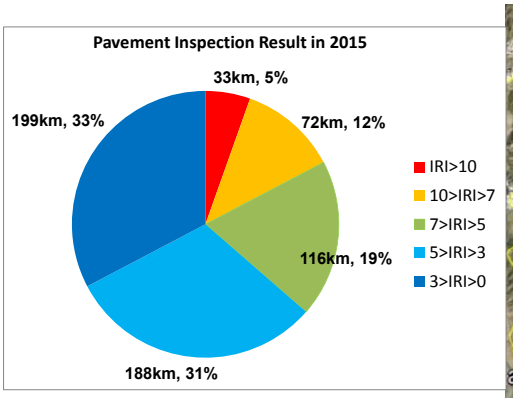


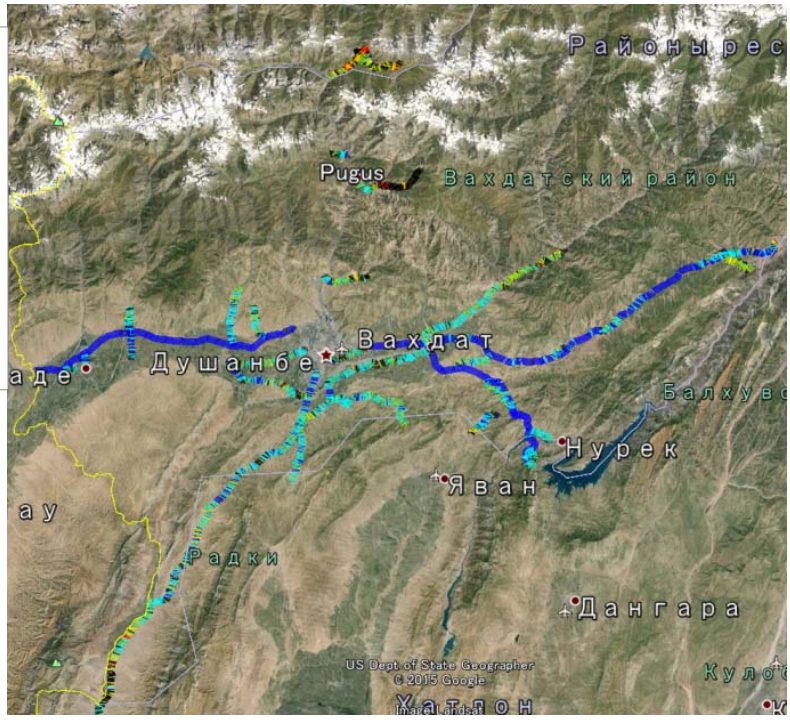
Gissar SETM

IRI>10	70km	11%
10>IRI>7	96km	15%
7>IRI>5	142km	23%
5>IRI>3	178km	28%
3>IRI>0	141km	22%
Total	627km	100%

Average IRI=6.1

IRI MEASUREMENT RESULT 2015 IN GISSAR SETM





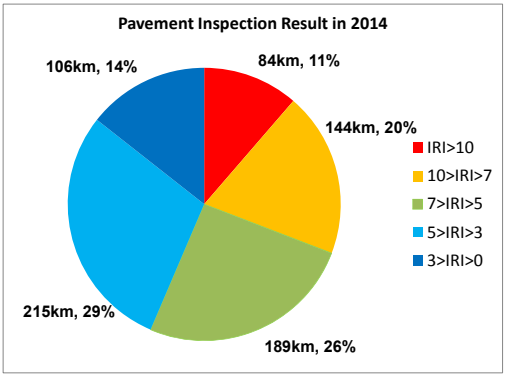
Gissar SETM

IRI>10	33km	5%
10>IRI>7	72km	12%
7>IRI>5	116km	19%
5>IRI>3	188km	31%
3>IRI>0	199km	33%
Total	608km	100%

Average IRI=4.9

IRI MEASUREMENT RESULT 2014 IN KURGAN TYUBE SETM

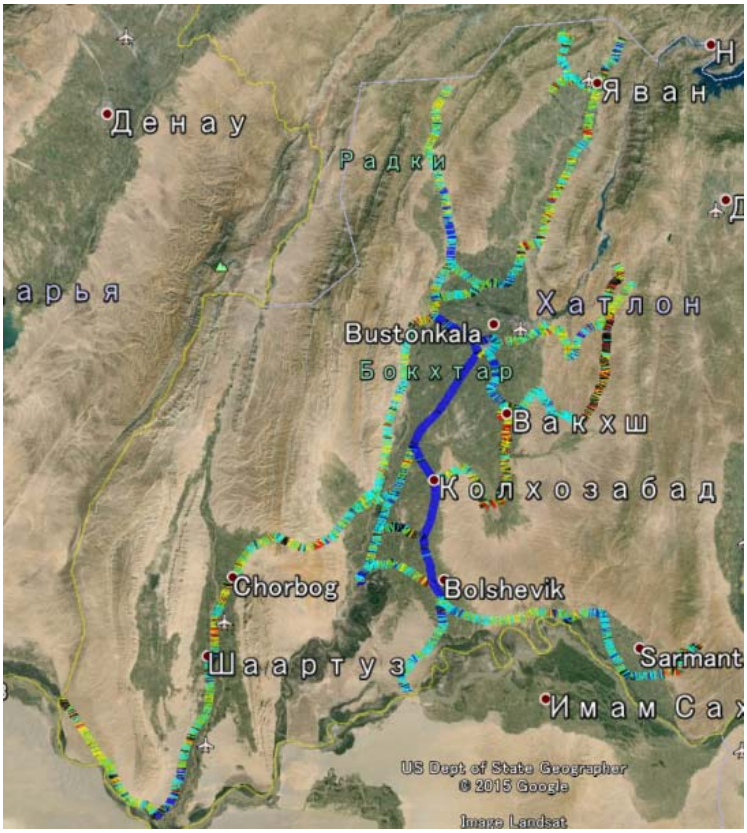
IRI Value	Road Condition	
3.0<		Excellent
3.0 to 4.99		Good
5.0 to 6.99		Fair
7.0 to 10.0		Poor
>10.0		Bad
NaN or white No.		Out of Speed Range



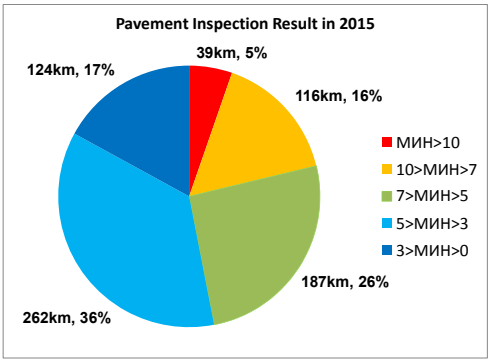
Kurgan Tyube SETM

IRI>10	84km	11%
10>IRI>7	144km	20%
7>IRI>5	189km	26%
5>IRI>3	215km	29%
3>IRI>0	106km	14%
Total	737km	100%

Average IRI=6.2



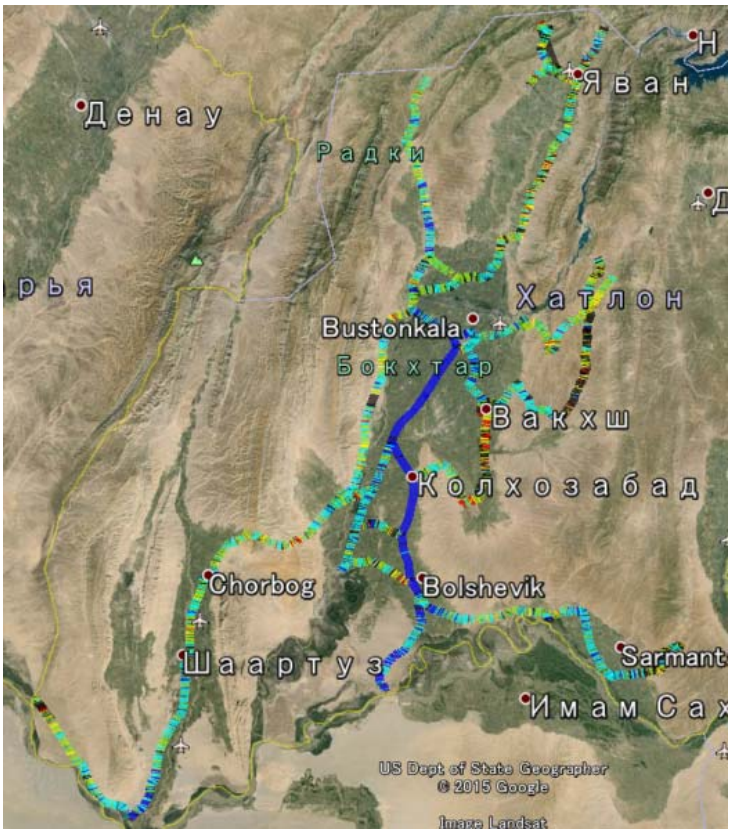
IRI MEASUREMENT RESULT 2015 IN KURGAN TYUBE SETM



Kurgan Tyube SETM

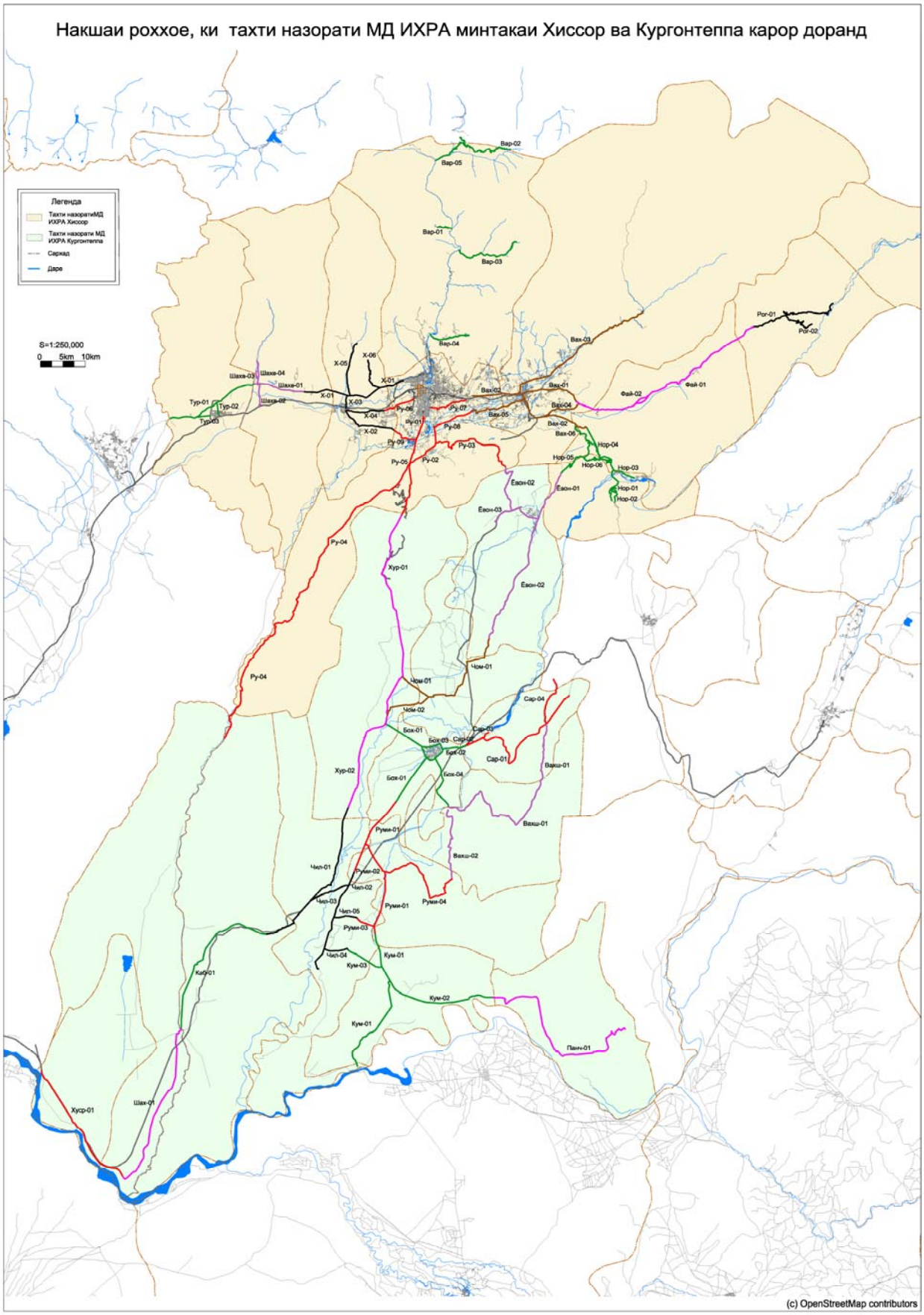
IRI>10	39km	5%
10>IRI>7	116km	16%
7>IRI>5	187km	26%
5>IRI>3	262km	36%
3>IRI>0	124km	17%
Total	728km	100%

Average IRI=5.4

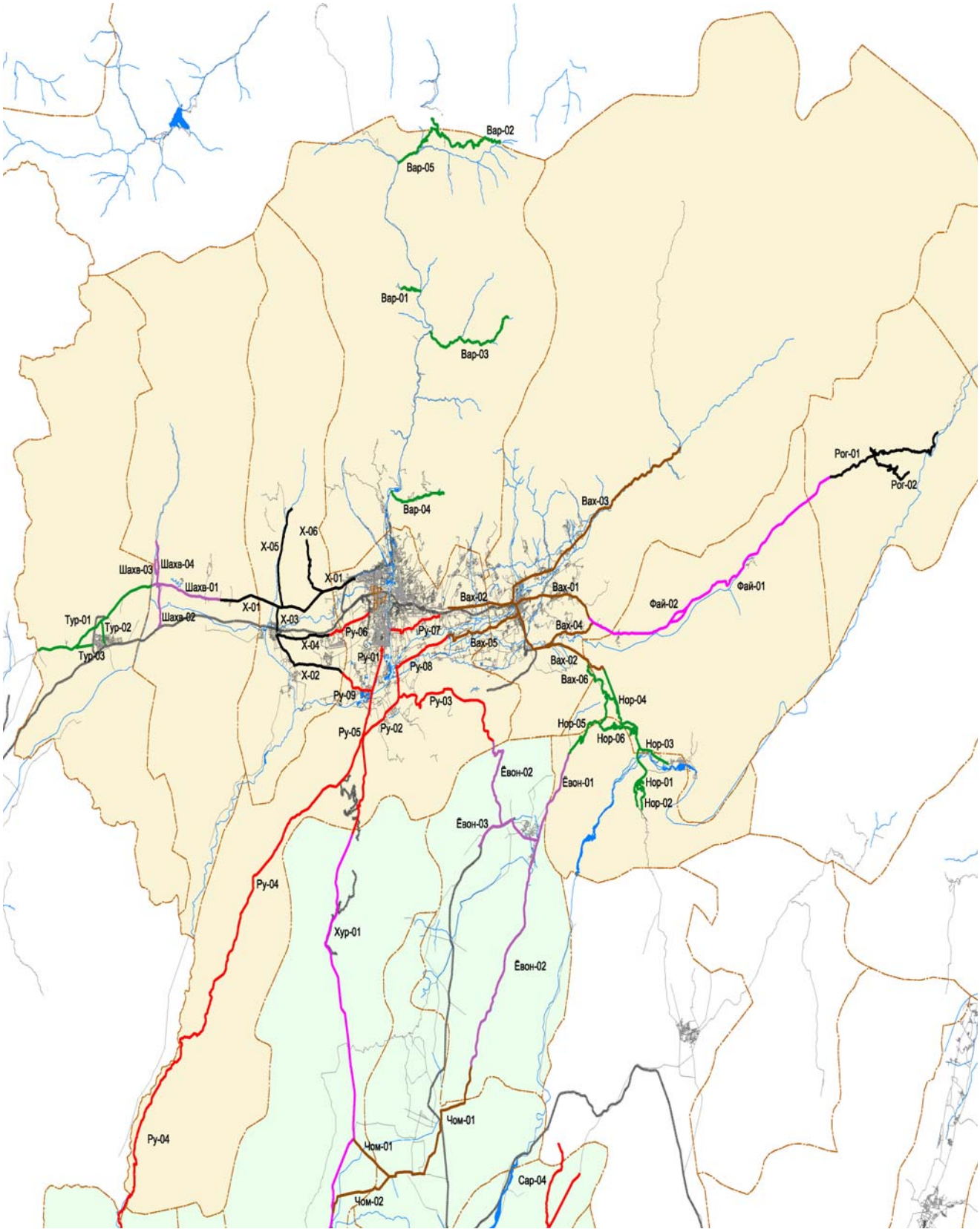


Appendix 4

Road Management Map


Накшаи роххое, ки тахти назорати МД ИХРА минтакаи Хиссор ва Кургонтеппа карор доранд
Легенда
Тахти назоратиМД ИХРА Хиссор
Тахти назорати МД ИХРА Кургонтеппа
Сархад
Дарё
S=1:250,000
0 5km 10km
(c) OpenStreetMap contributors

Road Management Map (Gissar area)



Road Management Map (Kurgan Tyube area)