Republic of Tajikistan
Ministry of Transport

Republic of Tajikistan
The Project for Improvement of Road Maintenance

Project Deliverables

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Project Deliverables

Project Deliverables	
ID	Tittle
PD-1	Pavement Inspection Guideline (Printed version)
PD-2	Pavement Repair Guideline (Printed version)
PD-3	Translation of Major specification
PD-4	PPT hands out pavement inspection workshop_2014
PD-5	PPT hands out pavement inspection workshop_2016
PD-6	IRI Summary 2016
PD-7	PPT hands out pavement repair workshop_2014
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PD-12	Hot-Mix material Applicability Map

PD-3

Instructions for evaluating the quality of the current repair and maintenance of roads VSN 10-87

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Document Status:	replaced
Russian name:	Instructions for evaluating quality of road maintenance (state)
Scope:	Instructions determine main provisions of evaluating road quality (state), hereinafter "maintenance" roads. Maintenance quality of road network 1, 2 and 3 are evaluated, served by region roads, highways (hereinafter "union") and their production units (Road Maintenance Units, RMU section), hereinafter "units", teams or master sections on the basis of instructions.
Summary	1. GENERAL PROVISIONS 2. PROCEDURE FOR EVALUATING THE QUALITY OF ROADS 3. ROAD MAINTENANCE QUALITY EVALUATION ANNEX 1 ANNEX 2 ANNEX 3 ANNEX 4 ANNEX 5 ANNEX 6 ANNEX 7
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Replaces:	• VSN 10-82 with amendments, approved by Ministry of highway 11/15/89
Replaced by the following:	• Interim Guidance on assessing the level of road maintenance FDR Russian Order 73 of 27.11.1997

MINISTRY OF HIGHWAY RSFSR

Instructions for evaluating the quality of the current repair and maintenance of roads VSN 10-87

APPROVED

By Ministry of Road RSFSR December 29, 1986

(As amended by November 15, 1989)

Moscow 1990

CONTENTS

RSFSR Ministry of Highway	Departmental regulations	BH 10-87
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1. GENERAL PROVISIONS

1.1. Instructions determine main provisions of road maintenance (state) evaluating quality, hereinafter "maintenance" of roads. Based on instructions, maintenance quality of road network 1, 2 and 3 are evaluated, which are served by region roads, highways (hereinafter "union") and their production units (Road Maintenance Units, RMU area), hereinafter "units", teams or master sections.

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1 Network of roads - set of road, served by Regional Department of Automobile Roads, roads or its subdivisions.

2 Road - road that connects geographic points.

3 Road section - section of the road (or the sum of segments roads) charged with one team (master section).

Included Rosdorni SRI, Vlad. PI KADI Kazakh branch Soyuzdorni, Trust "Orgdorstroy" Ministry of highway USSR, Trust "Lattehorgdorstroy" Minavtoshosdora Latvian SSR, Trust "Orgdorstroy" Ministry of highway Moldova SSR	Approved by Ministry of Highway RSFSR 29 December 1986	Compliance date 1 April 1987 (with amendments of 1 January 1990)

1.2. Quality evaluation is used to determine the level of serviceable roads or separate sections; forms the basis for planning tasks on maintenance quality and financial incentives to managers, professionals and unions employees and its branches, and workers employed in road maintenance. It is basis for determining amount of material incentive funds and salary fund for quality maintenance and preparation of appropriate forms of reporting, and evaluation of unions and its subsidiaries in general.

1.3. The quality of roads maintenance (sections) is evaluated by point system. Evaluation of road network is calculated from the results of quality evaluation of surveyed roads (sections) that are determined on the basis of assessments of individual road elements (∗1), listed in table. 1. Road elements evaluation is submitted on the basis of visual inspection by sequentially arranged sections by defects identification (∗2).

_____

(∗1) Road element - road design elements.

(∗2) Defects identification - section of road (equal to 1 km), which is graded by integer evaluation (5, 4, 3, 0).

1.4. Exempt from evaluation (under condition of traffic signs installation)

- Sections of roads exposed to natural disasters during the period established by relevant authorities;

- Dirt roads during muddy season;

- Sections or road elements suffered from accident during the period established by relevant authorities;

- Sections of road, where repair or reconstruction works are carried out at the time of inspection, only under condition of safe crossing of vehicles on them (if these conditions are not provided, this site is rated "0").

1.5. If road traffic accidents (RTA) are caused due to a fault of road service during evaluation period, the monthly assessment for this section is set "0".

2. PROCEDURE FOR EVALUATING THE QUALITY OF ROAD MAINTENANCE

Acceptance and inspection quality control of road maintenance is carried out in the following order.

Acceptance of road maintenance quality is carried out by Road Maintenance Units (∗3) Committee on a monthly basis – up to the 5th day of the month, following is the reporting period. The committee includes Chief Engineer (Deputy Chief of Operating) RMU, a representative of trade union organization, master and team manager who perform work on road maintenance, and also may include representatives of traffic police and road transport companies. Committee personnel are approved by Regional Department of Automobile Roads, on the proposal of RMU chief or head of RMU – under commission of Regional Department of Automobile Roads. The Committee evaluates the quality of road maintenance by overall road sections survey.

_____

(∗3) RMU, RMU section or other road subdivision is a part of Regional Department of Automobile Roads road.

Inspection quality control of road maintenance is carried out by Regional Department of Automobile Roads committee on a quarterly basis – up to the 10th of month, following the reporting quarter. The committee includes executive officers of Regional Department of Automobile Roads, road, traffic police and road transport companies. Committee personnel, order and control schedule is approved by Regional Department of Automobile Roads order. Committee's work is conducted in the presence of head or chief engineer who inspects RMU. Committee evaluates the quality of all national and republican road maintenance, as well as at least 25% length of local roads, served by RMU (during one year local roads network should be evaluated)(∗ 1).

_____

(∗1) Roads might independently develop and approve survey procedure of main serviced roads with the approval of Glavmagistral and Administration of Technology and Quality.

Committee of Regional Department of Automobile Roads, roads may hold extraordinary supervisory control of road quality maintenance on any road section.

The results of inspection control are executed with relevant act (annex No. 7).

Ministry systematically organizes inspection quality control of road maintenance by special schedule and taking into account work plan of comprehensive audits. Inspection control is carried out by Ministry executive officer in the presence of Deputy Chief, who is charge for road maintenance, or Regional Department of Automobile Roads chief engineer, road. The results of Ministry inspection control executed with relevant act, which is passed to Head of Regional Department of Automobile Roads, road.

Auditable organization submits to these committees following documents:

a) Road passport;

b) Approved according to established procedure scheme of road signs dislocation;

c) Inspection card for previous evaluation period;

d) Certificate of road accidents caused due to a road service fault registered in traffic police authorities.

3. CALCULATION OF QUALITY EVALUATION OF ROAD MAINTENANCE

3.1. Quality evaluation of road maintenance (section) is set by following formula:

$$S = \frac{P_{до} + P_{зп} + P_{ис} + P_{од} + P_{бо}}{П} \quad (1)$$

where *Рдо, Рзп, Рис, Род, Рбо* are maintenance quality indicators of road elements: pavement, roadbed, drainage, artificial structures, the situation of the road and landscaping;

П - number of estimated elements.

3.2. Quality value of each road element is determined by inspection during driving on the road; using total, sequential evaluation of defect sections (recommended form of defect list is presented in Appendix № 2). Filling order and inspection card of road (section) is shown in Appendix №3.

3.3. If one of defect section of road pavement is evaluated by score "0", then all over road section is *Рдо = 0*.

3.4. Monthly quality evaluation of maintenance for team (section), serving one road equated to evaluation, which is set by formula (1).

Monthly quality evaluation of maintenance for team (section), serving two or more roads, as well as monthly quality evaluation of subdivision maintenance is set by following formula:

$$S_{ср} = \sum_{i=1}^{n} S_i \cdot l_i / \sum_{i=1}^{n} l_i \quad (2)$$

where *Si* is quality evaluation of maintenance of *i*-road

li - length of *i* -road;

n - total number of evaluated roads.

3.5. Quarterly evaluation of maintenance quality for subdivision (union) is calculated using formula:

$$S_{кв} = \sum_{i=1}^{3} S_{мi} \cdot l_i \Big/ \sum_{i=1}^{3} l_i \quad (3)$$

where *Smi* - quality evaluation of maintenance of subdivision (union) for *i* month;

li - the length of estimated road in *i* month on this subdivision (union).

3.6. The annual quality evaluation of maintenance for subdivision (union) is calculated using the formula:

$$S_г = \sum_{i=1}^{4} S_{кв.i} \cdot l_i \Big/ \sum_{i=1}^{4} l_i \quad (4)$$

where *Sкв.i* is quality evaluation of maintenance for this subdivision (union) for *i* quarter;

Li - the length of estimated roads in *i* quarter in this subdivision (union).

Evaluation of road maintenance quality is reflected in the statistical reports on Form 4-CP (Roads) and is represented in superior organization at a stated time (instructions of Ministry of Highways RSFSR from 17.04.89 № GD-4/520).

ANNEX 1

Table 1

Defects grading 5, 4, 3, 0

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
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
2. Road bed and drainage	No defects On roadside with improved pavement is no snow cover The terms item 1,2 is observed for roadsides with stabilized crushed stone, gravel and ground	Uncleared trees and shrubs (after uprooting) on right of way, taking into account technology cycle; slight damages of roadside cross slopes; separate unfilled cracks with mastic on roadside with improved pavement Snow bank is on edge of road bed The terms item 1,2 is observed for roadsides with stabilized crushed stone, gravel and ground	On bask slope and reserve there are uncut grassy and trees and shrubs; nonobservance of roadside cross slope; pollution of right of way; excess of roadside edge over surface is less 40mm; unfilled cracks and edge damages with mastic on roadside with improved pavement Hollow spots, wheel tracking on road side Roadsides are cleared up from blockage no less than ½ widths. Snow protection equipment is broken	Scouring of roadsides and slopes, silting and water stagnation in gutters. Shrub is on roadside. Gutters damage. Excess of road surface edge is over 40sm of road border surface. Snow protection equipment is absent on sections and it is subject to snow drift. Roadsides are not cleared up from snow or cleared up from snow bank less than ½ width
3. Artificial construction:	Maintenance of bridge roadway and overpass is evaluated the same as item 1			
a) Bridges, overpass	No defects No snow cover on artificial construction; in the time of black ice it is filling with deicing agents	Slight damages (single sagging on superstructure surface, single hairline crack, small guard rail distortion)	Separate elements of damages without loss of stability; cracks, spalls in reinforced concrete constructions; damage in movement joint; pollution or absence of painting on artificial construction elements; exposure of	Lack of guard rails or channelizing devices, corrosion of metal elements of construction; damages of guard rails, sidewalk, movement joints, strengthening of cones and slopes. Exposure of rigid

			reinforcement	reinforcement in girders of superstructure, cracks on sidewalk, centre rib of girder, console of superstructure; elements gap of continuous girder; mud on metal substructure, roadway slab leaching which forms stalactites; poles damages, pier scouring
b) pipes	No defects	Lack of whitewashing or pipe portal painting	Cracks, pipes elements spalls, small subsidence of elements and silting of pipes holes	Portal damages, pipes silting are more than ¼ diameter; pipes holes haven't closed with shield during winter period. Trees and shrubs became overgrown in and out of pipes holes
4. Road condition (road safety management)	No defects Road signs, marking, guardrails and sidewalk are cleared up from snow	Slight pollution (snow-covered) or damages on horizontal and vertical marking, road signs, but it doesn't make difficult to their visibility. Slight pollution or sidewalk pavement damages, underground crosswalk, warning column of emergency network	Signs and guardrail are installed with violation of GOST. Pollution (snow-covered), damages and other reasons, cause difficulties to visibility of horizontal and vertical marking, guardrails, signs, guide devices. Disorganized exit, imperfect marking making, major damages on sidewalk pavement. Pollution, painting damages and coating, lack of light of	Lack of guardrails in necessary places or their major damages without appropriate marking. Absence (according to dislocation), pollution (snow-covered) or road signs damages, which cause difficulties to visibility

			underground crosswalk, defects of separate elements of emergency network	
5. Improvements and planting (enclosed bus stop, rest area, parking site, toilets, variety entertainment and others)	No defects Landing sites on bus stops, parking site, rest areas are cleared from snow, if black ice it is filling with deicing agents	Slight pollution (snow-covered) of improvements elements	Small damages and lack of benches, garbage cans in necessary places. Landing sites, parking site are wasty, not fully cleared up from snow, damages on pavements	Insanitation, damages on improvements elements; black ice on landing site, parking site and rest area, are not filling with deicing agents in estimated date agreed with traffic police

ANNEX 2

List of Defects

Name of revealed defect	Location section (km), where defect is revealed	Remarks

ANNEX 3

Road (section) inspection card _____

(name of road, section, pavement type)

length _____ km _____ road class

Road element	Quality evaluation of inspected section of damage detection road *Ri*	Location of damage detection sections (km), which has current quality evaluation	Total damage detection sections, which have current quality evaluation $\sum_i$	Overall evaluation of damage detection, which have equal quality $i\sum_i$	Road quality evaluation on this element $P=\frac{\sum i \cdot n_i}{\sum n_i}$
1	2	3	4	5	6
Road pavement from	0 3 4 5				Рд.о.=
Road bed	0 3				

	4 5				Рз.п.=
Artificial construction	0 3 4 5				Ри.с.=
Road conditions (road safety management)	0 3 4 5				Ро.д.=
Improvements and planting	0 3 4 5				Рб.о.=

Total evaluation of inspected road maintenance

$$S = \frac{P_{з.п.} + P_{и.с.} + P_{о.д.} + P_{б.о.}}{n}$$

Date of road inspection "_____" _____ 19_____	Committee chairman Committee member

Filling order and road (section) inspection card processing

1. Each inspected section damage detection for each road element is evaluated by rating 5, 4, 3, 0, depending on revealed defects.

2. Section location of damage detection is filled in inspection card, depending on rating.

   If defects are revealed on some damage detection section and rating is different, so for this section the lowest rating is accepted.

3. Index of maintenance quality of each road element (*P*) is calculated according to following formula:

$$P = \frac{\sum R_i \cdot m_i}{\sum m_i}$$

where *Ri* is quality evaluation of damage detection (0, 3, 4, 5);

$\sum m_i$ is number of damage detection sections.

4. By value (*P*) of road elements, quality evaluation of road maintenance (*S*) is calculated using formula 1.

5. Column 3 of inspection card might be not filled according to committee judgment. In such

case, sum of damage detection sections are determined by list of defects and then filled into column 4 of card inspection which have rating 0, 3, 4, 5.

ANNEX 4

(Sample of filling)

List of defects of Pytalovo Belarus road with asphalt concrete pavement and 10km length of Local Road

Name of revealed defect	Location of sections (km), where current defect is revealed	Remarks
1	2	3
Flaking	2, 3, 6, 10	
Lack of sanding in places of bitumen spreading	4, 5, 7, 8, 9, 10	
Water stagnation in gutters	1, 5	
Nonobservance of roadside cross slope	4-10	
Uncleared trees and shrubs (after uprooting)	2, 3, 4, 5, 9	
Absence of guardrails on bridges	1, 3	
Damages on separate elements of railing	1, 2, 5, 8, 10	
Bridge small damages	2, 4, 5, 6, 8, 10	
Lack of road signs	4, 5	
Disorganized exits	1-4, 10	
Insignificant signs pollution	2, 5, 6, 8, 9	
Enclosed bus stop damages	10	
Lack of benches, garbage cans in necessary places	1-5, 8	
Slight pollution of improvements elements	2, 3, 7, 9, 10	

ANNEX 5

(Sample of filling)

Inspection card of Pytalovo Belarus road with asphalt concrete pavement and 10km length of Local Road

Road element	Quality evaluation of inspected section of damage	Location of damage detection sections (km), which has	Total damage detection sections, which have current quality	Overall evaluation of damage detection, which have	Road quality evaluation on this element

	detection road *Ri*	current quality evaluation	evaluation $\sum n_i$	equal quality $R_i \sum n_i$	$P = \frac{\sum R_i \cdot n_i}{\sum n_i}$
1	2	3	4	5	6
Road pavement from	0 3 4 5	 2, 3, 6, 10 4, 5, 7, 8, 9	0 4 5 10-9=1	 3x4=12 4x5=20 5x1=5	$P_{...} = \frac{37}{10} = 3{,}7$
Road bed	0 3 4 5	1,5 4, 6 – 10 2, 3	2 6 2 10-10=0	0 3x6=18 8	$P_{...} = \frac{26}{10} = 2{,}6$
Artificial construction	0 3 4 5	1, 3 2, 5, 8, 10 4, 6	2 4 2 10-8=2	0 3x4=12 4x2=8 10	$P_{...} = \frac{30}{10} = 3{,}0$
Road conditions (road safety management)	0 3 4 5	4, 5 1, 2, 3, 10 6, 8, 9	2 4 3 10-9=1	0 12 12 5	$P_{...} = \frac{29}{10} = 2{,}9$
Improvements and planting	0 3 4 5	10 1-5, 8 7, 9	1 6 2 10-9=1	0 18 8 5	$P_{...} = \frac{31}{10} = 3{,}1$

Total evaluation of inspected road maintenance

$$S = \frac{3{,}7 + 2{,}6 + 3{,}0 + 2{,}9 + 3{,}1}{5} = 3{,}06$$

Date of road inspection 3.08.88	Committee chairman Committee member

ANNEX 6

Type of defect	Defect characteristics
1	2
1. Wheel tracking	Distortion of the cross-section along the track
2. Hollow spots	Damages of the coating of different shapes as pits with distinct edges (more than 3 cm deep and 200 sq. cm in size)
3. Flaking	Damages of pavement due to loss of grains of mineral material (less than 3 cm deep and 200 cm^2 in square)
4. Surface scaling	Destruction of the surface of the coating by delamination of thin films and flakes of material being destroyed by water and frost
5. Breakings	Damage of pavement in the form of deep and large-area slots on tracks
6. Sagging	Distortion of coating profile in the form of hollow with gentle slopes

7. Surface shift	Displacement of a bitumen-containing layer to the base, usually in areas of braking and stopping a vehicle
8. Holes	Damage of cement concrete pavement surface in the form of hollows, connected with defects in construction technology
9. Comb	Destruction of crushed stone coating, gravel and soil in the form of transverse ridges and recesses
10. Edge spall	Destruction of edges joints and corners of concrete slab surfaces, destruction of the edges of a non-rigid pavements in places of joining curbs
11. Scouring of road pavement	Destruction of road pavement with surface waters
12. Snow cover	Snow bank in one or more layers covering the road surface
13. Packed snow	Snow on road surface which has undergone significant compaction under influence of transport
14. Snow bank	Accumulation of snow, formed in a longitudinal bank form, as a result of cleaning and pavement shoveling
15. Black ice	Icing of roadway coating not filling with deicing materials
16. Snow protection devices	All kinds of devices that are designed to prevent snow drifts: board panel fencing, fences, walls, nets
17. Snow protection device making	Condition, where snow bank in the alignment of protection has a height equal to the height of snow protection devices (for panel board fencing: permissible height of bank is 2/3 of its height)

Note. 1. Defining the characteristics of certain types of defects using the handbook "Road terminology": / Ed. MI Weizmann. - Moscow: Transport, 1985, 310 p.

2. Emergency situation refers to the situation, forcing other road users dramatically change the speed, direction of travel, or take other measures to ensure their own safety or that of the citizens

(The Decree of USSR Supreme Soviet Presidium dated from 15 March 1983).

ANNEX 7

ROAD INSPECTION QUALITY CONTROL ACT

_____

(name of road organization or its division)

for the period _____

(evaluation period)

We, the undersigned:

Chairman of the Committee _____

(full name)

Members of the Committee:

_____

(full names)

conducted a selective assessment of road maintenance quality on _____ ___, 19__:

national road _____

republican road _____

regional and local road _____

(names and length of road sections),

Accidents related to poor roads maintenance

_____

As a result of the inspection control, following quality evaluation of these roads (areas) were obtained: _____

Final quality evaluation checked by road organization (division):

_____

Committee chairman _____

(signature)

Committee member_____

(signature)

I have read the results of the inspection control

_____

(signature of head of the inspected organization)

Road maintenance inspections quality

Transportation and operational condition of public roads requires significant improvement.

There are cases of complaints and appeals on part of drivers about the poor conditions of traffic way (especially in winter), lack of information on the roads, and unsafe driving.

In order to improve the quality of maintenance and safety of roads, the Ministry of Automobile Roads of RSFSR developed and introduced the system of economic relations of road organization – “Instructions on road maintenance quality assessment”.

Instructions provide the procedure to control main elements of roads (road pavement, subgrade, artificial structures, engineering construction and landscaping).

The results of control are defined evaluation of road organizations and, consequently, affect the amount of material incentive funds (wages).

To improve reliability and objectivity of results of the inspection quality of public road maintenance, respective Commission includes representatives of Traffic Police of USSR Ministry of Internal Affairs and road companies.

Considering above, the Ministry of Automobile Transport of the RSFSR proposes to heads of territorial industrial associations of road transport to ensure the participation of their representatives in the work of inspection commissions formed by territorial organizations of the Ministry of Automobile Transport of RSFSR.

At the same time we inform that the Ministry of Internal Affairs of the USSR (Ordinance as of 18 October 1988 No. 1/4668) made it mandatory for the representatives of the Traffic Police of the autonomous republics and the executive committees of the regional departments of internal affairs on a quarterly basis to participate the inspection committee to assess road maintenance.

The Instructions and procedure for inspection control can be found in regional department of automobile roads.

Deputy Head of General Office of Traffic Police of Ministry of Internal Affairs of the USSR	Deputy Minister of Automobile Transport of RSFSR	Deputy Minister of Automobile Roads of the RSFSR
E. M. Vaulin	A. K. Vasilyev	N. I. Golovanov
04.12.89 No. 27/r-2034	15.12.89 No. VA-20/1190	06.12.89 No. NG-4/229

THE ORDER

of economic sanctions execution for failure to meet the targets of road maintenance quality

1. Evaluation quality of road maintenance inspection control by the Committee of the Regional Department of Automobile Roads is final for inspected Road Maintenance Units for quarter (if specified control is carried out by the 15th day of month following the reporting quarter) and is included in calculation of final evaluation of road maintenance for the Regional Department in general and automobile road.

2. If inspection control is carried out in any other (except as indicated in paragraph 1) time of quarter, the evaluation thereon is final for the audited Road Maintenance Units in the current month and is included in calculation of the quarterly evaluation for this Road Maintenance Units.

3. Similar procedure is applied for quality control inspection of road maintenance and carried out by Ministry Committees.

4. If quality evaluation inspection of road maintenance on Department of Automobile Roads and automobile road becomes lower than actual evaluation for the quarter (by more than 1%), the executives of Department of Automobile Roads will be deprived of all bonuses for operating results for the quarter (No. 6-c as of 10/11/90).

5. Failure to meet the annual target on road maintenance quality will lead to non-payment of reserved amounts and balances on other estimate lines out of the material incentive fund at the end of year.

6. Material incentive fund of current quarter of Department of Automobile Roads and Road Maintenance Units that demonstrated decline in the quality of road maintenance shall be reduced by 2% for each 0,01 points; an alternative sanction is a reduction in pay - 0.2% for each 0,01.

GUIDELINE FOR CONSTRUCTION OF ROAD ASPHALT PAVEMENT

(Revision of VSN 93-73) MOSCOW «TRANSPORT» 1978

Guideline for Construction of Road Asphalt Pavement is prepared to develop GOST 9128-76 " Specification: Asphalt Mixture for Road and Airfield and Asphalt Bitumen", GOST 12801-77 "Test Method: Asphalt Mixture for Road and Airfield " and SNIP III-40-78"Highways: Rules of Production and Acceptance of works." It contains information detailing the rules of construction works on asphalt concrete pavement , production of asphalt concrete mixtures, and application of asphalt bitumen. It describes modern design of pavements with asphalt concrete mixture, asphalt test methods, design principles of asphalt mixtues, surfactants and polymers used for additives, and methods of physical- chemical activation used for mineral materials.

This guideline is approved by Chief of Technical Department of Ministry of Road and is intended for use of engineers and technical workers.

INTRODUCTION

Time has elapsed since the publication of the VSN 93-73 "Guideline for construction of road asphalt pavements" approved by GOST 9128-76 "Specification: Asphalt Mixture for Road, Airfield and Asphalt Bitumen". Apart from the fact that the new GOST describes the requirements for all types of asphalt mixture, this guideline has made amendments and modifications.

Over the past period new GOST was enacted on the test methods of mixture and bitumen and on some mineral materials used in asphalt concrete mixture. With advanced experience in new road structures, research has been conducted with relation to improving the construction technology and the quality of asphalt concrete pavements.

All this resulted in the need to develop "Guideline for construction of road asphalt concrete pavement." It details the work sheet for the production of asphalt mixtures used in hot, warm and cold , and the construction of road asphalt concrete pavements in SNIP III-40-78. "Highways: Rules of production and acceptance of works." Along with this, the Guideline provides information relating to the materials used for the production of asphalt mixeture ; modern pavement structure with asphalt surfacing ; methods of administering additives in asphalt mixture of surfactants and polymers , methods of production and use of activated mineral materials , methods of ensuring adequate roughness of asphalt concrete pavements ; asphalt test methods and methods for evaluating the performance characteristics of the finished surfacing , an example of the design of asphalt mixture. Guideline has been developed to replace manual VSN 93-73.

1. DEFINITION, CLASSIFICATION AND REQUIREMENTS FOR ASPHALT CONCRETE

1.1. Asphalt concrete pavement is obtained after compaction of asphalt mixture.Asphalt mixture(hereinafter called as mixture) shall be produced by mixing in a heated state with aggregate of various sizes, natural or crushed sand, mineral powder and bitumen refering to certain ratios. Properties of mixtures and asphalt concrete pavement(hereinafter called as asphalt pavement) shall conform to the requirements of GOST 9128-76.

1.2. Depending on the type of stone material, mixtures are divided into:

Crushed Stone type consisting of crushed stone, sand , mineral powder and bitumen ;

Gravel type: consisting of natural gravel, sand or sandy gravel , mineral powder and bitumen

Sandy type: consisting of sand , mineral powder and bitumen.

1.3. Mixtures depending on the viscosity of the bitumen used and the temperature of mixtures for placing in paving layer are divided into Hot, Warm and Cold types.

Hot mixture shall be produced using viscous bitumen BND 90/130, BND 60/90, BND 40/60, BN 90/130, BN 60/90 in accordiance with GOST 22245-76. Temperature of Hot mixture when laying shall be not below 100~120 °C. The surfacing of such mixtures shall be cured mainly after cooling the compacted layer of mixture.

Warm mixture shall be produced using viscous bitumen BND 200/300 , BND 130/200 , BN 200/300 and BN 130/200 in accordance with GOST 22245-76 and with liquid bitumen MG 70/130 and SG 130 / 200 in accordance with GOST 11955-74.Warm mixture‘s temperature during placing shall be not below 70 ~ 80 ° C.
Duration of forming a surface may vary from several hours to several weeks depending on the type of bitumen (or viscous cutback bitumen) , mineral powder (activated or non-activated), weather conditions of temperature at the placing place of the mixture as well as the combination and intensity of the movements of equipment and their capacity.
Cold mixture shall be produced using liquid bitumen SG 70/130 (medium –solidify-speed type) or MG 70/130(slow- solidify-speed type) in accordance with GOST 11955-74.Cold mixture for placing may be stored as a stock for the period of 4~8 months (depending on the brand of liquid bitumen). Cold mixture shall be placed in an ambient temperature not below 5 °C in spring and not below 10 °C in autumn.

The hardening duration of such mixtures is slow (20~40 days) depending on the brands of liquid bitumen, kinds of mineral powder (activated or non-activated) ,weather conditions, traffic volume and capacity.

The use of activated mineral powder helps to reduce the period of hardening in Cold mixture paving up to 10 - 15 days.

1.4. Hot and Warm mixture (using crushed stone and gravel)are classified into following types depending on the maximum size of aggregate:

Coarse-graded type - maximum saze 40 mm,

Medium-graded type - maximum saze 20 mm

Fine-graded type - maximum saze 15 mm or 10 mm.

Sandy type . - maximum saze 5 mm

1.5. The maximum size of aggregate shall not exceed 60% of structural thickness of upper layer (wearing course)in a compacted state, and 75% of lower layer(binder course) .

1.6. Hot and Warm mixture are subdivided into as follows according to their purpose :

a) Dense mixture : with Air Voids of 2.5 ~ 5% applied to wearing course , optionally containing mineral powder ;

b) Porous mixture :with Air Voids of 5 ~ 10 % used in binder course and the base

Table 1.1

Types of mixture depending on the content of sand or aggregate

Type of Mixture	Percentage of crushed stone or sand contained in mixture
Hot and Warm	
A	50 ~65 % crushed stones
B	35 ~50 % crushed stone or gravel
C	20 ~35 % crushed stone or gravel
D	Not less than 33% of a fraction of 1.25 - 5 mm in crushed sand
E	Not less than 14% of a fraction of 1.25 - 5 mm in the natural sand (or a mixture of natural sand and crushed sand)
Cold	
B_X	35 ~50 % crushed stone or gravel
C_X	20 ~35 % crushed stone or gravel
D_X	Not less than 33% of a fraction of 1.25 - 5 mm in crushed sand
E_X	Not less than 15 % of a fraction 1,25 - 5 mm in the natural sand (or a mixture of natural sand and crushed sand)

Table 1.2

Mineral materials for Hot and Warm mixture depending on types (Refer to GOST 9128- 76)

Class of mixture	Type of mixture	Mineral materials			
		Crushed stone (gravel)		Sand	Mineral Powder
		Name of rocks and materials	Strength(kgf/cm^2) or class, not lower		
I	A, B	Igneous and metamorphic	1200	Natural and crushed sand at least Mk 2mm and natural activated at least Mk 1.7mm	Predominantly activated and non-activated according to GOST 16557-71
	C	same	1000		
	A, B	sedimentary non-carbonate	1000		
	C	Same	800		
	C	Same	1000		
	B	metallurgical slags	1		
	C	Same	2		
	B	Crushed stone from gravel	Cr. 8		
	C	same	Cr. 12		
	D	-	-	Crushed sand at least Mk 2 of the rocks used in the form of rubble in I make type A	same
II	A, B	Igneous and metamorphic	1000	Natural and crushed sand at least Mk 2 and natural sand activated by at least Mk 1.7	activated and non-activated according GOST 16557-71 and basic metallurgical slag mill ground
	C	same	800		
	A	sedimentary noncarbonate	1000		
	B	Same	800		
	C	Same	600		
	B	sedimentary carbonate	800		
	C	same	600		
	A, B	metallurgical slags	2		
	C	Same	3		
	A	Crushed stone from gravel	Cr. 8		
	B, C	same	Cr. 12		
	D	-	-	Mk crushed at least Mk2 of the rocks used in the form of rubble mark II type A	same
	E	-		Natural at leastMk 2 or a mixture of naturalsand with crushed sand	same
III	B, C	Igneous and metamorphic	800	Nature sand Mk least 1, and the crushed sand	Fiine carbonate rocks according to GOST 16557-71 and basic metallurgical slag, powdered waste industry
	B	sedimentary carbonate and noncarbonated	800		
	C	Same	600		
	B, C	metallurgical slags	3		
	B	Crushed stone from gravel	Cr. 12		
	C	same	Cr. 16		
	E	-	-	Natural sand Mk not less than 1.0	same
IV	B	Igneous and metamorphic	800	same	Fine carbonate and non carbonate rocks, powdered waste industry
	C	same	600		
	B	sedimentary carbonate and non-carbonated	600		
	B	same	300		
	B	metallurgical slags	3		
	C	same	4		
	B	Crushed stone from gravel and gravel	Cr. 16		
	C	same	Cr. 24		
	E	-	-	same	Same

Note. It is allowed to use low marks(Mk) mineral materials for the highest class of mixture subject to technical and economic feasibility.

Table 1.3

Mineral materials for Cold mixture depending on types$ classes (Refer to GOST 9128-76)

Class of Mixture	Bitumen brand	Type of Mixture	Crushed stone (gravel)		Sand	Mineral powder
			Name of rocks and materials	strength or class, not lower		
I	SG	B_X	Igneous and metamorphic	1000	Natural and crushed sand at least Mk 2 and natural sand activated by at least Mk1.7	Predominantly activated and inactivated in accordance with GOST 16557-71, the main mill ground metallurgical slag
		C_X	same	800		
		B_X	sedimentary carbonate and noncarbonated	800		
		C_X	same	600		
		B_X	metallurgical slags	1		
		C_X	Same	2		
		C_X	Crushed stone from gravel	Cr. 8		
		C_X	same	Cr. 12		
II	SG	E_X	-	-	Crushed sand at least Mk2, activated natural at least Mk 1.7 and a mixture thereof	Predominantly activated and inactivated in accordance with GOST 16557-71, the main mill ground metallurgical slag
	SG	B_X	Igneous and metamorphic	800	Natural and crushed at least Mk 2 and natural sand activated by at leastMk 1.7	Unactivated and activated in accordance with GOST 16557-71, basic metallurgical slag mill ground
	MG	C_X	same	600		
		B_X	sedimentary carbonate and non-carbonated	800		
		C_X	same	600		
		B_X	metallurgical slags	2		
		C_X	same	3		
		B_X	Crushed stone from gravel	Cr. 12		
		C_X	same	Cr. 16		
		E_X	-	-	same	same

Note. It is allowed to use lower grades of mineral materials for the highest class of asphalt concrete, subject to technical and economic feasibility.

Table 1.4

Physical and mechanical properties of Hot and Warm: Dense mixture

Description	Class of Mixture			
	I	II	III	IV
VMA(%) by volume :				
type A & B	15~19	15 ~ 19	15 ~ 19	15 ~ 19
type C & D	18 ~22	18 ~ 22	18 ~ 22	18 ~ 22
Type E	-	-	Not more than 22	Not more than 22
Air Voids (%)by volume	2.5 ~ 4,5	2.5 ~ 4.5	2.5 ~4.5 / 3.0 ~5.0	2.5 ~4.5 / 3.0~5.0
Water absorption(%)by volume				
Type A	2.5 ~ 4,5	2.5 ~ 4.5	-	-
Type B & D	1.5 ~ 3.5	1.5 ~ 3.5	1.5 ~3.5 / 1.5 ~4.0	1.5 ~3.5 / 1.5 ~4. 0
Type C & E	1.5 ~ 3.0	1.5 ~ 3.0	1.0 ~ 3.0 / 1.5 ~4,0	1.0 ~ 3.0 / 1.5 ~4.0
Swelling(%) by volume, not more than				
	0.5	1.0	1.0	1.5
Compressive strength,M Pa (kgf/cm2), not less, at temperatures:				
a) 20 °C for all types of asphalt	2.4 (24) / 2.0 (20)	2.2 (22)/ 1.8 (18)	2.0 (20) / 1.8 (18)	1.6 (16) / 1.4 (14)
b) 50 °C for asphalt types:				
TypeA	0.9 (9) / 0.8 (8)	0.8 (8) / 0.7 (7)	-	-
Type B &C	1.0 (10) / 0.9 (9)	0.9 (9) / 0.8 (8)	0.9 (9) /0.8 (8)	0.8 (8) /0.6 (6)
Type D	1.4 (14) / 1.0 (10)	1.2 (12) / 0.9 (9)	-	-
Type E	-	1.2 (12) / 0.9 (9)	1.0 (10) / 0.8 (8)	0.8 (8) /0.6 (6)
c) 0 °C for all types, not more	12.0 (120)	12.0 (120)	12.0 (120)	12.0 (120)
Coefficient of water resistant, not less				
	0,9	0,85	0,8 / 0,7	0,7 / 0,6
Coefficient of water resistance, long-term water saturation (15day), not less				
	0,85 / 0,80	0,75 / 0,60	0,70 / 0,60	0,60 / 0,50

Description	Class of Mixture			
	I	II	III	IV
Bonding between bitumen and mineral part of the mixture	Sustain (all types)			

Notes:

1 . In areas with excessive moisture, it is better to apply lower limit of saturation and air voids
2. The numerator shows the properties of hot tmxture and the denominator shows that of warm mixture.
3. For the areas in climatic zone Z_{-IV} and Z_V, strength index at 50 °C shall be increased by20% when using aggregate and 30% when using gravel and sand
4. For the areas in climatic zonesZ_I andZ_{II}, strength index at 0 ° C shall not exceed 9.0M Pa (90 kgf/cm2).

Table 1-5

Physical and mechanical properties of Cold mixture

Properties	Class of Mixture	
	I	II
VMA ,% by volume, not more:		
Type B_X	18	18
C_X	20	20
E_X	21	21
Air Voids (%)by volume	6 ~10	6 ~10
Water absorption,% by volume	5 ~9	5 ~9
Swelling,% by volume, not more than	1.2	2.0
Compressive strength, MPa (kgf/cm2), not less, at temperatures: 20 °C:		
a) before warm-up asphalt		
Water saturated	1.1 (11) / 1.2 (12)	0.7 (7) /0. 8 (8)
dry	1.5 (15) / 1.7 (17)	1.0 (10) / 1.2 (12)
b) after warm-up of asphalt		
watersaturated	1.6 (16) / 1.8 (18)	1.0 (10) / 1.2 (12)
dry	1.8 (18) / 2.0 (20)	1.3 (13) / 1.5 (15)
Coefficient of water resistant, not less:		
a) before warm up	0.75	0.60
b) after warm up	0.9	0.80
Coefficient of water resistance, long-term water saturation, not less:		
a) before warm up	0.5	0.4
b) after warm up	0.75	0.65
Hardening test by number of strokes : not more than	10	10
Bonding between bitumen and mineral part of the mixture	Sustained good	

Note. . The numerator shows the properties of fine –graded type and the denominator shows that of sandy type..

Table 1.6

Additional recommended physical and mechanical properties of Hot and Warm mixture for surface/wearing course

Properties	Type and class of mixture			
	Hot		Warm	
	Class I	Class II	Class I	Class II
Swelling after prolonged water saturation(%)by volume, not more than				
	1,5	1,8	1,8	2,0
Marshall Test Method:				
a) Stability at 60 °C, KN (kgf), not less than,				
Type A & B	6.0 (600)	5.0 (500)	5.0 (500)	4.0 (400)
Type C & D	5.0 (500)	4.5 (450)	4.0 (400)	4.0 (400)
Type E	-	4.0 (400)	-	3.5 (350)
b) Flow (^{1}/10 mm)	≤ 40	≤ 40	25 ~ 40	25 ~ 40
c) conditional stiffness, KN / mm (kgf / mm), not less than				

Properties	Type and class of mixture			
	Hot		Warm	
	Class I	Class II	Class I	Class II
Type A & B	2.0 (200)	1.7 (170)	1.7 (170)	1.5 (150)
Type C & D	1.7 (170)	1.7 (170)	1.5 (150)	1.5 (150)
Type E	-	1.3 (130)	-	1.3 (130)

Notes:1. Recommended asphalt properties are approximate and shall not be a reason for rejection in the evaluation of quality of the mixtures or pavemnt.

2 Properties are not standardized for hot and warm mixture classs III and class IV and cold mixture,

Table 1.7

Properties of Porous nixture

Properties	Standard
VMA (%) by volume, not more than	24
Air Voids (%) by volume	5 ~10
Water absorption (%) by volume	3 ~ 9
Swelling (%) by volume, not more than	1.5

Table 1.8

Combined Grading of mineral Aggregate :Hot and Warm mixtures and content of bitumen

Name of asphalt mixture	Percentage by wight Passing sieave											
	40	20	15	10	5	2.5	1.25	0.63	0.315	0.14	0.071	Bitumen, content % by weight
I. Mixture : Dense mixture for surface course												
I-1Continues graded grading												
Medium -graded:												
A	-	95 - 100	78 - 85	60 - 70	35 - 50	24 - 38	17 - 28	12 - 20	9 - 15	6 - 11	4 - 10	5,0 - 6,0
B	-	95 - 100	85 - 91	70 - 80	50 - 65	38 - 52	28 - 39	20 - 29	14- 22	9 - 16	6 - 12	5,0 - 6,0
C	-	95- 100	91 - 96	80 - 90	65 - 80	52 - 66	39 - 53	29 - 40	20- 28	12- 20	8 - 14	6,0 - 7,0
Fine-graded:												
A	-	-	95 - 100	63 - 75	35 - 50	24 - 38	17 - 28	12 - 20	9 - 15	6 - 11	4 - 10	5,0 - 6,0
A	-	-	-	95 - 100	35 - 50	24 - 38	17 - 28	12 - 20	9 - 15	6 - 11	4 - 10	5,0 - 6,0
B	-	-	95 - 100	75 - 85	50 - 65	38 - 52	28 - 39	20 - 29	14 - 22	9 - 16	6 - 12	5,5 - 7,0
B	-	-	-	95 - 100	50 - 65	38 - 52	28 - 39	20 - 29	14 - 22	9 - 16	6 - 12	5,5 - 7,0
C	-	-	95 - 100	85 - 93	65 - 80	52 - 66	39 - 53	29 - 40	20 - 28	12 - 20	8 - 14	6,0 - 7,0
C	-	-	-	95 - 100	65 - 80	52 - 66	39 - 53	29 - 40	20 - 28	12 - 20	8 - 14	6,0 - 7,0
Sandy-graded:												
D	-	-	-	-	95 - 100	68 - 83	45 - 67	28 - 50	18 - 35	11 - 23	8 - 14	7,0 - 9,0
E	-	-	-	-	95 - 100	74 - 93	53 - 86	37 - 75	27 - 55	17 - 33	10 - 16	7,0 - 9,0
I-2 Open Graded gradings												
Medium- graded												
A	-	95 - 100	78 - 85	60 - 70	35 - 50	35 - 50	35 - 50	35 - 50	17 - 28	8 - 15	4 - 10	5,0 - 6,5
B	-	95 - 100	85 - 91	70 - 80	50 - 65	50 - 65	50 - 65	50 - 65	28 - 40	14 - 23	6 - 12	5,0 - 6,5
Fine-graine:												
A	-	-	95 - 100	63 - 75	35 - 50	35 - 50	35 - 50	35 - 50	17 - 28	8 - 15	4 - 10	5,0 - 6,5
A	-	-	-	95 - 100	35 - 50	35 - 50	35 - 50	35 - 50	17 - 28	8 - 15	4 - 10	5,0 - 6,5
B	-	-	95 - 100	75 - 80	50 - 65	50 - 65	50 - 65	50 - 65	28 - 40	14 - 23	6 - 12	5,5 - 7,0
B	-	-	-	95 - 100	50 - 65	50 - 65	50 - 65	50 - 65	28 - 40	14 - 23	6 - 12	5,5 - 7,0
II. Mixture: Porous mixture used for binder course and base												
II-1Continues graded grading												
Coarse-graded												
	95 - 100	-	57 - 80	45 - 73	27 - 60	18 - 48	10 - 37	7 - 26	4 - 19	2 - 12	0 - 4	4,0 - 6,0

Name of asphalt mixture	Percentage by wight Passing sieave											
	40	20	15	10	5	2.5	1.25	0.63	0.315	0.14	0.071	Bitumen, content % by weight
Medium-graded												
	-	95 - 100	68 - 85	52 - 76	27 - 60	18 - 48	10 - 37	7 - 26	4 - 19	2 - 12	0 - 4	4,0 - 6,0
Fine-gradede												
	-	-	95 - 100	67 - 85	35 - 65	27 - 50	18 - 38	12 - 27	6 - 18	2 - 13	0 - 6	4,0 - 6,5
I-2 Open Graded grading												
Coarse-graded												
	95 - 100	62 - 82	52 - 72	42 - 60	30 - 50	30 - 50	30 - 50	30 - 50	20 - 32	10 - 18	0 - 4	4,0 - 6,0
Medium-graded												
	-	95 - 100	72 - 88	60 - 80	35 - 65	35 - 65	35 - 65	35 - 65	22 - 44	10 - 25	0 - 4	4,0 - 6,0
Fine-graded												
	-	-	95 - 100	70 - 88	35 - 65	35 - 65	35 - 65	35 - 65	22 - 44	10 - 25	0 - 6	4,0 - 6,5

Notes: 1. Increase in the content of gravel mixtures (in recommended table limits) shall be conducted in the presence of natural sand ,on the contrary decrease shall be in the case of crushed sand .

2. In case of using activated mineral powders, limits of bitumen shown in the table shall be reduced by 0.5 ~ 1.0 %.
3. It is permitted to use with an appropriate feasibility study the mixture recommended for the use of surface course as lower layer.
4. With heavy loads conditions , the amount of mineral powder for the lower layer may be increased to 8%.

Table 1.9

Combined Grading of mineral Aggregate :Cold mixture and content of bitumen

type of mixture	Percentage by wight Passing sieave									
	15	10	5	2,5	1,25	0,63	0,315	0,14	0,071	Bitumen content,% by weight of the mineral
Fine-graded:										
Type B_X	95 - 100	79 - 85	50 - 65	33 - 53	21 - 39	14 - 29	10 - 22	9 - 16	8 - 12	3.5 – 5.5
Same	-	95 - 100	65 - 75	43 - 53	27 - 38	19 - 29	13 - 22	10 - 16	9 - 13	
Type C_X	95 - 100	85 - 90	65 - 80	53 - 60	39 - 49	29 - 38	22 - 31	12 - 22	13 - 17	4.0 – 6.0
Same	-	95 - 100	75 - 82	53 - 66	38 - 55	29 - 44	22 - 35	16 - 25	13 - 19	
Sandy-graded:										
Type D_X	-	-	95 - 100	65 - 82	42 - 68	26 - 54	18 - 43	14 - 30	12 - 20	4.5 – 6.5

Notes: 1. Increase the content of gravel (the recommended limits) shall be with the application of natural sand, on the contrary,decrease shall be with the application of crushed sand.

2. In case of using activated mineral powders ,limits of approximate content of bitumen shown in the table shall be decreased by 0.5 ~ 1%.

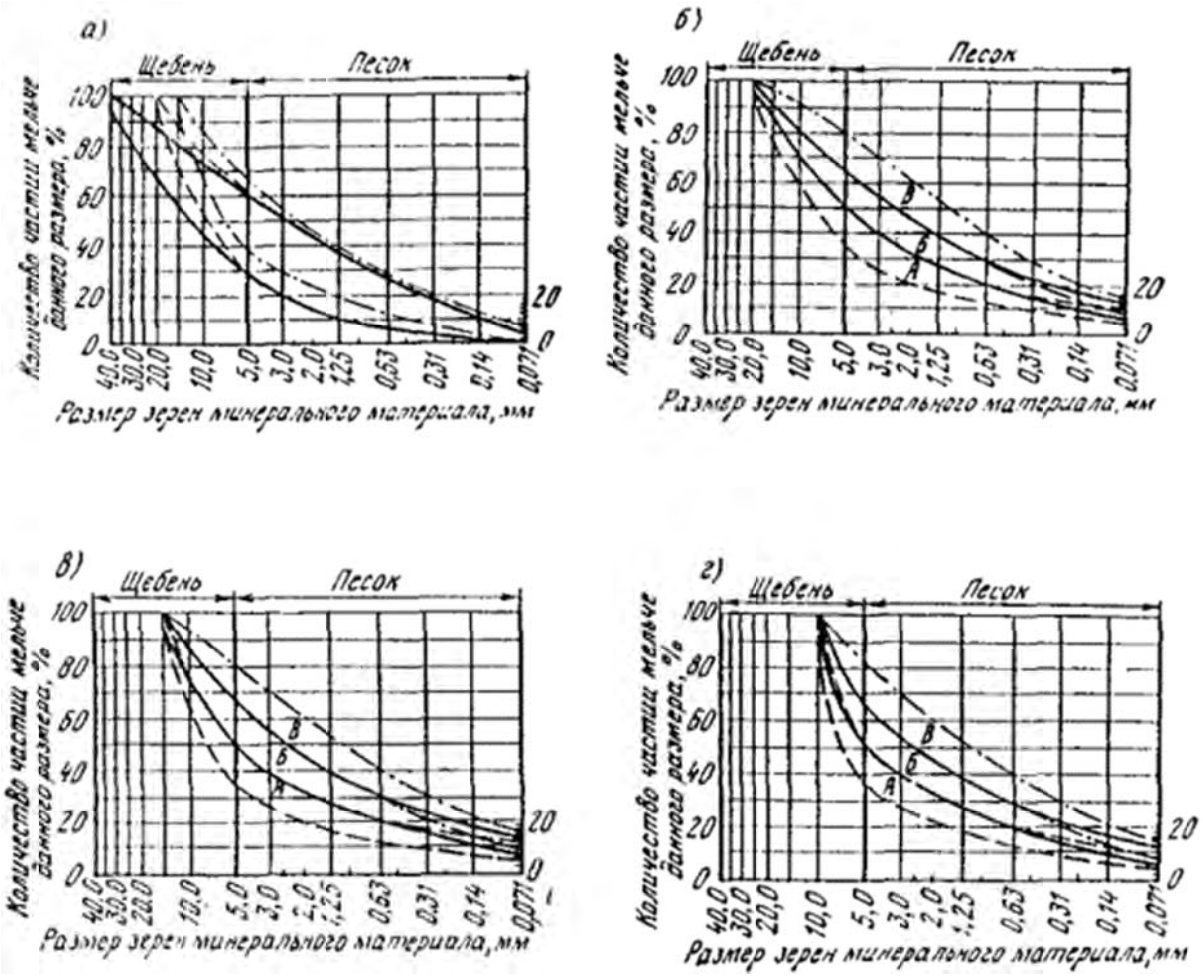


Fig. 1.1. Combined Grading of mineral Aggregate :Hot and Warm mixtures with continuous particle size:

A : coarse-, medium and fine-graded (for the binder coarse and the base)

B, C&D - mediumand fine-graded (for surface coarse)

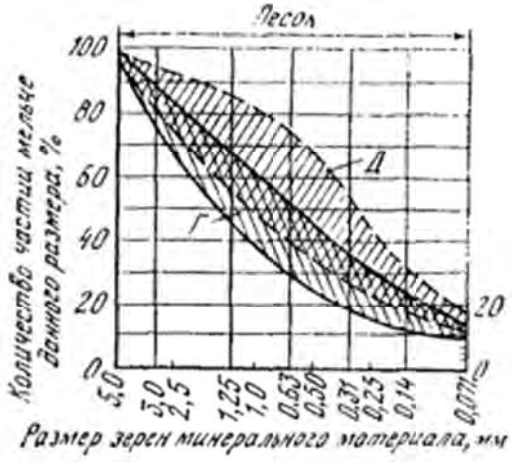


Fig. 1.2. Combined Grading of mineral Aggregate :Hot and Warm with Sandy-grained mixtures

Fig 1.3. Combined Grading of mineral Aggrega**te :**
Hot and Warm mixtures with open graded particle size
:

A: coarse, mediumand fine-graded (for the binder coarse and the base),

B: medium and fine-graded (for surface coarse)

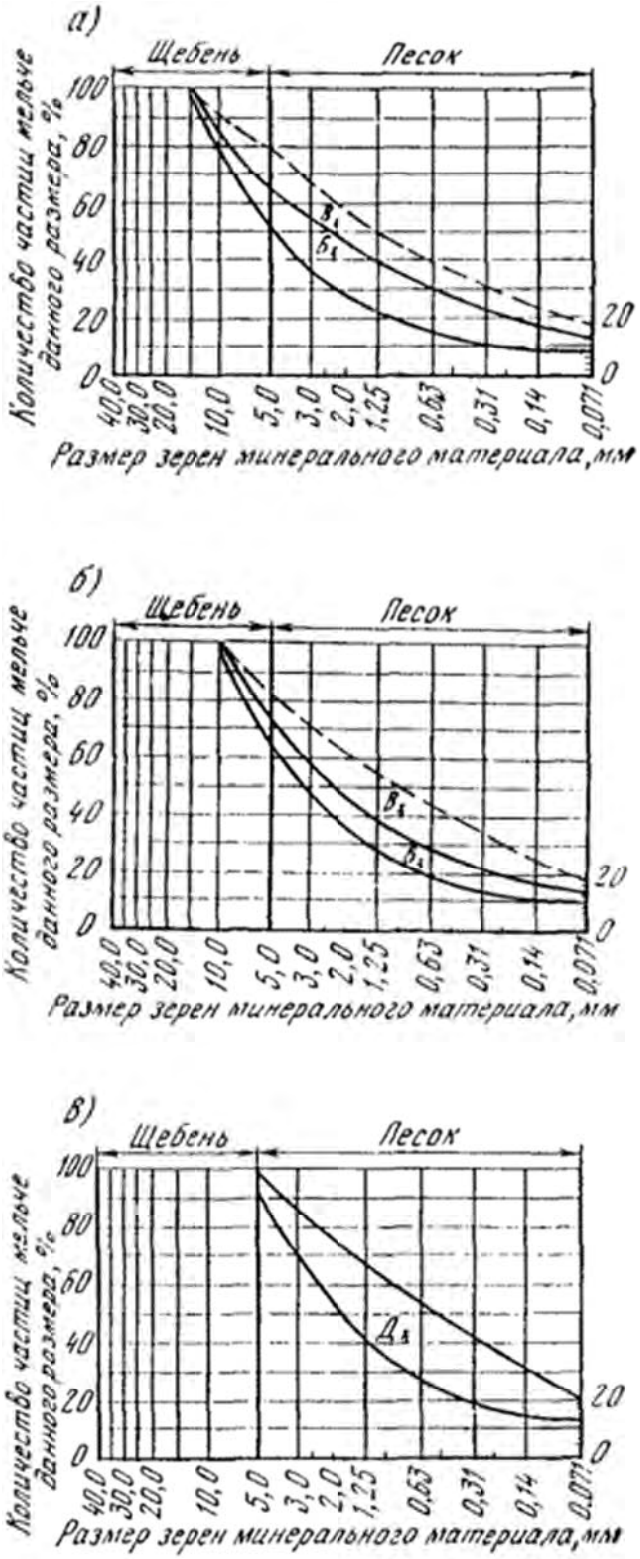


Fig. 1.4. Combined Grading of mineral Aggregate **:C**old mixture:

A and B : fine-graded; C : sandy-graded

Cold asphalt operation in the initial stage generally has a air void of more than 5%, but eventually it becomes approximately same as that of the dense hot and warm mixture. Cold mixture shall be applied only to the surface course.

1.7. Dense type mixture are divided into the types listed in Table 1.1 depending on their content of gravel or sand (natural or crushed)

1.8. Physical -mechanical properties of Dense type mixture (Hot and Warm) depending on the quality of these mineral materials used and the amount of crushed stone (gravel) are shown in Table 1.2 and 1.4.

Physical-mechanical properties of Cold mixture depending on the quality of the mineral materials used and liquid bitumen brand are shown in Table 1.3 and 1.5.
The physical and mechanical properties of Hot and Warm mixture for surface course shall meet the requirements of Table 1.4 and 1.6, Cold mixture shall be of Table 1.5. Hot and Warm Porous mixture for the lower layers of pavement and bases shall comply with the requirement of properties shown inTable 1.7.
1.9. Combined grading for Hot and Warm mixeture and content of bitumen shall comply with Table 1.8, as for cold mixeture- Table 1.9 and Fig. 1.1 ~ 1.4.
1.10.Class I mixture using activated mineral powder content of which is 2% below the prescribed requirements may be named as another class/type by the State authority.

2. TYPE of PAVEMENT STRUCTURE with ASPHALT CONCRETE MIXTURE : SCOPE and CONDITIONS of USE

2.1. Mixture shall be used for the improvement of major pavement and minor pavement on the roads having category of R_I toR_{IV}.
Advanced major paving shall use Hot mixture class I and II and Warm mixture class I, and advanced mimor paving shall apply Hot mixture class III and IV, Warm mixture class II ~ IV, and Cold mixture class I and II .
Recommended usage on different types of mixture for the surface course is shown in Table 2.1.
Hot mixture is used for surfacing and bases on the carriageway of road categories R_I ~R_{IV} as well as categoryR_{III}-p and R_{IV}-p for access roads to industry factories ..
Warm mixture is used for pavement on the road having road category of R_{III},R_{IV} and R_{IV}-p in climatic zoneZ_{II} to $_V$, and on Road category R_I to $_{IV}$, R_{III}- p and R_{IV}- p in climatic zone Z-$_I$.
Cold mixture is used for pavement on the road having category of R_{III}, $_{IV}$ and $_{IV}$- p in climatic zone Z_{II} to $_V$.
During the use of mixture in urban area, class and type of mixture shall be selected depending on the purpose of urban roads and streets in accordance with SNIP II- 60 -75 (Table 49 paragraph 9.38) .
2.2. Construction of paving layer and thicknesses for surfacing and bases shall be determined project by project. Fig. 2.1 shows examples of typical road structures with asphalt concrete pavement in accordance with "Standard design of pavements in total road- network of the USSR" (Series 503-0-11, Road Project Department , 1976)

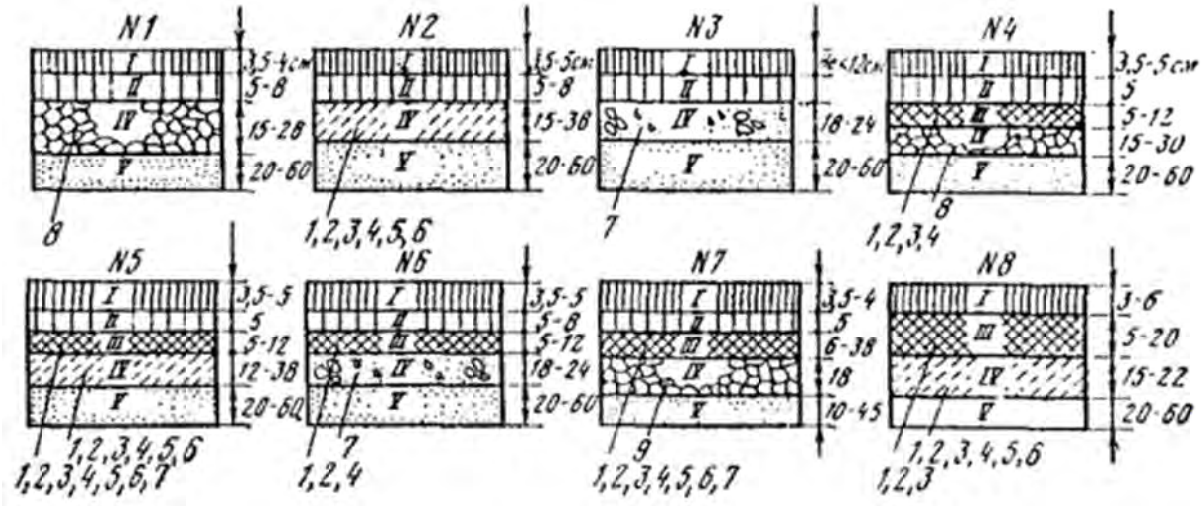


Fig. 2.1. Examples of typical road structures with asphalt surfacing

I - the top layer(wearing course) : Hot, Warm , Cold mixture ;

II - bottom layer(binder course) : Hot Porous mixture / coarse, medium and fine-graded ;

III - Base layer (Base course)

1 - hot or porous mixturet : coarse& medium-graded ,

2 - aggregate treated by viscous bitumen or bitumen emulsion ,

3 - porous macadam emulsion- mineral mixture ,

4 - hot gravel porous asphalt or couase- , medium- ,

5 - gravel-sand mixture , treated by bitumen emulsion in combination with cement ,

6 - aggregate treated by viscous bitumen by impregnation method ,

7 - gravel mixture with the addition of 25 ~ 45 % gravel treated by bitumen emulsion ;

IV - Base layer (Base course)

1 – crushed stone or gravel materials stabilized by cement ,

2 - grit or gravel materials , fortified ashes, ash , slag mixtures or granular slag in combination withcement

3 - soils stabilized mineral binders (strength class I)

4 - gravel-sand mixture stabilized by portland cement , ash entrainment , slag mixtures or granulated slag in combination with cement

5 - soils stabilized mineral binders (strength class II) ,

6 - soils stabilized mineral binders (strength classIII) ,

7 - Concrete usung ordinary Portland cement: strength type 75 , 100 and 125 ,

8 - aggregate of natural stone , gravel or slag ,

9 - or a mixture of crushed stone and gravel (with 30% gravel) ;

V - Sand Subbase.

Note. In case the structure number 2 as the base for layer IV using material stabilized by cement , accumulated thickness of two layer of surfacing is at least 12 cm.

2.3 Pavements with mixture generally have the following structural layers : surface layer(monolayer or bi-layer), base course(herein after calledas base) (single-layer or double-layer) and additional layer of subbase , drainage blanket , frost protection layer , leveling course , silt/mud protection layer .

2.4. Surface layer may be of single and dual layer. Single-layer surfacing is permitted only on the base which is constructed made of black coated gravel or mixture of aggregate which is treated by bitumen with impregnation method.

Single-layer surfacing and the surface(wearing) course of the two-layer surfacing shall satisfy the requirement of dense, Hot and Warm mixture in Table 1.4 and as for Cold mixture conforming to Table 1.5.

For the binder coarse of surfacing, it is preferable to use Porous mixture that meets the requirement inTable 1.7.

2.5. For surface course of Hot, Warm and Cold mixture , bitumen brand and type of grading is selected depending on the category of roads and climatic conditions of the construction site (see Table 2.1).

2.6. Recommended thickness of asphalt surfacing shall be as follows:

Single surfacing by hot and warm mixture : 4 to 6 cm

Cold mixture :3 to 4 cm

Upper layer(Wearing course) in two layer surfacing of fine and medium grained :3.5 to 5 cm

sandy grained : 3 to 3 5 cm,

Binder coarse of surfacing of medium- grained: 4 to 6 cm,

coarse- grained: 5 to 8 cm

The overall thickness in two-layer surfacing with a upper layer of mixture with crushed stone (types A, B, C) shall be of 7.5 to 13 cm, sandy type (types C, D)shall be of 7 to 9.5 cm

Minimum thickness of surfacing on the base course made of cement concrete is of 12 cm, the smallest thickness of pavement by cold asphalt : of 3 cm, the protective layer (surface treatment) : of 1.5 cm

In constructions involving two-layered surfacing on the base of black gravel or porous mixture, layer thickness shall be of 8 cm (see Fig . 2.1 structure No. 4 to 7) , it is advisable to make the thickness of lower layer and upper layer eaqual each other .
Such substitution is suitable for achieving higher density and reducing cost due to laying in one layer instead of two.

Table 2.1

Recommended application of the top layer of asphalt concrete pavement

(depending on the road category and climatic zone)

climatic zone	Type of mixture	Road category								
		$R_{I, II \& III-p}$			$R_{III \& IV-p}$			R_{IV}		
		Class of mixture	Type of mixture	Brand of bitumen	Class of mixture	Type of mixture	Brand of bitumen	Class of mixture	Type of mixture	Brand of bitumen
1	2	3	4	5	6	7	8	9	10	11
Z_I	Hot	I	A, B, C, D	BND 90/130	II	A, B, C, D, E	BND 90/130 BND 60/90	IV	B, C, E	BND 90/130 BN 90/130 BND 60/90 BN 60/90
					III	B, C, D	BND 90/130 BN 90/130			
	Warm	I	A, B, C, D	BND 130/200 BND 200/300 BN 70/130 SG 130/200	II	A, B, C, D, E	BND 30/200 BND 00/300 BG 70/130 SG 130/200	III & IV	B, C, D	BND 130/200 BN 130/200 BND200/300 BN 200/300 SG 70/130 SG 30/200
	Cold	Not use			Not use			Not use		
Z_{II} &Z_{III}	Hot	I	A. B, C, D	BND 60/90 BND 90/130	II	A, B, C, D, E	BND 60/90 BND 90/130	IV	B, C, D	BND 60/90 BN 60/90 BND 90/130 BN 90/130
					III	B, C, D	BND 60/90 BN 90/130 BND 90/130 BN 60/90			
	Warm	Not use			II	A, B, C, D, D	BND 130/200 BND 200/300 BG 70/130 SG 130/200	III & IV	B, C, E	BND 130/200 BN 130/200 BND 200/300 BN 200/300 BG 70/130 SG 130/200
	Cold	Not use			I	B_x, C_x, E_x	SG 70/130	II	B_x, C_x, E_x	SG 70/130 MG 70/130
Z_{IV} &Z_V	Hot	I	A	BND 40/60 BND 60/90	II	A, B, D	BND 40/60 BND 60/90 BND 90/130	IV	B	BND 40/60
			B, C, D	BND 40/60		B, E	BND 40/60 BND 60/90		C, E	BND 40/60 BND 60/90 BN 60/90
					III	B	BND 40/60			
						B, E	BND 40/60 BND 60/90 BN60/90			
	Warm	Not use			II	A, B, C, D, E	BND 130/200 BND 200/300 BG 70/130 SG 130/200	III и IV	B, C, D	BND 130/200 BN 130/200 BND 200/300 BN 200/300 BG 70/130 SG 130/200
	Cold	Not use			I	B_x, C_x, E_x	SG 70/130	II	B_x, C_x, E_x	SG 70/130 MG 70/130

2.7. Asphalt pavement shall satisfied with a transverse slope(gradient) of 15~20 ‰. Longitudinal gradient of roads usually shall not exceed 60 ‰. In some cases on the road category R_{III} , longitudinal gradient over 60 ‰ (but not more than 80 ‰) may be allowed. In this case, desired roughness of surfacing shall be maintained and displacement stability shal be enhanced.
2.8. Base under asphalt surfacing shall be made of porous mixture, black gravel, emulsion-mineral mixtures, gravel treated with viscous bitumen or bitumen emulsion according to the

method of impregnation and stone materials or soils stabilized by cement, granulated slag, bitumen emulsion together with cement as well as aggregate by the method of wedging .

When choosing the type of base under surfacing, it shall be borne in mind that the base materials stabilized by cement and other inorganic binder material shall work well in milder climate areas. For areas with extreme continental climate, preference shall be given to the base course with the use of bitumen.

2.9. Porous mixture designed for base course shall comply with the requirement in Table 1.7

For base course it is allowed to use a dense mixture recommended for upper surfacing with appropriate feasibility study. In particular, such base course are recommended in the roads with high traffic density.

Combined gradation of aggregate in each type of mixtures is shown in Table . 1.8.

2.10. Base course of black gravel and crushed stone processed by bitumen in the method of impregnation shall be arranged according to the " Guidance for pavement made of aggregate treated with organic binder material " (VSN 123-77) .

2.11. Base course of stone materials stabilized by emulsion and emulsion together with cement shall be arranged according to the "Technical Guidelines on preparation and application of emulsions" (VSN 115-75)

Crushed stone shall meet the requirements specified in the "Technical Guidelines for the Base course of stone materials, not stabilized or strengthened by inorganic binders" (VSN 184-75).

When preparing the medium setting black gravel, anionic and cationic as well as inverse emulsion, highly viscous bitumen and liquid bitumen in combination with MA and CA -1 shall be used.

Crushed stone treated by emulsion may be used immediately after preparation or stocked for the future, ie are stacked and then used when necessary. This method works not only to eliminate the dependence of construction projects from the mixing plant but also to speed up the process of base course forming binder during the storage period of aggregate.

For the treatment of aggregate designed for stacking immediately after mixing, emulsions containing bitumen BND 40/60, BND 60/90, BN 60/90, BND 90/130 and BN 90/130 shall be used.

Treated aggregate stocked for future use shall apply direct emulsions prepared with low viscosity bitumen (penetration value of 200 - 250) , inverse viscous bitumen (EO- B) and inverse liquid bitumen (EE) in combination with CA and MA- 1 prepared by bitumen BND 40/60 , BND 60/90 and BN 60/90 ..

Combined grading in Porous mixtures for base course shall comply with Table 1.8.

For processing mixture of felsic rocks it is advisable to use cationic emulsion providing good adhesion of bitumen with mineral material and the rapid formation of the mixture.

For processing mixture of basic rocks it is recommended to use anionic emulsions providing usually a good bonding.

For gravel mixture providing better workability and greater bearing capacity of layer, it is recommended to enrich the percentage of crushed particle upto 25 to 45 % (as total amount of gravel particles.)

In the absence of opportunities to enrich the mixture of gravel aggregate, it is advisable to use a method of treating by an anionic emulsion together with cement allowing to increase the bearing capacity of the structural layer.

In case two binders are used(emulsion and cement), it is advisable to contain gravel particle (larger than 5 mm) less than 50% in order to strenghen the sand and gravel-sand mixtures .

Emulsion of slow-setting type (cationic or anionic) shall be prepared using viscous bitumen. Sandy-type mixture may be of natural sand or a mixture of natural sand and waste of crushed rocks (screening)of granite or limestone .

Layer made of mixtures treated with two binders (emulsion and cement) are less rigid, more water-resistant and frost –resistant compared with the mixtures fortified with cement. The presence of these material in the asphalt binder increases its resistance to shrinkage and thermal stresses. Compared with bituminous sangy mixture. mixtures treated with two binders is different in high strength andin high modulus of elasticity.

2.12. Base course of stone materials, reinforced cement , granulated slag or staged at the method of wedging shall be arrange in accordance with the " Technical Guidelines on base couse of stone materials, not fortified and reinforced with inorganic binders " (VSN 184-75).

Base course is made of stone materials reinforced by cement or granulated slag , used or ordinary aggregate of fractionated natural rocks, gravel , slag , gravel, crushed gravel , artificial stone materials (keramdor etc.), gravel-sand mixed materials , natural sand, sand crushing of waste as well as other materials (coquina, weak limestone, sandstone, etc.) Content of clay particles shall be less than 5% in these materials .

Gravel and crushed stone stabilized by cement or other mineral binders for base course shall meet the requirements of VSN 184-75.

As binder material, granulated blast-furnace slag and phosphate, cement, lime and other active inorganic materials shall be used.

Crushed stone using fractionated natural rocks , rubble from mining waste and inactive gravel and slag inclusions after the release of metal shall be arranged for base course in a manner of wedgeing method. (refer toGOST 8267-75 " Crushed natural stone for construction work " and GOST 3344-73 " Crushed slag blast furnace and steelmaking for road construction "). Durability of aggregate must comply with VSN 184-75.

2.13. Base course of soils stabilized by cement, emulsion, emulsion together with cement, ashes, shall be arranged in accordance with the "Regulations on the use of soil reinforced by cementations materials, base course and pavements of roads and airfields" (CH 25-74).

Rules of works on different types of base course is detailed in the relevant paragraphs of this section.

3. REQUIREMENT for MATERIAL used for PRODUCTION of ASPHALT MIXTURE

Crushed stone and gravel

3.1. For asphalt mixtures ,material shall be of aggregate produced by crushing the massive rocks, boulders, stones,large gravel and indecomposable metallurgical slag and gravel to meet the requirements of GOST8267-75, GOST10260-74, GOST3344-73, GOST8268-74 and paragraphs 3.2～3.8 of this guidline.

3.2. Properties of crushed stone and gravel on the strength, abrasion and frost resistance are shown in Table 3.1～3.4.

3.3. Containing percentage of weak weathered rock particles shall be not more than 10% for upper surfacing and for the lower surfacing 15 %.

3.4. Aggregate shall not contain the following % by weigt of flat or elongated particles in each mixtures type:

Type A (gravel 50 - 65 %) ..... 15 %
Type B and Dx (gravel 35 - 50 %) ..... 25 %
Type Bx (" 20 - 35 %) ..... 35 %

3.5. Aggregate made of clay (marl) limestones, sandstones and clay shales shall not be used.

3.6. Property of crushed particles in crushed gravel shall be not less than that specified in Table 3.1 (considering that crushed grains has one fractured surface).

3.7. Amount of silicious particles in the crushed gravel or natural gravel shall not exceed 25 %. Amount of particle made of carbonate rocks shall be not more than 30 % for mixture types A and B.

3.8. Content of dust and clay particles in the aggregate (gravel) shall not exceed the percentage in Table 3.2.

Table 3.1

Requirement for crushed stone and gravel for mixtures

№ п/п	Indicators	Hot and Warm mixture														Cold mixturet			
		for Surface course										for Binder course		for Base		for Surface course			
		Class I			Class II			Class III		Class IV						Class I		Class II	
		Type mixture										Road category				Type of mixture			
		A	B	C	A	B	C	B	C	B	C	I, II	III, IV	I, II	III, IV	B_x	C_x	B_x	C_x
1	Strength (kgf/cm^2), not less than:																		
	a) crushed stone of igneous and metamorphic rocks																		
		1200	1200	1000	1000	1000	800	800	800	800	600	800	600	600	600	1000	800	800	600
	b) crushed stone of sedimentary carbonate rocks																		
		-	-	1000	-	800	600	800	600	600	300	600	400	400	300	800	600	800	600
	c) crushed stone from other sedimentary rocks																		
		1000	1000	1000	1000	800	600	800	600	600	300	600	400	400	300	800	600	800	600
	d) crushed stone from gravel																		
		-	Dr 8 (1000)	Dr 12 (800)	Dr 8 (1000)	Dr 8 (1000)	Dr 12 (800)	Dr12 (800)	Dr 16 (600)	Dr 16 (600)	Dr24 (400)	Dr 12 (800)	Dr 16 (600)	Dr 16 (600)	Dr24 (400)	Dr 8 (1000)	Dr12 (800)	D.12 (800)	Dr 16 (600)
	e) gravel																		
		-	-	-	-	-	-	Dr12 (800)	Dr 16 (600)	Dr16 (600)	Dr24 (400)	Dr 12 (800)	Dr 16 (600)	Dr 16 (600)	Dr.24 (400)	-	-	Dr.12 (800)	Dr 16 (600)
	f) class crushed stone of metallurgy slag																		
		-	1	2	2	2	3	3	3	3	4	3	4	4	4	1	2	2	3
2	Drum wear in the tray, not lower than:																		
	a) crushed stone of igneous and metamorphic rocks																		
		И-I	И-I	И-II	И-II	И-II	И-III	И-III	И-III	И-III	И-IV	И-III	И-IV	И-IV	И-IV	И-II	И-III	И-III	И-IV
	b) crushed stone of sedimentary carbonate rocks																		
		-	-	И-I	-	И-II	И-III	И-II	И-III	И-III	И-IV	И-III	И-IV	И-IV	И-IV	И-II	И-III	И-II	И-III
	c)crushed stone from other sedimentary rocks																		
		И-I	И-I	И-II	И-II	И-II	И-III	И-II	И-III	И-III	И-IV	И-III	И-IV	И-IV	И-IV	И-II	И-III	И-II	И-III
	d)crushed stone from gravel																		
		-	И-I	И-II	И-I	И-II	И-III	И-II	И-III	И-III	И-IV	И-II	И-III	И-III	И-IV	И-I	И-II	И-II	И-III
	e) gravel																		
		-	-	-	-	-	-	И-II	И-III	И-III	И-IV	И-II	И-III	И-III	И-IV	-	-	И-30	-40
3	Frost-resistance degree of crushed stone, gravel, not less:																		
	a)harsh climatic conditions																		
		50	50	50	50	50	25	25	25	25	25	25	25	25	25	50	50	50	25
	b)mild climatic conditions																		
		25	25	25	25	25	15	15	15	15	15	15	15	15	15	25	25	25	15
4	Number of crushed grains in crushed gravel(,%) by weight, not less than																		
		-	100	80	100	80	70	80	60	70	50	80	70	70	50	100	80	80	60

Notes:

1. Harsh climatic conditions are characterized by an average monthly temperature of the coldest month below -15 ° C, moderate climate: from -5 to -15 ° C, soft climate: to -5 ° C.
2. Requirements listed in Table 3.1 for crushed stone for class I and II types A and Bmixture may be also appled for the aggregate employed in rough surfaces coatings by heated black crushed stone or surface treatment.
3. For asphalt class IV type B and type III, the use of carbonate rocks rubble mark 400 pretreated with a mixture of bitumen with surfactants of the anionic type may be allowed. Under the same conditions, the use of carbonate rocks aggregate mark 200 in mixture class IVtype B may be allowed.
4. In case of any discrepancy between the figures in wear and tear of aggregate , the worst performance shall be taken.

Table 3.2

Requirements for aggregate(gravel) on the content of dust and clay particles

Ttype, class and purpose of mixture	Content of dust and clay particles in the crushed stone /gravel(%)by weight, not more than	
	From sedimentary carbonate rocks	From igneous, metamorphic and sedimentary rocksand the rest
Hot and Warm for Binder course and Surface coarse:		
I and II	2	1
III and IV	3	2
Cold for surface coarse:		
I	2	1
II	3	2
Hot and warm for base	4	3

Table 3.3

Characteristics of crushed stone in hardness (refer to GOST 8267-75)

Type of test	Frost resistance of crushed stone		
	(Mpz) millipoise15	millipoise25	millipoise50
Immediate freezing:			
a) number of cycles	15	25	50
b) Loss in weight after the test (%) no more than	10	10	5
In sodium sulfate solution:			
a) number of cycles	3	5	10
b) Loss in weight after the test(%,) no more than	10	10	10

Sand

3.9. Sand used for the production of mixtures shall be crushed sand made of natural unfractionated rock to meet the requirements of GOST 8736-77 : major size (fineness modulus FM > 2.5) , medium size (fineness modulus FM = 2.5~2.0). Instead of crushed sand, sand produced by crushing waste rock of which largest grain size is5mm may be used.

In the selection of the mineral part of mixture on the principle of continuous grading, fine and very fine sand (with a fineness modulus of less than 2.0) may be appled , if it is enriched with coarse sand (natural or crushed). The amount of additive is set in such a way that the gradation of crushed stone, sand and mineral powder meet the requirements of Table 1.8 and 1.9.

If there is no coarse sand in the compositions of Hot and Warm mixture types A and B , fine sand in the design consept of open graded grading (see Table1.8) may be selected. Fine sand shall not be used (except activated) in Cold Mixture.

3.10. To improve the quality , activate sand with lime hydrate* may be reccommended (contents of 3～4% by weight in vibro ball/ mill equipment or a special facility in accordance with paragraph 5.40)

* Hydrated lime to activate sand shall comply with GOST 9179-70.

Fineness modulus of activated sand shall be not less than 1.7.

3.11. Sandy mixtures of crushed sand shall use coarse sand with a fineness modulus of more than 2.5 and the content of the grain size of 5~1.215 mm not less than 33 %.

Sandy mixtures of natural sand or a mixture of natural and crushed sand shall use large and medium sand with a fineness modulus of more than 2 and the content of the grain size of 5 ~ 1.25 mm no less than 14%. The fine sand may be used for this purpose after activation of lime.

3.12. Sandy-type mixtures for type D shall use crushed sand obtained from crushing igneous rocks strength of which is not less than 1,000kgf/cm2. The content of particles less than 0.071 mm in crushed sand shall not exceed 5 %as well as clay particle not exceeding 0.5%. Content of carbonate rocks in the sand made of crushed gravel shall not exceed 30%.

3.13. Hot and Warm mixtures class I & II and Cold mixture class I shall use crushed sand made of igneous, metamorphic and sedimentary rocks having strength of at least 800kgf/cm2 or gravel having strength not less than 1000kgf/cm2.

Hot and Warm mixtures class III & IV and Cold mixtures class II shall use crushed sand having strength of not less than 400 or gravel not less than 600 kgf/cm2.

The sand made from the crushed carbonate rock intended for the production of Cold mixtures may be allowed to contain particles smaller than 0.071 mm up to 20 % if those particles is obtained by pulverizing the carbonate rock.

Table 3.4

Characteristic of crushed stone on crushability and wear

Rocks from which obtained crushed stone	type of crushed stone and gravel																	
	1200	1000	800	600	400	300	1st class	2nd class	3rd class	4th class	Ab-I	Ab-II	Ab-III	Ab-IV	1st class	2nd class	3rd class	4th class
	Weight loss(%) of crushed gravel under compression in saturated condition										Weght Loss(%) byWearin crushed stone in the tray drum							
Igneous &extrusive																		
	9 -11	11- 13	13- 15	15-25	-	-	-	-	-	-	to 25	25-35	35-45	45-60	-	-	-	-
Ingeous (deep intrusion) and metamorphic																		
	12- 16	16- 20	20- 25	25- 34	-	-	-	-	-	-	to 25	25-35	35-45	45-60	-	-	-	-
sedimentary massive																		
	11	11 - 13	13- 15	1 - 20	20- 28	28- 38	-	-	-	-	to 30	25-35	35-45	45-60	-	-	-	-
Crushed gravel																		
	-	to 10	10- 14	14- 18	18- 26	-	-	-	-	-	to 20	20 - 30	30 - 40	40 - 50	-	-	-	-
Gravel																		
	-	to 8	8 - 12	12-16	16 24	-	-	-	-	-	to 20	20 - 30	30 - 40	40 - 50	-	-	-	-
Slag																		
	-	-	-	-	-	-	to15	15 - 25	25 - 35	35 - 45	-	-	-	-	to 25	25 - 35	35 - 45	45 - 55

3.14. In sandy and fine-graded (grain size up to 10 mm) Hot, Warm and Cold mixture class II, crushedstoneand sandy gravel activated is allowed to use(except for a grading in mixture type A) . Natural gravel shall have a charaxteristic of not less than Dr.12. Gravel may be crushed in special plant (see paragraph 5.39) in the presence of activating by following materials:

a) Bitumen BND90/130, BND60/90* enriched with higher aliphatic amines (cationic surfactant) in an amount of 0.25 % by weight of bitumen ;

* As an exception, bitumen BN 90/130 and BN 60/90 may be applied

b) Resins or tars produced during low-temperature processing of solid fuel (coal or brown coal, oil shale, butt, wood). Tars or resins used in blends with bitumen in a ratio of 1:1 - 1:2 or without bitumen. Content of activating material is 1.5~2.5 % by weight gravel.

3.15. The content of the sand grains passing sieve 0.14mm, shall be not morer than 15% , and crushed sand of the activated gravel products - more than 25 %. Amount of dust and clay particles determined by elutriation test shall not exceed 3% and 7% for crushed non-activated sand and clay content shall not be more than 0.5%

Mineral powder

3.16. Mineral powder for mixtures shall be obtained by grinding (milling) of carbonate rocks,limestone, dolomite limestone, shell limestone, bituminous limestone and dolomite and other carbonate rocks as well as basic metallurgical slags.

3.17. Hot and warm mixtures Class III and IV may be allowed to use industrial waste powder: fly ash from power heating station, dust ash from cement plants , asbestos production waste, coal ash as well as mill ground non carbonate rocks (for Mark IV) as mineral powders.

3.18.Activated mineral powders obtained by grinding the carbonate rocks decribed in paragrapf 3.10 (except tar) together with an activating material may be used to improve the quality of mixture.

3.19. Activating materials are:

a) Product mixture containing the anionic surfactants (SAW) kind of higher carboxylic acids with viscous bitumen.

The ratio by weight of these products and bitumen shallt be 1:1 ~ 3:1. The list of products containing higher carboxylic acids as shown in Table 3.12 as well as in the " Instructions for the use of surfactants in the construction of pavements using bitumen " (VSN 59-68) . Products containing higher carboxylic acids shall have an acid number below 50 mg KOH per 1 g and the saponification number is not less than 120 mg KOH for 1 g;

b) A mixture of anionic surfactants such as iron salts of higher carboxylic acids with viscous bitumen.

For the preparation of surfactants such as iron salts of higher carboxylic acids are ferric grades I and II coresponding to the requirements of GOST 11159-76. Composition of surfactants such as iron salts of higher carboxylic acids are given in Instructions VSN 59-68;

c) A resin or tar (see Table 3.12) obtained by low-temperature processing of the solid fuel (shale oil , bituminous or lignite , peat . tars or resins used in blends with bitumen in a ratio of 1:1 ~ 1:2 or without bitumen .

d) Repellent silicone fluid 136-41 corresponding to the requirements of GOST 10834-76 .

3.20. Products which are not listed in paragraph 3.19 nay be allowed to use in order to activate the mineral powders, if activated mineral powders comply with the requirements in Table 3.5.

3.21. Total amount of activating material except 136-41 hydrophobizing liquid shall be of 1.5 ~ 2.5 %, and the liquid repellent shall be of 0.25 ~ 0.50 % by weight of milled material.

3.22. Petroleum bitumen used for the preparation of activating materials shall comply with the requirements of GOST 22245-76.

3.23 Brand of bitumen used for activating mixture depending on the type of mixture (hot, warm, cold) and climatic conditions of the construction area are shown in Table3.6

3.24. In order to accelerate the formation of the pavement of Cold or Warm mixture prepared with liquid bitumen SG 130/200 or viscous bitumen BND 200/300, it is recommended to use mineral powder activated with a mixture of bitumen with anionic substances such as iron salts of higher carboxylic acids (RF, FCC, FOP, PCG, according to FGS Instructions inVSN 59-68).

Table 3.5

Technical requirements for mineral powder from carbonate rock

Propertiess	Type of Powder	
	activated	Non-activated
Grain composition(%) by weght:		
Particle smaller than 1.25 mm	100	100
Passing sieave 0,315mm is not less than	95	90
Passing sieave 0.07imm is not less than	80	70
Porosity (%) by volume not more than	30	35
Swelling of samples of a mixture of bitumen with mineral powder(%)by volume, not more than	1,5	2,5
Bitumen capacity(g per 100 cm3)absolute volume, not more than	50	65
Moisture (%) by weight, not more than	0.5	1.0

Notes: 1. If activated mineral powder is prepared from carbonaceous rocks with clay content more than 5%, the swelling percentage are allowed to 2.5%, and bitumen capacity - to 65 cm3 per 100 g.

2. In mineral powders derived from rocks whose compressive strength is above 40MPa (400 kgf/cm3), the allowable parcentage of grain composition of particles 0.071 mm shall be 5% lower than that provided in Table 3.5.

3.25 Carbonate rocks for the production of activated and non-activated with mineral powders shall not contain clay impurities more than 5% . Polluted carbonate rock and clay impurities are judged by the total content of sesquioxides (Al2O3 + Fe2O3)which shall be not more than 1.7 %.

3.26. When activated powders or tar resins (in paragraph 3.19), and liquid repellent 136-41 (paragraph 3.19 d) in the rock are used,allowable percentage of clay impurities shall be up to 15% (sesquioxides shall be up to 5 %).

3.27. Powdered industrial wastes used as mineral powders shall be free of contaminants and shall not contain calcium oxide (CaO) .

Note. The presence of calcium oxide shall be checked by the method described in the guideline.

Table 3.6

Bitumen brands for activating mixture

Asphalt miixture	Climatic zone		
	Z_I	Z_{II} and Z_{III}	Z_{IV} and Z_V
Hot	BND 200/300	BND 130/200	BND 90/130
	BND 130/200	BND 90/130	BND 60/90
Warm	BND 200/300	BND 130/200	BND 90/130
	BND 130/200	BND 90/130	BND 60/90
	BND 90/130	BND 60/90	BND 40/60
	BND 60/90	BND 40/60	
	BND 40/60		
Cold	-	BND 60/90	BND 60/90
		BND 40/60	BND 40/60

Note. In case of non-availability of bitumen BND , bitumen BN with the same penetration value at 25 ° C may be permitted to use as an exception.

3.28. Mineral powders made of carbonate rocks shall comply with the requirement in Table 3.5 (GOST 16557-71) , other powder shall complywith the requirements in Table . 3.7.

Mineral powders shall be tested in accordance with GOST 12784-71.

3.29. With regard to the quality of mineral powders listed in paragraph 3.17, further check shall be conducted on the properties of mixture prepared using these powders. Coefficient of water resistance of the specimen from hot and warm mixture with air voids of 4.5~5 % after 15 days saturation shall comply with Table 1.4 (depending on the type and class of asphalt). The percentage of mineral particle in dense mixture shall use the upper limit in grading –envelop , ie with a maximum percentage of mineral powder (see Fig. 1.2).

3.30. Mineral powder shall be dry and loose. Activated mineral powder, moreover, shall be uniform in color and hydrophobic. The difference in the content of the mixture in samples taken from each batch of suppled powder shakll be within the range of± 0.15% by weight of the powder (see GOST 12784-71) .

Note: Powders and activated resins listed in paragraph 3.19 are not imposed on hydrophobicity.

Table 3.7

Technical requirements for mineral powder from non-carbonate rocks and industrial waste.

Indicators	Type of powder		
	From metallurgical slags and non-carbonate rocks	Industrial waste	
		Ash entrainment from heat station	Dust ash from cement plants
Grain composition,% by weight, not less than:			
Particle smaller than 1.25 mm	100	100	100
Passing sieave 0,315mm is not less than	90	55	90
Passing sieave 0.07i is not less than	70	35	70
Porosity(%)by volume, not more than	35	45	45
Swelling of samples of a mixture of bitumen with mineral powder,% by volume, not more than	2,5	not normalized	2,5
Coefficient of water resistance of samples of powder mixtures with bitumen	not normalized	0,6	0,8
Indicator bitumen capacity(g per 100 cm3) (absolute volume), not more than	same	100	100
Water soluble compounds(%)by mass, not more than	»	1	6
Moisture(%) by weight, not more than	1,0	2,0	2,0
The content of alkali metal oxides (Na2O + K2O) (%)by mass, not more than	not normalized		6
Loss in laying(%)by weight, not more than	same	20	not normalized

Notes:

1. Mixtures class IV is allowed to use mineral powder containing particles finer than 0.071 mm not less than 60%.
2. Porosity, coefficient of water resistance and bitumen capacity of slag mixtures from power heating plant shall be determined by the particles which passes sieve 0.315 mm.
3. Bitumen capacity of mineral powder shall be determined only in establishing the suitability of a new material (rock) for the preparation of mineral powder in cases of dispute.
4. Content of alkali metal oxides shall be determined by chemical analysis in cement factories and indicated in the certificate. .

Table 3.8

Mineral powder for mixture

Type of mineral powder	Type and brand of asphalt				
	Hot and Warm				Cold
	I	II	III	IV	I и II
Activated powders of mineral carbonate rocks	+	+	-	-	+
Validating mineral powders of carbonate rocks	+	+	+	+	+
Metallurgical slag mill-ground	-	+	+	-	+
Non- carbonate rocks mill-groind	-	-	-	+	-
Powdered industrial waste	-	-	+	+	-

Notes:

1. Mineral powders provided for the highest class of mixture may be used for lower class mixture only if feasible.
2. Class I mixture shall use primarily activated mineral powders.

3.31. Production of activated mineral powders shall be guided by "Technical guidance for the production of activated mineral powders and their use in asphalt concrete" (VSN 113-65).
3.32. Selection of mineral powders on the types and classes of mixture shall be carried out in accordance with the Table 1.2, 1.3 and 3.8.

Bitumen

3.33. For the production of mixtures, viscous oil road bitumen(hereinafter called viscous bitumen) and liquid petroleum road bitumen(hereinafter called liquid bitumen) inTable 3.9 and 3.10 shall be used corresponding to the requirements of GOST 22245-76 and GOST 11955-74. Hot and Warm mixture class I and II shall use only bitumen BND, and for Hot. Warm mixture class III and IV as well as mixtures designed for base course and lower layers of surfacing may apply bitumen BN appropriate viscosity grades along with bitumen BND.
3.34. Brand of viscous bitumen as well as liquid bitumen is selected depending on the type of mixture, climatic conditions of the area and road category. Bitume for Cold mixture is subject to the conditions and durations of storing the mixture in stock. Choosing brand of bitumen shall be guided by Table 2.1.
3.35. Refineries of viscous bitumen produce the bitumen with or without surfactant.

When producing the bitumen with additives developed by surfactant ,brand name of bitumen add index n, for example, BND 200/300.

When delivered bitumen does not provide adhesion to the mineral part of asphalt in accordance with GOST 9128-76, surfactant shall be introduced at asphalt plant.
3.36. Liquid bitumen produced in refineries by mixing viscous bitumen shall meet the requirements of GOST 22245-76 and GOST 11955-74''Liquid petroleum products (thinners) established fractional composition with addition of surfactant''.
3.37. In exceptional cases and in the absence of liquid bitumen, SG and MG may be prepared by mixing viscous bitumen with diluent and surfactant at the asphalt plant.

Liquid bitumen SG is prepared by mixing the viscous bitumen BND 40/60 or BND 60/90 with diluents having following characteristics:

initial flash point not lower than 145 °C,
50 % of the product is evaporated at a temperature not exceeding 215 ° C,
96% flashes at a temperature not higher than 300 ° C.

The following items may meet the requirement:

Arctic diesel (GOST 305-73), winter diesel W (GOST 305-73), kerosene for technical purposes (GOST 18499-73) . Extracts from the relevant State Standards are given in Attachment

Liquid bitumen MG is prepared by mixing viscous bitumen BND 40/60 or BND 60/90 with diluents, 50 % of which is evaporated at a temperature of 280 ° C, and 96 % by weight is evaporated at temperature 360 ° C.
The following items may meet these requirements:

A summer diesel fuel L (GOST 305-73); fuel for high speed diedels DZ ,DA, DS (GOST 4749-73), green oil (GOST 2985-64) Extracts from the relevant State Standards are given in Attachment.

Ratio of bitumen and diluent as well as the optimal amount of surfactant is preliminary determined in laboratory. Indicative diluent and surfactant concentration required to produce various brand of liquid bitumen are given in Table 3.11 and 3.12.
3.38. Liquid bitumen shall be prepared in a separate bitumen tank equipped with steam heating. 70% of volume shall be dehydrated viscous bitumen in the tank. The temperature of production shall be within 90~100 ° C for SG and 100 ~110 °C for MG. Then, in the bitumen with constant stirring administered in small portions thinner without heating and surfactant warmed to 50 ~ 70 °C. Stirring is carried out by bitumen circulation pump or other means to obtain a homogeneous material.

To maintain the required ratio of diluent and surfactant, components shall be put into the tank through the dispenser.

3.39. In some cases, bitumen BND 130/200 and 200/300 used for the preparation of warm asphalt mixes may be obtained by dilution at asphalt plant

Table 3.9

Requirements of Viscous Bitumen

Properties	Bitumen brands									Test method :GOST:
	BND 200/300	BND 130/200	BND 90/130	BND 60/90	BND 40/60	BN 200/300	BN 130/200	BN 90/130	BN 60/90	
1. Penetration value (0.1mm):										GOST 11501-73
a) at 25 ° C	201 ~ 300	131 ~ 200	91 ~ 130	61 ~ 90	40 ~ 60	201 ~ 300	131 ~ 200	91 ~ 130	60 ~ 90	
b) 0 °C, no lower	45	35	28	20	13	-	-	-	-	
2. Softening point by ring and ball method(°C) no lower than										GOST 11506-73
	35	39	43	47	51	33	37	40	45	
3. Ductility (cm) at least:										11505-75
a) at 25 °C	-	65	60	50	40	-	70	60	50	
b) at 0 °C	20	6	4.2	3.5	-	-	-	-	-	
4. Brittleness Temperature (°C) not higher										11507-65
	-20	-18	-17	-15	-10	-	-	-	-	
5. Flash Point(°C) not lower than										4333-48
	200	220	220	220	220	200	220	220	220	
6. Clutch with marble or sand										11508-74, метод А
	Sustained or cured on sample 2					-	-	-	-	
7.. Change of softening temperature after heating(°C) not more than,										18180-72 or 11506-73 3.2. -76
	8	7	6	6	6	8	7	6	6	
8. Penetration index										attachment to 22245-76
8. Penetration index	From +1 to -1					From +1 to -1.5				
9. Water soluble compounds(%) not more than										11510-65
	0,2	0,2	0,3	0,3	0,3	-	-	-	-	

Notes . 1. Allowed to asphalts produced with the addition of surfactants , in terms of reduction rules " elongation at 25° C ' for 10 % and an increase in the content of water-soluble compounds to 0.5 %.

2. Allowed for bitumen manufactured in Azerbaijan SSR, increase of water-soluble compounds to 0.4 %.

3. In the manufacture of bitumen BND, which in the prescribed manner astate quality mark was awarded ,definition of property in item 6 in table3.9 should be carried out by the control sample number 1 , except BND 200/300 and bitumen BND 40/60 should have a brittleness temperature not higher minus 12 ° C. Norms in the table according to claim 3b for bitumen BND only applies to bitumen certified by

4. The indicator of property 7 in the table is optional to 01/01/1980

Table 3.10

Requirements of Liquid Bitumen

Indicators	Bitumen brands					Test method in accordance with GOST:
	BG 70/130	SG 70/130	SG 130/200	MG 70/130	MG 130/200	
1.Ttemtative viscosity by the hole 5 mm at 60 ° C,						11503-74
	71 - 130	71 - 130	131 - 200	71 - 130	131 - 200	
2.Quantity of vaporized diluent when exposed bitumen in an oven (60 °, 5 h), or vacuumthermostat (100 ° C, 1 hr),% by weight of bitumen, at least: In thermostate (60 °C, 5 h)						11504-73
In thermostate (60 °C, 5 h)	7	8	7	7	5	
In vacuum thermostate (100 °C, 1 h)	7	-	-	-	-	
In thermostate (100 °C, 3 h)						
In vacuum thermostate (100 °C, 2 h)	-	8	7	-	-	
In thermostate (110 °C, 5 h)						
In vacuum thermostate (100 °C, 3 h)	-	-	-	7	5	
3 Softening Point of residue after determining the amount of vaporized diluent(° C), not lower						11506-73
	37	39	39	29	30	
4.Flash Point in open oven(° C) not lower than						

Indicators	Bitumen brands					Test method in accordance with GOST:
	BG 70/130	SG 70/130	SG 130/200	MG 70/130	MG 130/200	
	37	50	60	110	110	4333-48
Test for adhesion with marble or sand	sustain in accordance with a control sample number 2					11508-74, method B with additions 4.3GOST 11955-74

Table 3.11

Approximate concentration of diluents used in the preparation of diluted bitumen

Required bitumen brand	Initial bitumen brand	Diluent for a given viscosity of bitumen(%)by weight	
		Diesel A and Z, kerosene for technical purposes	A diesel fuel for DZ-speed diesel engines, DA, DS, green oil
BND 200/300	BND 60/90	4 - 7	5 - 8
	BND 90/130	3 - 5	4 - 7
BND 130/200	BND 60/90	4 - 6	4 - 6
	BND 90/130	3 - 4	3 - 5
SG 130/200	BND 40/60	14 - 18	-
	BND 60/90	12 - 16	-
SG 70/130	BND 40/60	16 - 20	-
	BND 60/90	14 - 17	-
MG 130/200	BND 40/60	-	17 - 23
	BND 60/90	-	14 - 18
MG 70/130	BND 40/60	-	19 - 25
	BND 60/90	-	16 - 20

Note. To prepare the bitumen BND 200/300 and BND 130/200 as a diluent, coal tar D-3, D-4 (6 - 18%) of D-5 (9 - 20%), coal tar oil (5 - 12%), oil shale (4 - 10%). may be used

For this viscous bitumen BND 40/60, BND 60/90 and BND 90/130 introduced thinners recommended for bitumen SG and MG in accordance with paragraph 3.37, as well as coal tar grades D-3, D-4, D -5, coal and oil shale.

3.40. Liquid bitumen BG and SG shall be stored in sealed containers, and bitumen MG – Bitumen shall be in closed type stock.

Periods of storage of liquid bitumen without heating from the date of manufacture are for bitumen BG - 2 months, SG - 6 months, MG - 8 months.

Surfactants and activators

3.41. When the device road asphalt concrete pavements where appropriate is recommended to use surface-active substances (surfactants) and activators.

3.42. Surfactants are used in the absence of bitumen adhesion with minerakl materials

There is a possibility to use wet mineral materials in fall and spring (surfactants may be allowed to use under residual moisture of mineral materials up to 1% during the preparation of hot mixture, and up to 3% during the preparation of warm and cold mixture) ;

to activate the surface of mineral materials (powder, sand , gravel);

to reduce caking of cold mixtures during storage and transportation .

Furthermore, the use of surfactants reduce the temperature of the mineral materials and heating the mixtures , increase the degree of encapsulation of the mineral surface of the bitumen particles ,reduce mixing time and improve the workability and the compactability of mixtures.

3.43. Ionogenic surfactants are divided into two classes: cationic and anionic.

Salt of superior, primary, secondary and tertiary aliphatic amines, tetra-substituted ammonium basesbelongs to cationic class.

Superior carboxylic acid, salts (soaps) of heavy and alkaline-earth metal of superior carboxylic acids belong to cationic class

the resin solid fuels shall be used as some of the surfactant.. List of surfactants and activators as well as recommendations for their use are given in Table 3.12.

Table 3.12

Surfactants and activators (SAA) using for production of asphalt mixture

Class of SAA	Recommended limit of surfactant concentration when administered		SAA temperature when injected into the bitumen or mineral material (°C)	Bitumen temperature when administered surfactant, °C			Name of surfactants and activators	Technical conditions for surfactants and activators
	in bitumen, the bitumen % by weight	for mineral material,% by weight of the mineral material		Viscous	Liquid bitumen			
					SG	MG		
Higher aliphatic amines cationic	0,5 - 1,5	0,05 - 0,15	50 - 70	110 - 130	70 - 100	100	BP-3, a product based on polyethylenepolyamine and synthetic fatty acids C21 - C26	TU 38-2-01-170-74 with modifications № 2
							Amines, aliphatic C17 - C21 (technical), the product of the hydrogenation process, the amination of fatty acids	TU 6-02-795-73
							Flotamin (octadecylamine stearic technical)	GOST 5.997-71
Anio-active higher Carboxylic Acid	3 - 5	0,2 - 0,3	50 - 70	110 - 130	70 - 100	70 - 100	Resin gossipolovaya (cotton tar), the product obtained as distillation residue in the distillation of fatty acids isolated from cotton soapstock	GOST 18-114-73
							Tar fat, a product obtained by distillation of fatty acids isolated after cleavage of natural fats	OCT 18-114-73
							Synthetic acid C17 - C20	GOST 38-7-25-73
							Distillation residue synthetic fatty acids	TU 38-1-07-54-74
							oxidized petrolatum	GOST 38-01-117-76
Resins solid fuels	10 - 12	1 - 3	50 - 100	110 - 130	70 - 100	70 - 100	Slate low-temperature resin (liquid shale bitumen within brands from P-2 to P-5)	RST ESSR 82-72
							Coal tar pitch	GOST 4492-69
							Pine tar	GOST11238-65
Activators	-	1 - 3	-	-	-	-	hydrated Lime	GOST 9179-70
							Portland cement and Portland cement hydrophobic 400 - 600	GOST 10178-62

Notes. 1. Temperature for liquid bitumen are that when preparing them for asphalt plants.

2. Features of application of surfactants in the case of introducing them to the mineral powder is mentioned in paragraph 3.19 and 3.21.

3.44. Class of surfactants shall be chosen taking into account of the nature and properties of mineral materials and bitumen.

3.45. When choosing a surfactant, cationic surfactant type of higher aliphatic amines shall be preferred to improves adhesion with bitumen and acidic mineral materials and main rocks. Simultaneously surfactants of this type are moderated aging high viscosity bitumen.

3.46. Surfactants may be introduced at asphalt plant:

a) into Bitumen. Wherein the surfactant is introduced into the bitumen tank or bitumen dispenser prior to feeding into the mixer. When introducing the surfactant into asphalt tank ,operating temperature may be maintained less than 3~4 hours;

b) on the surface of the mineral material prior to its processing with bitumen. In this case, the surfactant is introduced in view of their low flow mixed with the plasticizer (1:1). As the plasticizer, it is best to use bitumen, the amount of which is accounted for a total dosage (a surfactant administration scheme is shown in Fig. 5.7 ~5.9).

3.47. The positive effect of the surfactant can be achieved only when they are used in optimum concentrations. Optimal concentrations within the recommended range (see Table 3.12) shall be specified in Table 3.12. In each case ,the nature and properties of the materials used shall be taken account

The criteria for assessing the optimum amount of surfactant is determined by

physical and mechanical properties of asphalt concrete. Exceeding the optimum amount of surfactant may lead to adverse effects

3.48. In those cases where asphalt, or does not contain surfactant comprises anionic surfactant to improve the adhesion of bitumen with mineral acid materials recommended activators (lime, cement, etc.) that is introduced into a mixture of mineral materials to its processing with bitumen in an amount of 1 ~ 3 % by weight of the mineral material.

3.49. For more information about the surfactant activator and peculiarities of their application are set forth in the "Instructions for use of surfactants in the construction of pavements using bitumen" (VSN 59-08).

STATE STANDARD OF USSR

ASPHALT MIXTURES FOR ROADS & AIRFIELD AND ASPHALT BITUMEN

SPECIFICATIONS

GOST 9128—84

Official Publication

STATE CONSTRUCTION COMMITTEE OF USSR

Specification for Asphalt mixtures for roads & airfield and asphalt bitumen

Revision of GOST 9128—76

OKP 57 1840, 57 1850

Resolution of the USSR State Committee for Construction on 13 February 1984
Deadline for implementing ResolutionNo.15 is set on 01.01.85

Failure to comply with the standard shall be prosecuted

This standard covers asphalt mixture used for surfacing and bases of highways, airports, city streets and squares, roads, industrial enterprises as well as asphaltic bitumen used for pavement.

Asphalt concrete is produced by mixing in mixing machines in a heated condition with crushed stone (gravel), natural or crushed sand, mineral powder and oil bitumen in the ratio determined by the requirements of this standard.

Recommended brand of asphalt bitumen used is shown in Annex 2 to Annex 4.

1. CLASSIFICATION

1.1. Asphalt mixture (hereinafter - the mixture) is classified into crushed stone type , gravel type and sand type.

1.2. Mixtures are divided into following types depending on the viscosity of bitumen and conditions of use:

Hot Type - produced using viscous bitumen and applied immediately after production at a temperature not below 120 ^{o} C.;

Warm Type - produced using both viscous and liquid bitumen and applied immediately after production at a temperature not below 70 ^{o} C;

Cold Type - produced using liquid bitumen accepted for long-term storage and applied at temperatures not below 5 ^{o} C.

1.3. Hot and Warm mixtures are divided into following types depending on the maximum sieve size of the mineral materials(aggregate):

Coarse- graded Type - with maximum aggregate size of 40 mm;

Fine -graded Type - with maximum aggregate size of 20 mm;
Sandy Type - with maximum aggregate size of 5 mm

Cold mixture is divided into Fine- graded Type and Sandy Type

1.4. Hot and Warm mixture is divided into following types depending on the Air Void:

Dense Type - with a Air Void of 2% ~7%;
Porous Type - with a Air Void of 7% ~12%
Highly Porous Type - with a Air Void of 12% ~18%

1.5.Mixtures are classified into the types specified in Table 1 depending on the content of crushed stone or gravel and depending on the type of sand used.

Table 1

Type of mixtures		**Percentage(%) of crushed stone or gravel by weight**	**Type of sand used**
Hot and Warm mixture; Dense	**Cold mixture**		
A	--	50%～65% of crushed stone	--
B	Bx	35%～50% of crushed stone or gravel	--
C	Cx	20%～35of crushed stone or gravel	--
D	Dx	--	Crushed or screening of crushed stone or natural sand
E	Ex	--	

1.6. Each mixture type is diveded into following Classes in accordance with the property of mixture:

Hot & Warm mixture

Type A - two classes: A_I and A_{II}
Type B, C and D - three classes($B,C,D)_I$, $(B,C,D)_{II}$ and $(B,C D)_{III}$,
Type E - two classes: E_{II} and E_{III}.

Cold mixture

Types Bx and Cx - two classes: $B_{XI\&}B_{XII}$, C_{XI} &C_{XII},
Type Dx - one class I(D_{XI}),
Type Ex - one class II.(E_{XII})

Hot and Warm mixture of Porous and Highly Porous mixture is divided into two classes: I and II

Table 2

Property	Standard Class of asphalt mixtures								
	Class I			Class II			Class III		
	Climatic zones								
	Z-I	Z-II& III	Z-IV& V	Z-I	Z-II& III	Z-IV& V	Z-I	Z-II& III	Z-IV& V
1. Compressive strength MPa(kgf/cm2) at Temperatures : a) not less than 20° C for all types of mixture	2,5 (25) 2,2 (22)	2,5 (25) 2,2 (22)	2,5 (25) 1,9 (19)	2,2 (22) 2,0 (20)	2,2 (22) 1,8 (18	2,2 (22) 1,8 (18)	2,0 (20) 1,6 (16)	2,0 (20) 1,6 (16)	2,0 (20) 1,6 (16)
b) not less than 50°C, asphalt type: Type A	0,9 (9) —	0,9 (9) —	0,9 (9) —	0,8 (8) —	0,8 (8) —	0,8 (8) —			
Type B & C	0,9 (9) 0,9 (9)	1,1 (11) 0,9 (9)	1,3 (13) 1,0 (10)	0,8 (8) 0,8 (8)	1,0 (10) 0,8 (8)	1,2 (12) 0,9 (9)	0,8 (8) 0,7 (7)	0,9 (9) 0,7 (7)	1,1 (11) 0,8 (8)
Type D	1,0 (10) 1,0 (10)	1,3(13) 1,0 (10)	1,6 (16) 1,2 (12)	0,9 (9) 0,9 (9)	1,2 (12) 1,0 (10)	1,4 (14) 1,1 (11)	0,8 (8) 0.8(8)	1,1 (11) 0,9 (9)	1,3 (13) 1,0 (10)
Type E	—	—	—	1,0(10) 0,8 (8)	1,2 (12) 0,9 (9)	1,2 (12) 1,0 (10)	0,8(8) 0.6(6)	0,9 (9) 0,7 (7)	1,0 (10) 0,8 (8)
c)not more than 0 °C for all types of mixture	9 (90) 7 (70)	11(110) 7 (70)	13(130) 8 (80)	10(100) 7,5 (75)	12 (120) 7,5 (75)	13 (130) 8,5 (85)	10(100) 8 (80)	12 (120) 8 (80)	13 130) 9 (90)
2. Coefficient of water resistant, not less than	0,95 0,90	0,90 0,80	0,85 0,75	0,90 0,85	0,85 0,75	0,80 0,70	0,85 0,80	0,75 0,70	0,70 0,60
3.Coefficient of water resistant with prolonged water saturation, not less than	0,90 0,85	0,85 0,75	0,75 0,70	0,85 0,80	0,75 0,65	0,70 0,60	0,75 0,70	0,65 0,60	0,60 0,50
4. Swelling (%) by volume, not more than	0,5 0,5	0,5 0,7	0,5 0,7	1,0 1,0	1,0 1,5	1,5 1,7	1,0 1,0	1,0 1,5	1,5 1,7

Note. The numerator is given to the requirements of Hot mixture, the denominator is to Warm mixture.

2. SPECIFICATIONS

2.1. Mixture shall be produced in accordance with the requirements of this standard for technological regulations approved in the prescribed manner.

2.2. The physical and mechanical properties of Dense asphalt Hot and Warm mixture depending on the Class and climate zone shall be as specified in Table 2 .

2.3. Void in Mineral Aggregate(VMA) of Dense asphalt mixture of types A and B shall be of 15～19 % by volume,and type C, D and E shall be of 18～22% by volume.

2.4. Air Voids and water saturation of Dense mixture depending on climatic zones shall be as specified in Table 3 .

Table 3

Property	Climatic Zones		
	Z_I	Z_{II} & Z_{III}	Z_{IV} & Z_V
Water absorption (%) by volume:			
Type A	2.0～3.5	2.0～5.0	3.0～7.0
Type B&D	1.5～3.0	1.5～4.0	2.5～6.0
Type C&E	1.0～2.5	1.0～4.0	2.5～6.0
Air Voids (%) by volume	2.0～3.5	2.0～5.0	3.0～7.0

2.5. The physical and mechanical properties of Porous and Highly Porous asphalt of fine- graded type and sandy- type for Warm and Hot mixture depending on mixture class shall be as specified in Table 4.

Table 4

Description	Class of Mixture	
	Class-I	Class- II
1,Compressive Strength not less than Mpa(kgf/cm2) at the temperature		
a) 20 °C		
Porous mixture	1.8(18)	1.5(15)
Highly Porous mixture	1.4(14)	1.2(12)
b) 50 °C		
Porous mixture	0,7(7)	0.5(5)
Highly Porous mixture	0.5(5)	0.4(4)
2.Coefficient of water resistant not less than	0.7	0.6
3.Coffecient of water reesistant with prolonged water saturation not	0.6	0.5

less than		

2.6. VMA for Porous mixture shall be not more than the following percentage by volume:

Porous mixture ---- 23%
Highly Porous : using crushed stone(gravel) ---- 24%
Highly Porous : using sand ----28%

2.7. Water-saturatation shall be not more than the following percentage by volume:

Porous mixture ----12%
Highly Porous mixture ---18%

2.8. Swelling ratio of Porous and Highly Porous mixtures shall be not more than the following percentage by volume

Class I not more than 1.0 %
Class II not more than 2.0 %

2.9. The physical and mechanical properties of Cold mixture for each class shall be as specified in Table 5 .

Table 5
Properties of Cold Mixture

Description		Class of Mixture	
		Class-I	Class-I
1. Compressive strength at temperature 20 °C, Mpa (kgf/sm^2), not less than:			
a) before warm-up	Type B_X &C_X	1.5 (15)	1.0 (10)
	Type D_X	1.7 (17)	—
	Type E_X	—	1.2 (12)
b)after warm-up	Type B_X, C_X	1.8 (18)	1.3 (13)
	Type D_X	2.0 (20)	—
	Type E_X	—	1.5 (15)
2. Coefficient of water resistant, not less than:			
a) before warm-up		0.75	0.60

b)after warm-up	0.9	0.80
3. Coefficient of water resistant with prolonged water saturation not less than:		
a) before warm-up	0.5	0.4
b)after warm-up	0.75	0.65
4. Swelling (%) by volume, not more than	1.2	2.0

2,10 VMA of Cold mixture shall be not more than the following percentage by volume:

For type B_X ---------18%
For type C_X ----------18%
For type D_X &E_X ---------21%.

2.11 Air Voids of Cold mixture shall be of 6～10%.

2.12 Water saturation of Cold mixture shall be of 5～9% by volume.

2.13 Index of strokes obtainted by testing of hardening after dry(Caking) for cold mixeture shall be less than 10 times .

2.14 . Mixture shall withstand the adhesion of the bitumen with mineral part of mixtures. In the absence of bonding, surfactant substance(surfactants) shall be applied.

2.15 . Grading of Hot and Warm mixture shall meet the requirements inTable 6&7and Cold mixture shall meet the requirements in Table8.

Table 6

Grading requirement of Hot and Warm mixture
Dense Mixture in the surface course

Name and type of mixtures	Percentage by weight Passing Sieve									
	20	**15**	**10**	**5**	**2,5**	**1,25**	**0,63**	**0,315**	**0,14**	**0,071**
Continues graded										
Fine- graded types:										
A	95 — 100	78 — 100	60 — 100	35 — 50	24 — 38	17 — 28	12 — 20	9 — 15	6 — 11	4 — 10
B	95 — 100	85 — 100	70 — 100	50 — 65	38 — 52	28 — 39	20 — 29	14 — 22	9 — 16	6 — 12
C	95 — 100	88 — 100	80 — 100	65 — 80	52 — 66	39 — 53	29 — 40	20 — 28	12 — 20	8 — 14
Sandy –graded types:										
D	—	—	—	95 — 100	68 — 83	45 — 67	28 — 50	18 — 35	11 — 24	8 — 16
E	—	—	—	95 — 100	74 — 93	53 — 86	37 — 75	27 — 55	17 — 33	10 — 16
Open graded										
Fine- graded types:										
A	95 — 100	78 — 100	60 — 100	35 — 50	28 — 50	22 — 50	18 — 50	14 — 28	8 — 15	4 — 10
B	95 — 100	85 — 100	70 — 100	50 — 65	40 — 65	34 — 65	27 — 65	20 — 40	14 — 23	6 — 12

Table 7

Name and type of mixtures	Percentage by weight Passing Sieve										
	40	20	15	10	5	2,5	1,25	0,63	0,315	0,14	0,071
Continues graded											
Dense: Coarse-graded type: A B	 95 — 100 95 — 100	 65 — 80 78 — 86	 55 — 70 70 — 80	 45 — 62 62 — 74	 35 — 50 50 — 65	 24 — 38 38 — 52	 17 — 28 28 — 39	 12 — 20 20 — 29	 9 — 15 14 — 22	 6 — 11 9 — 16	 4 — 10 6 — 12
Open graded											
Dense: Coarse- graded type: A B	 95 — 100 95 — 100	 65 — 80 78 — 86	 55 — 70 70 — 80	 45 — 62 62 — 74	 35 — 50 50 — 65	 28 — 50 40 — 65	 22 — 50 34 — 65	 18 — 50 27 — 65	 14 — 28 20 — 40	 8 — 15 14 — 23	 4 — 10 6 — 12
Continues graded											
Porous and Highly Porous coarse -graded	95 — 100	70 — 100	57 — 100	45 — 76	27 — 65	18 — 50	10 — 38	7 — 28	4 — 22	3 — 15	2 — 8
Highly Porous sandy-graded	—	—	—	—	95 — 100	68 — 100	45 — 100	28 — 88	18 — 73	10 — 45	4 — 10
Open graded											
Porous and Highly Porous coarse-and fine-graded	95 — 100	65 — 100	54 — 100	42 — 88	30 — 65	25 — 65	18 — 65	12 — 65	8 — 40	5 — 22	2 — 8

Table-8

Grading requirement of Cold mix used for surface course

Name and type of mixtures	Percentage by weight Passing Sieve									
	20	15	10	5	2,5	1,25	0,63	0,315	0,14	0,071
Fine-graded types: Bx Cx	 95 — 100 95 — 100	 85 — 100 88 — 100	 70 — 100 80 — 100	 50 — 65 65 — 80	 33 — 50 50 — 60	 21 — 39 39 — 49	 14 — 29 29 — 38	 10 — 22 22 — 31	 9 — 16 16 — 22	 8 — 12 12 — 17
Sandy-graded types:	—	—	—	95 — 100	66 — 82	46 — 68	26 — 54	18 — 43	14 — 30	12 — 20

D_X and E_X										

Recommended content of bitumen in mixture is given in Appendix-1

2.16. The composition of the Hot and Warm mixture of dense type and Cold mixture class I and II containing products screenings by crushing igneous rocks shall include mineral powders corresponding to section 3.5 of this standard in such an amount that the content of these finer powders 0.071 mm is not less than 50 % by weight of this fraction.

2.17. In the composition of the Hot and Warm mixture for dense type class II and Cold mixture class II containing products screening and crushing gravel used in climatic zones $Z\text{-}_{IV}$ & $Z\text{-}_{V}$ may allowed to include mineral powder. The content of the proportion passing 0.071 sieve and calcium carbonate magnesium (MgCO3+CaCO3) is not less than 40% by weight

2.18. In a mixture of Dense asphalt class III and Porous and Highly Porous asphalt class I and II containing screenings products and mineral powders may not be allowed to include.

2.19. In the composition of the Hot and Warm mixture of type D, natural sand shall be allowed to contain in an amount not exceeding 30% by weight in order to improve workability.

2.20. In Cold mixture class I and II containing products by crushing carbonate rock and mineral powders may not be allowed to include in the mixture.

2.21. Limits of error of dispensing components when producing the mixture shall not exceed:

± 3% for the aggregates (gravel) by weight of corresponding component

± 1.5% for mineral powder and bitumen by weight of corresponding component

2.22 Temperature of mixture at the outlet of the mixer and when placing in a constructive layer shall be as specified in Table 9.

Table 9

Type of mixture	**Brand of Bitumen**	**Temperature of mixtures(°C)**	
		at release from the mixer	**In asphalt paver during paving of structural layer, not less than**
Hot	BND 40/60 BND 60/90 BND 90/130 BN 60/90 BN 90/130	140 — 160	120
Warm	BND 130/200 BND 200/300 BN 130/200 BN 200/300	120 — 140	100
	SG 130/200	90 — 110	70
	MG 130/200 MGO 130/200	100 — 120	
Cold	SG 70/130	80 — 100	5
	MG 70/130 MGO 70/130	90 — 100	

2.23. In case of applying activated mineral powders or surfactant mixtures the temperature of hot bitumen using BND 40/60, BND 60/90, BND 90/130, BN 60/90 and BN 90/130 shall be 20 ^{o}C lower, when using bitumen BND 130 / 200, BND 200/300 BN 130/200 BN and 200/300, 10 ^{o} C lower compared with the temperature in Table. 9.

2.24. Temperature of hot mixture may be 10 ^{o}C higher than that indicated in Table. 9 if laying work is carried out at ambient temperature of below 5^{o}C

3. REQUIREMENTS FOR MATERIALS

3.1. Bitumen

3.1.1. Hot mixtures shall use viscous oil road bitumen BND 40/60, BND 60/90, BND 90/130, BN 60/90, BN 90/130 in accordance with GOST 22245-76, and for heat-mated mixtures highly viscous bitumen BND 130/200, BND 200/300, BN 130/200, BN 200/300, GOST 22245-76, as well as liquid bitumen SG 130/200, MG 130/200 and MGO 130/200 in accordance with GOST 11955-82 shall be used

For the production of cold mixture, liquid petroleum road bitumen SG 70/130, MG 70/130 and the MGO 70/130 in accordance with GOST 11955-82 shall be applied.

Cold mixture class I shall apply liquid bitumen SG. It is also possible to make use of MG and MGO in case using activated mineral powder or mineral materials pretreated by f bitumen with surfactants.

Cold mixture class-II shall apply liquid bitumen SG, MG and MGO.

3.1.2. Particular of bitumen shall be selected depending on the type of mixture, climate zone and the airfield shall be in accordance with the recommended ANNEX 2～4.

3.2. Crushed stone and gravel

3.2.1. Production of mixture shall use crushed stone produced by crushing rock in accordance with GOST 8267-82 , as well as crushed stone (gravel) / GOST 10260-82 , crushed stone from metallurgic and slag / GOST 3344-83, gravel / GOST 8268-82 .

It shall not be allowed to use rubble of clay (marls), limestone, argillaceous sandstone and clay slate.

3.2.2. Production of mixture shall use crushed stone or gravel with following fractions:

5mm ～ 10mm; 10mm ～ 20mm, 20mm ～ 40 mm.

It is allowed to use aggregate and gravel as a mixture of adjacent fractions.

3.2.3. Percentage of containing lamellar (flaky) shape in aggregate shall not exceed:

15% for mixture Type-A
25% for mixture Type-B & Bx
35% for mixture Type –C & Cx

3.2.4. Properties of strength and other characteristics of crushed stone and gravel depending on the class, type and form of mixtures shall be as specified in Table 10.

3.3. Sand

3.3.1. Production of mixture shall use natural sand and crushed sand conforming to GOST 8736-85.

3.3.2. Products screenings and sand produced by rock crushing and gravel conforming standard technical documentation duly approved shall be allowed to use

3.3.3. Properties of crushed sand and screenings products from rock crushing and gravel depending on class, type and form mixtures shall be as specified in Table 11.

3.4. Sand with gravel

3.4.1 Production of mixture shall use sand with gravel conforming to GOST 23735-79.

3.4.2. Gravel which is part of sand and gravel shall meet the requirements in Table 10

3.5 Mineral Powder

3.5.1 Use of activated and non-activated mineral powder for the production of mixture shall be in accordance with GOST 16557-78.

3.5.2 Following material may be used as mineral powders:

(i)Shredded basic metallurgical slag:- in Hot and Warm mixture class II and III for a Dense asphalt,class I and II-
-in Porous and Highly Porous mixture and for Cold mixtures class II;

(ii)Powder from industrial waste: -in Hot and Warm mixture class-III for dense asphaltic concrete and class I and II
-in Porous and Highly Porous mixture class I and II.

Properties of crushed major metallurgical slag powder and industrial wastes shall be as specified in Table 12.

Table 10

Property of Crushed stone and Gravel

Description	**Norms for mix grades**													
	Class I						**Class II**						**Class III**	
	Hot and Warm types			Cold type		Porous and Highly Porous	Hot and Warm types			Cold types		Porous and Highly Porous	Hot and Warm types	
	A	**B**	**C**	**B_x**	**C_x**		**A**	**B**	**C**	**B_x**	**C_x**		**B**	**C**
1.Strength(kgf/cm2)in cylinder not less than:														
crushed stone of igneous and metamorphic rocks	1200	1200	1000	1000	800	800	1000	1000	800	800	600	600	800	600
Same for the aggregates of sedimentary rocks	1200	1000	800	800	600	600	1000	800	600	800	600	400	600	400
crushed stone of metallurgical slag	—	1200	1000	1000	1000	800	1200	1000	800	800	600	600	800	600
2 Type of Crushed stone from gravel, not more	—	Cr. 8	Cr. 12	Cr. 8	Cr. 12	Cr. 16	Cr. 8	Cr. 12	Cr. 16	Cr. 12	Cr. 16	Cr. 24	Cr. 16	Cr. 24
Gravel, no more	—	—	—	—	—	—	—	—	Cr. 16	Cr. 12	Cr. 16	Cr. 24	Cr. 16	Cr. 24
3. Abrasion not below:														
a)Crushed stone of igneous and metamorphic rocks														
	Ab-I	Ab-I	Ab-II	Ab-II	Ab-III		Ab-II	Ab-II	Ab-III	Ab-III	Ab-IV		Ab-III	Ab-IV
b)Crushed stone of sedimentary carbonite and non-carbonate rocks														
	Ab-I	Ab-II	Ab-II	Ab-II	Ab-III	Non-standardized	Ab-I	Ab-II	Ab-III	Ab-III	Ab-IV	Non-standardized	Ab-III	Ab-IV
c) of gravel or crushed stone from gravel														
	—	Ab-I	Ab-II	Ab-I	Ab-II		Ab-I	Ab-II	Ab-III	Ab-II	Ab-III		Ab-III	Ab-III
Characteristic on frost resistance for all types of crushed stone and gravel, not less than:														

a) in the severe and moderate climates b) mild climates	FR. 50 FR. 25	FR. 50 FR. 25 5	FR. 50 FR. 25	FR. 50 FR. 25	FR. 50 FR. 25	FR. 25 FR. 25	FR. 50 FR. 25	FR. 50 FR 15	FR. 25 FR 15	FR . 25 FR 15	FR. 25 FR 15	FR . 15 FR 15	FR. 25 FR 15	FR 25 FR 15

- Cr : Crushed
- Ab : Abrasion
- FR : Frost Resistance

Notes:

1. In Dense asphalt mixtures for type B class II, as well as Porous and Highly Porous mixture class I, it is allowed to use the sedimentary carbonate rocks grade 400 which is pretreated by bitumen with surfactants of anionic type. Under the same condition, it is allowed to use sedimentary carbonate rocks grade 300 for a mixture of dense asphalt type B class III, as well as Porous and Highly Porous mixture class II.
2. Climatic conditions are characterized by an average monthly temperature as follows:
   Severe : coldest month below -15 ^{o} C,
   Moderate : from minus 5 to minus 15 ^{o} C,
   Soft : to minus 5 ^{o} C.

Table 11

Properties of crushed sand crushing and screening products from **rocks and gravel**

Type of Mixture	Norm for brand mixture								
	Class-I			Class-II				Class -III	
	Hot, Warm and Cold types		Porous and High Porous	Hot, Warm and Cold types			Porous and high porous	Hot, Warm and Cold types	
	A, B, B_x, C, C_x	D, D_x		A, B, B_x, C, C_x	D	E, E_x		B, C	D
Tensile strength of the original rock in compression, MPa (kgf/cm2), not less	80 (800)	100 (1000)	60 (600)	60 (600)	80 (800)	60 (600)	40 (400)	40 (400)	60 (600)
Brand original gravel on the divisibility, not lower	Cr. 12	Cr. 12	Cr. 16	Cr. 16	Cr. 12	Cr. 16	Cr. 24	Cr. 24	Cr. 16
Mass fraction of clay impurities,%, not more	0,5	0,5	0,5	0,5	0,5	0,5	1,0	1,0	1,0

Note. For mixtures of type D Class- I and II, crushed sand and screening products only from igneous rocks shall be used.

Table 12
Property of Slag

Indicators	Norms by material types		
	major shredded metallurgic slags	**fly ash and a mixture of ash and slag**	**dust ash cement plants**
1. Grain composition(%) by weight not less: fne,25 mm fine 0,315 mm fine 0,071 mm	 100 90 70	 100 55 35	 100 90 70
2. Porosity(%)by volume, not more than	40	45	45
3. Swelling of samples of a mixture of bitumen with mineral powder,% by volume, not more than	2,5	Not standardized	2,5
4 Coefficient of water resistance of sample of powder mixture with bitumen ,at least	0,7	0,6	0,8
5. Bitumen capacity(g) not more	100	100	100
6. Water soluble compounds(%)by mass, not more than	Not standardized	1	6
7. Moisture(%)by weight, not more than	1,0	2,0	2,0
8. Content of alkali metal oxides (Na2O + K2O) (%)by mass not more than	Not standardized	Not standardized	6
9. Loss on ignition(%)by weight, not more than	same	20	Not standardized
10. The content of free calcium oxide (CaO) wt %	0	0	0

4. SAFETY REQUIREMENT

4.1 Production of mixtures for road and airfield surfacing and bases shallt comply with all building codes and safety regulations in construction; ‘’Safety Regulations for the construction, repair and maintenance of roads , approved by Ministry of Road on April 28, 1977 and on February 25: RSFSR 1977’’ and agreed with the Central workers Unionof road Transport and highways January 25, 1977 , ‘’Safety and health regulations for construction and repair of city roads , work on asphalt factories and production bases of road maintenance organizations imposed by order of the Ministry of housing and community services of the RSFSR of 11 June 1976’’ and agreed with the Central workers Union of local industry and municipal servicesin in April 29, 1976

5. RULES OF ACCEPTANCE

5.1. Mixtures shall be accepted lot by lot.

5.2. When receiving and delivering hot and warm mixture, a lot consist of the weight of mixture of the same mix proportion produced at one plant during oneday or one shift’s production, but quantity shall not be more than 400 tons per lot.

5.3. As for the acceptance of cold mixture a lot shall not exceed 200 tons when mixture is placed in a warehouse.

5.4 . When cold nixture is delivered from the warehouse by automobiles , the amount of mixture of the same composition , same consumer and withina same day shall be numerated.

When delivering cold mixture from the warehouse into rail or water craft ,the amount of mixture, shall be numerated based on the same train or barge(craft).

5.5. Quantity of supplied mixture is determined by weight.

Mixture delivered by wagons or trucks shall be weighed on rail or by truck scales . Weght of cold mixture delivered by ship shall be determined by the draught

5.6. For quality control of the mixture at the enterprise / manufacturer,one sample from each batch shall be taken and tested. Sampling shall be made in accordance with GOST 12801-84 .

Quality control of these mixtures is determined by the following characteristics :

Temperature of produced mixture ;
Grading and content of bitumen ;
Water saturation ;
Swelling ;
Compressive strength at 20 ^{o}C for all mixtures, at a temperature of 50 ° C for hot and warm mix ;
Water resistance coefficient ;
Compaction characteristic for cold mixture .
Consolidation characteristic determined 2-3 times per shift.

5.7. The manufacturer shall be also required to conduct periodic monitoring of the mixtures based on the following characteristics:

VMA;
Air Void ;
Compressive strength at 20 ^{o}C after warm-up (only for cold mixes) and at 0 ^{o} C (Hot and Warm mixture);
Coefficient of water resistance after prolonged water saturation ;
Adhesion of bitumen with mineral mixtures part .

Periodic monitoring shall be conducted at least once every six months and whenever the materials used in production of mixtures as well as the design of the mixture has been changed..

5.8. Consumers have the right to control checking of mixture in compliance with this standard , while observing the sampling procedure established by standard GOST 12801-84 and using the test methods specified in GOST 12801-84 .

5.9 . To control testing of asphalt mixture delivered by trucks, three samples shall be taken from different location directly from the truck bodies .

For routine tests of cold mixture delivered by rail or water craft , three samples shall be taken from each cargo or barge . Each sample of the mixture shall be taken from different locations of the cargo or barge at different depths .

Samples shall not be mixed and tested separately .

In case of unsatisfactory results in the tests, at least one sampleshall be retestied based on twice the number of sample .

The lot shall be rejected in case of unsatisfactory results in retest .

5.10 . If hot and warm mixture is not homogenious when observing visually the presence of segregation , uncoated aggregate , bitumen and accumulation of mineral powder as well as by the unproper mixting temperature required in table. 9, mixture shall be discarded

6. TEST METHODS

6.1. Test for asphalt mixetures shall be in sccordance with GOST 12801-84.

6.2. Methods of test materials used for the production of mixtures shall comply with GOST 11501-78, GOST 11503-74, GOST 11504-73, GOST 11505-75, GOST 11506-73, GOST 11507-78, GOST 11508-74, GOST 11510 - 65, GOST 11511-65, GOST 11512-65 and GOST 4333-48 for bitumen, GOST 8269-76 for crushed stone and gravel, sand GOST 8735-75, GOST 12784-78 for mineral powder.

7. IDENTIFICATION, HANDLING AND STORAGE

7.1. When delivering mixture to the consumer, the manufacturer shall accompany mixture docket , which describes :

manufacturer's name ;
numbering and date of issue ;
name and address of the consumer;
kind, type and class of the mixture;
weight of the mixture;
temperature of the hot mixture;
departure time of hot mixture;
termof storage (cold mix) ;
designation of this standard.

7.2. Hot and warm mixture is transported to the paving area by truck with docket accompanied in each trucks .

7.3. Cold mixture is transported by trucks, rail wagons or barges with docket accompanied in each vehicle .

7.4. In summer, the cold mixture may be stored in the open air , in the autumn and winter - in closed warehouses or under a canopy in stacks up to 2 m high.

8. WARRANTY OF MANUFACTURER

8.1. The manufacturer shall guarantee the compliance of the requirements of this standard under any conditions of transportation and storage.

8.2. Warranty period of storage shall be:

4 month from the date of preparation - cold mixture using SG 70/130
8 months from the date of preparation-cold mixture using MG 70/130 and the MGO 70/130

ANNEX 1
Recommended **Bitumen content in mixture**

Type and name of mixture	**Type of mixture**	**Type of mixture**	**Bitumen content,% by weight of the mineral**
Hot and Warm Coarse graded	A	Dense	5,0 — 6,0 / 5,0 — 6,5
	B	Dense	5,5 — 6,5 / 5,5 — 7,0
	—	Porous	4,0 — 6,0 / 4,0 — 6,5
	—	Highly Porous	2,5 — 3,0 / 2,5 — 3,5
Fine graded	A	Dense	5,0 — 6,0 / 5,0 — 6,5
	B	Dense	5,5 — 6,5 / 5,5 — 7,0
	C	Dense	6,0 — 7,0
	—	Porous	4,5 — 6,0 / 4,5 — 6,5
	—	Highly Porous	2,5 — 3,5 / 2,5 — 4,0
Sandy	D, E	Dense	7,0 — 9,0
	—	Highly Porous	4,0 — 6,0
Cold: Fine-graded	B_x	—	3,5 — 5,5
	C_x	—	4,0 — 6,0
Sandy	D_x, E_x	—	4,5 — 6,5

Note. Bitumen content for mixtures with continuous graded composition is given in the numerator, in the denominator- for open graded composition

ANNEX 2

Recommended **Asphalt Brand for surface course depending on Road category**

climatic zone	Type of Asphalt mixture	Road category					
		I, II, III_p, I_c		III, IV_p, I_c, II_c		IV, II_c	
		Mix Class	Bitumen brand	Mix Class	Bitumen brand	Mix Class	Bitumen brand
I	Dense: Hot and Warm	I	BND 90/130 BND 130/200 BND 200/300	II	BND 90/130 BND 130/200 BND 200/300	III	BND 90/130 BND 130/200 BND 200/300 SG 130/200
II, III	Dense : Hot and Warm	I	BND 60/90 BND 90/130 BND 130/200 BND 200/300 SG 130/200	II	BND 60/90 BND 90/130 BND 130/200 BND 200/300 BN 60/90 BN 90/130 BN 130/200 BN 200/300 SG 130/200 MG 130/200	III	BND 60/90 BND 90/130 BND 130/200 BND 200/300 BN 60/90 BN 90/130 BN 130/200 BN 200/300 SG 130/200 MG 130/200 MGO 130/200
	Cold mixture	Not standardized		I	SG 70/130	II	SG 70/130 MG 70/130 MGO 70/130
IV, V	Dense	I	BND 40/60 BND 60/90 BN 40/60 BN 60/90	II	BND 40/60 BND 60/90 BND 90/130 BN 40/60 BN 60/90 BN 90/130	III	BND 40/60 BND 60/90 BND 90/130 BN 40/60 BN 60/90 BN 90/130
	With cold mixtures	Not applicable		I	SG 70/130	II	SG 70/130 MG 70/130 MGO 70/130

Notes:

1. Bitumen brand BN 40/60 conforms to the specifications approved in due course.
2. Urban expressways and arterial streets and roads shall use asphalt mixtures of types and class recommended for roads categories I and II; roads for industrial and warehouse area shall use the mixture recommended for road category III, and the rest of the streets and roads shall use the mixture recommended for road category IV.

ANNEX 3
RECOMENDED

Brand of asphalt used for construction and reconstruction of runway and taxiways and airfield

climatic zone	Type of Asphalt mixture	Load category					
		I, II, III		IV		V	
		Mix Class	Bitumen Brand	Mix Class	Bitumen Brand	Mix Class	Bitumen Brand
Z-I	Dense : Hot mixture	I	BND 90/130	II	BND 90/130	III	BND 90/130
Z-II&Z-III	Dense : Hot mixture	I	BND 60/90 BND 90/130	II	BND 60/90 BND 90/130 BN 60/90 BN 90/130	III	BND 60/90 BND 90/130 BN 60/90 BN 90/130
Z-IV& Z-V	Dense : Hot mixture	I	BND 40/60 BND 60/90 BN 40/60 BN 60/90	II	BND 40/60 BND 60/90 БНД 90/130 BN 40/60 BN 60/90	III	BND 40/60 BND 60/90 BND 90/130 BN 40/60 BN 60/90 BN 90/130

ANNEX-4
RECOMENDED

Brand of asphalt used for construction and reconstruction of the Surface layers of taxiways, parking areas and apron of airfields

climatic zone	Type of Asphalt	Load category					
		I, II, III		IV		V, VI	
		Mix Class	Bitumen Brand	Mix Class	Bitumen Brand	Mix Class	Bitumen Brand
Z-I	Dense with hot and warm mixture	I	BND 90/130	II	BND 90/130 BND130/200	III	BND 90/130 BND 130/200 BND 200/300 SG 130/200
Z-II&Z-III	Dense with hot and warm mixture	I	BND 60/90 BND 90/130	II	BND 60/90 BND 90/130 BND 130/200 BN 60/90 BN 90/130	III	BND60/90 BND90/130 BND130/200 BND200/300 BN 60/90 BN 90/130 SG 130/200
Z-IV& Z-V	Dense with hot mix	I	BND 40/60 BND 60/90 BN 40/60 BN 60/90	II	BND 40/60 BND 60/90 BND 90/130 BND 40/60 BN 60/90	III	BND 40/60 BND 60/90 BN 90/130 BN 40/60 BN 60/90 BN 90/130
	With cold mix	Not applicable		I	SG 70/130	II	SG70/130 MG 70/130 MGO 70/130

CONSTRUCTION STANDARTS AND RULES

HIGHWAYS

SNiP 3.06.03-85

7. ARRANGEMNET OF MACADAM BASE, GRAVEL BAD, SLAG BASE AND COATING AND BRIDGE

7.1. The thinnest layer should be 1.5 times exseed the largest particles and be at least 10 cm when laying on the base and not less than 15 cm for laying on the sand.

The maximum layer thickness should not exceed the values given in Table. 5.

Table 5

Type of material	Max thickness of compacted layer, см, when using rollers			
	With smooth rolls, 10 t And more	lattice and a pneumatic tire weight 15 t or more	vibration combined weight, t	
			Up to10	16 and more
Hard-sealable (of igneous and metamorphic rocks of the brand strength of 1000 and more durable gravel, well rolled, vitrified slag structure)	18	24	18	24
Easy-sealable (of igneous and metamorphic rocks of the brand strength of less than 1000, sedimentary, sharp-edged gravel, slag with a porous structure)	22	30	22	30

7.2. The volume of loose gravel is to be determined safety factor on the seal . For sand and gravel (crushed stone) mixtures optimal grain composition and gravel fractions 40-70 and 70-120 mm brand strength and over 800 safety factor on the seal material should take approximately 1.25-1.3

and chips marks for strength 600-300 - 1.3-1.5 . Factor slag seal depending on its density should take approximately 1.3-1.5 .

7.3. It is allowed to take chips and gravel and put them in a pile on the subgrade or intermediate storage for subsequent use in the arrangement of the pavement .

ARRANGEMENT OF MACADAM BASE AND COATING BY WEDGE METHODS

7.4. Works on arrangement of Macadam base and coatings with wedge methods is to be made in two stages: distribution of main fraction of chips and its preliminary compaction (compression and intersaizure);

Distribution of wedging chips (garetting of 2-3 times) with compaction of each fraction. Single garetting is used for base. When applying siltage ships in strength less than 600 for arrangement of base works in one stage can be done.

If necessary, the post-compaction is carried out with controlling of transport movement on the width of base (pavement).

7.5. The first and second stages of the base is compatced with Rollers having pneumatic tires weighing not less than 16 tonnes, with tire pressure 0.6-0.8 MPa, trailed vibrating rollers weighing not less than 6 m, latticed weighing not less than 15 tonnes, self propelled rollers weight not less than 10 m and the combined weight of more than 16 tons total number of passes of the static type shall be not less than 30 (10 on 1 stage and 20 in the second), combined type - not less than 18 (6 and 12) and vibration-type - not less than 12 (4 and 8).

Chips base strength of less than 600 and ductility PL2, Pl3 are compacted with Rollers pneumatic tires weighing not more than 16 tonnes at least 20 passages or vibratory plates..

7.6. To reduce the friction between the chips and acceleration inter-saizure rolling should be done by pouring water the gravel (approximately 15-25 litre/m2 compaction slag gravel - litre/m2 25-35 in the first stage and 10-12 litre/m2 by wedging fractions).

7.7. In the second stage should be made garetting layer of chips with factions of fine gravel with successively smaller sizes**..**

When use hard-compaction of chips, before distribution of wedging materials the layer of chips should be treated by organic viscous material rate 2—3 L/m^2.

Consumption of wedged fractions should be accepted according Table 6

7.8. After end of pavement compaction on surface, grit from igneous rocks with strength not less 800 (sedimentary rocks-not less 600) in an amount 1m3 per 100m2 should be distributed and compacted tentatively 4-6 passes..

At the end of slag layer compaction with active and high-active slags, and if upper layer not arranged, watering should be done within 10-12 days with rate 2—2,5 l/m^2.

Table 6

Sie of main fraction of ships, mm	Consumption of wedge fractions, m^3, per 1000 m^2 with its size, mm		
	20 — 40	10 — 20	5 — 10
40 — 70	—	15	10
70 — 120	10	10	10

Note. During construction of base with chips fraction 40—70 mm by wedge method, it should be used single wedge with ships mixture or sandy-chips fractions 5—20, 0—20, 0—10 mm, but for using chips 70—120 mm fractions 5—40 mm should be applied. Mix consumption must comply with requirements in Table 6

ARRANGEMENT OF BASE AND PAVEMENT WITH SAND-GRAVEL AND SAND-CRUSHED STONE MIX

7.9. Sand-gravel and sand-crushed tone mix of optimal granulometric composition according GOST 25607—83 is allowed to prepare on the road..

During laying the mixture should have moisture, close to optimal deviation not more than 10 %. In case of insufficient of moisture, mix should be damped 20-30 minute prior to compaction.

7.10. Layer should be compacted in accordance with requirements of parag. п. 7.5. The quantity of roller passes should be reduced up to 30%.

ARRANGEMENT OF MACADAM BASE, NOT THE FULL DEPTH WITH SAND AND CEMENT MIX WITH MIXING METHOD

7.11. After distribution the crushed stone should be dumped (water consumption 10 L/m^2) and roll it 2—3 passes on one track.

7.12. Preparation of sand-and cement mix for treatment of upper part of chips layer, should be carried out in mixers with forced mixing.

7.13. Delivered on the road sand and cement mix, should be layed on the top of distributed crushed stone with profiler or motor grader.

7.14. Stirring of sand and cement mix with crushed stone is carried out with profiler miller, multishank ripper or scarifier.

The resulting mixture should be moistened if necessary to optimum moisture and produce secondary mixing and layout and compaction roller 12-16 passes with pneumatic tires on one track .

At the end of the seal base should make finishing profiler and finally seal the surface layer with smooth rolls weighing 6-13 t 1-2 one passage wake.

After finishing the base should be cared by filling bitumen emulsion at a rate of 0.6-0.8 litre/m2 or placer sand (light loam) 4-6 cm layer and keep it wet for 20 days

ARRANGEMENT OF MACADAM BASE. TREATED NOT THE FULL DEPTH WITH MIX OF PENETRATION METHOD

7.15. Sand and cement mix should have moisture with 20—40 % more ore less than optimum (overwetting or not wetting).

Sand and cement mix introduced in crushed stone layer under the influence of vibration or pressure..

7.16. Crushed stone should be leveled with motor grader and dumped 3-10 L/m^2. For ensure the site transport passing, crushed stone rolled with smooth rolls weighing 6—8 t for 1—2 passes on one trail..

7.17. It is necessary to distribute sand and concrete mix on the surface of crushed stone layer with profiler or motor grader.

7.18. Pushing mixture in crushed stone layer to a depth of 5 cm should be done 2-3 passes rollers on pneumatic tires by one track.

7.19. The final compaction of base (pavement) after impregnation of gravel layer, compaction should be carried out with rollers on pneumatic tires with 12—16 passes on one track.

7.20. For impregnation of chips layer of sand and cement mix with vibration method on depth of 7 cm, mix should be distributed by profiler with tamper.

7.21. For impregnation mixture by vibration and pressure to a depth of 10 cm, the vibratory roller (1-2 passage on one track) should be used.

7.22. The acm roller should be used for impregnation of mix to a depth 17 cm.

The number of cam roller by one track (tentatively) is determined depending on required thickness of impregnation of crushed stone by mix according Table 7.

Table 7

Thickness of treated part of base, cm	Number of roller pass by one track
10	4 — 6
14	8 — 10
17	13 — 15

SPECIFICITY OF WORK ON ARRANHEMENT OF MACADAM BASE AND GRAVEL BAD AND PAVEMENTS IN THE NEGATIVE TEMPERATURE

7.23. At temperatures from 0 to -5 ° C for the duration of the work distribution, profiling and compaction of the material stone ma ¬ humidity up to 3% should not exceed 4 hours and at a lower temperature - 2 hr moisture content more than 3% of it should be treated sodium chloride salt in an amount of 0.3-0.5% by weight.

7.24. Seal the stone material at negative temperatures should be done without humidification.

Movement of vehicles on the base (cover) allowed only after full compaction.

7.25. Base of active blast furnace slag should arrange fractions of ballasts, not larger than 70 mm. Before laying the top layer on the bottom layer, should be compacted to open the movement of vehicles to 15-20 days for the final compaction of the sub-base.

7.26. During the thaw, and before the spring thaw base (cover), arranged at a negative temperature should be cleared of snow and ice and provide drainage.

Adding of material and correcting deformities base (cover), arranged at subzero temperatures should be read only after drying of the subgrade and base (covering).

QUALITY CONTROL

7.35 . During arrangement of macadam base, gravel bad , slag bases, pavements should be in referred inaddition paragraph 1.13 control : at least once per shift – humidity of crushed stone and sand and cement mixture according to GOST 8269 - 76 and GOST 5180 - 84, and the strength of Unmodified GOST 23558 - 791 ;

constantly visually - quality seals , adherence to care.

7.36 . Quality seal of macadam base , gravel bad and slag bases and pavements should be checked by controlling the passage of the roller weighing 10-13 tons for the entire length of the

controlled section , after which on the basis of (cover) there should be no trace and waves occur before the roller and roller placed under your gravel should get crushed.

8. ARRANGEMENT OF MACADAM BASE, GRAVEL BAD SANDY MATERIALS, TREATED WITH INORGANIC BINDER

MIX PREPARATION

8.1. Mixtures should prepare usually forced mixing in mixers . It is allowed preparation of a mixture by mixing on the road in accordance with the requirements of paragraph 6.7 and 6.10 .

8.2 . Unloading and supply of stone materials in the department receiving hoppers proportioning mixing plant should be carried forklift or pallet equipped with feeders .

8.3. Domain and steel (steel) slag , slag and ash Heat station wet trapping should be stored outdoors. Stored for more than 6 months slag and ash , used as a binder, before use must be tested for activity.

8.4. To enhance the activity of metallurgical slag should be pulverized to the ball mill , pre- dried in a drying drum. For complex binder is fed into a ball mill powder activator (cement , lime , alkali , etc.). Crushed slag should be stored in closed warehouses .

8.5. Dosing accuracy of the constituent materials in the mixture shall be as specified in Table. 8.

Table 8

Ingredient	Deviation of specified consumption, % by weight
Viscous	Up to 2
Aggregate	" 5
Water and water solution	" 2

8.6. Mixing water should ensure its optimum moisture content during compaction based on moisture loss during transportation and distribution. When the air temperature above 20 ° C in a mixture of trans- porting dump trucks should be covered with a tarpaulin.

8.7. Solutions SDB of alkali melt , liquid glass , chlorides should prepare for mortar mixing plant sites , if necessary with heated water.

8.8. Length conveying mixtures of stone materials with cement setting start is not less than 2 hours, not to exceed 30 minutes at an air temperature during laying above 20 ° C and 50 min - temperature below 20 ° C. Seal mixture should end before the end of the cement has set .

8.9. Mixture of stone materials with slag, ash with the addition of slaked lime and without it should be compacted within 2 days..

ARRANGEMENT OF BASE (SURFACE)

8.10 . Base (pavement) of stone materials treated with inorganic binders , should arrange , as a rule, on a dry ¬ year with an average daily temperature not lower than 5 ° C.

8.11. Maximum layer thickness is chosen to be dense state ¬ army in accordance with the requirements of section 7.1 for legkouplotnyaemogo material.

8.12 . Sealing material layer should usually pneumatic tire rollers or vibrating rollers. Estimated number of passes on one track may be taken as corresponding ¬ tively 16 and 10 .

At the end of the seal should produce surface finish or maintainer profiler followed by consolidation gladkovaltsovym roller weighing 6-8 tons for two - four passes on one track .

8.13 . Care base (pavement), comfortable with the use of cement , should be carried out in accordance with the requirements of paragraph 7.14.

When the device spoya overlying pavement base unit per day (sub base) care for him is not made .

8.14 . Motion -built transport and device layer overlying the base , arranged using slag ash permitted immediately after sealing .

Movement and the arrangement of surface layer overlying the base (pavement), arranged by using cement as the main binder or additives permitted only after the strength of not less than 70 % of the project or the day of arrangment the base

SPECIFICITY OF WORKS ON LOWER TEMPERATURE AND NEGATIVE TEMPERATURE

8.15. Preparation and laying stone materials treated with inorganic binders, when daily average temperature in the range from 5 to 15 ° C should be implemented with the adoption of special measures: insulation base, heated water and aggregates, the introduction of a mixture of aqueous solutions of chloride salts..

8.16. Approximate amount of input into the mixture of chloride salts, depending on the air temperature should be taken according to Table. 9.

Table 9

Air temperature during the work, °C	Количество солей, %, к массе воды, содержащейся в смеси
From 0 to minus 5	NaCl 5 % or $CaCl_2$ 3 % or $CaCl_2$ 2 % + NaCl 3 %
From minus 5 to minus 7	$CaCl_2$ 3 % + NaCl 4 %
" " 7 " " 10	$CaCl_2$ 3 % + NaCl 7 %
" " 10 " " 15	$CaCl_2$ 6 % + NaCl 9 %

8.17 Concentrated solutions of sodium chloride and calcium should prepare a density less than 1.29 g/cm3 (0.427 kg of the anhydrous salt in 1 liter of water), and sodium chloride is not more than

1.15 g/cm3 (0.25 kg anhydrous salt to 1 liter water), while sodium chloride can be dissolved in hot water.

8.18. The prepared solutions should be periodically stirred, pumped by a pump into storage tanks and diluted with water to the concentration indicated in the Table. 9, depending on temperature.

8.19. At subzero temperatures humidity sand and gravel during storage stack should not exceed 3-4%. Application of frozen sand is allowed only after dropping out clods larger 10 mm.

8.20. Mixture without salty additives should be prepared in the mixing machines, as a rule in closed areas, using the preheated aggregate and water. Maximum permissible temperature of water is 80 ° C, the aggregate is50 ° C. The temperature at the outlet from the mixer 35-40 ° C. Low heated mixture at the end of transportation must be at least 25 ° C. When the outdoor temperature to minus 15 ° C during transport must be specified at the beginning of works and should not exceed 60 minutes.

Mixture should be transported in insulated exhaust gases and a sheltered body of the car-truck.

8.21. Seal and cover the mixture should end before its freezing.

8.22. Surface of base should insulate with backfill layer of sand or sandy loam with a minimum thickness of 10 cm or cover with other heaters, so that before freezing fortified material gained strength not less than 70%.

8.23. When the foundation of mixtures with slow-hardening (slag, ash and other) cementitious material should not freeze until the end of the seal, while one may be administered sodium chloride without reducing the total amount of added salt. To insulate the base with such materials is not allowed.

After thawing, if necessary, make the alignment and to seal layer.

Quality Control

8.24 . When the device bases and pavements of gravel , sand and gravel materials treated with inorganic cementitious materials ¬ als should be in addition to the 1.13 control :

at least once per shift - humidity mixture according to GOST 5180-84 , GOST material strength and density 23558-791 salt solutions at subzero temperatures ;

at least once in seven shifts - dosing precision checkweighing mixture components ;

constantly - quality seals , adherence to care.

8.25 . Quality seals should be checked by the control pro ¬ stroke roller weighing 10-13 tons for the entire length of the controlled section , after which on the basis of (cover) there should be no trace and waves occur before the roller.

9. ARRANGEMENT OF BASE AND SURFACE WITH TAR CONCRETE MIXTURES, BLACK CRUSHED STONE OF CHIPS MIX WITH PENETRATION ORGANIC BINDER AND MIXING METHOD ON THE ROAD

9.1. Before production of work it should be checked the clutch binder surface of mineral materials in accordance with GOST 12801-84, GOST 18659-81. With insufficient of adhesion, additives of surface surfactants and activators should be used (lime, cement)

9.2. The heating temperature of organic binders materials in use must be within the limits specified in Table. 10.

Table 10

Binder mark	Heating temperature of bider, °C	
	without surfactants	with surfactants
Bitumen on GOST 22245-76		
BND 40/60, BND 60/90, BN 60/90	130 — 150	110 — 130
BND 90/130, BN 90/130, BND 130/200, BN 130/200	100 — 120	90 — 100
BND 200/300, BN 200/300	90 — 100	90 — 100
Bitumen on GOST 11955-82		
SG 130/200, MG 130/200	90 — 100	90 — 100
SG 70/130, MG 70/130, MGO 70/130	80 — 90	80 — 90
SG 40/70, MG 40/70, MGO 40/70	70 — 80	70 — 80
SG 25/40, MG 25/40	60 — 70	60 — 70
TAR CONCRETE on GOST 4641-80		
DO-7, VDP-6, VDP-7	100 — 120	—
D-6, DO-6	90 — 110	—
D-5	80 — 100	—
D-3, D-4	75 — 90	—
EMULSION on GOST 18659-81		
EBA-1, EBA-2, EBA-3, EBK-1, EBK-2, EBK-3	Without heat	—
REVERSE EMULSION	60 — 70	—

EMULSION PREPARATION

9.3. Bitumen emulsions are prepared in special machines-dispersers.

For the preparation of bituminous emulsions direct type to apply bitumen emulsifiers and in accordance with the requirements of GOST 18659-81.

9.4. Bitumen temperature entering to emulsion machine should be around, °C:

BND 40/60, Bn 40/60 ..... 130 — 140
BND 60/90 and BND 90/130, BN 60/90, BN 90/130 ..... 120 — 130
BND 130/200, BN 130/200 .....100 — 120
BND 200/300, BN 200/300 ..... 90 — 100

9.5. The temperature of the aqueous solution of the emulsifier, the entering emulsion to the machine, should be no higher than 80 ° C. Temperature sum bitumen and emulsifier solution do not exceed 200 °C.

9.6. For the preparation of inverse emulsions should use coal tars road GOST 4641-80 grades D-1, D-2 and D-3; shale bitumen road (PCT ESSR 82-79) stamps S-12/20, S-20/35, S-35/70, S-70/130 oil shale fuel according to GOST 4806-79, and mixtures of bitumen BND 40/60, BND 60/90 and BND 90/130 shale bitumen or shale oil.

9.7. In the binder used for the preparation of inverse emulsions, must contain at least 5% of phenols. At lower levels of phenols in the original binder it is necessary to add phenol carbolic technical GOST 11311-76 phenols or coal liquid in the missing numbers or contact Petrova kerosene in the doubled amount. Besides phenols in the emulsifier for inverse emulsions must enter the sodium hydroxide and sodium chloride

9.8. As emulsifiers for pastes should be used: lime (hydrated lime or milled single piece of pumice), containing not less than 60% of calcium oxide and magnesium filterpress dirt - defecation-waste from sugar production are stored in heaps not more than 1 year and containing not less than 80% of the particles are smaller 0.071 mm, and other finely divided mineral materials.

ARRANGMENT OF BASE AND PAVEMENT WITH TAR CONCRETE MIX

9.9. Heating temperature of tar in accordance with the Table. 10 should be maintained no more than 5 hours. It is allowed to maintain tars in hot condition for 8-10 hours at a temperature not exceeding 70 ° C for tars grades D-6 to 6, to 7, VAR-6, and VAR-7 not higher than 60 ° C for stamps and D-4 D-5.

9.10. Tar concrete mixtures should be prepared as a rule in forced mixers.

Freefall mixer and dispensing mineral material prior to drying and heating may be used only for the preparation of mixtures of coarse tar macadam.

9.11. Limits of error for dosing components constituting tar macadam mixture must comply with the requirements of GOST 25877-83. When drying with mineral materials before preparing the mixture should be ensured complete removal of moisture.

9.12. During cooking the mixture in the mixer tar macadam be administered first mineral materials and mix them (dry mixing) and then administered tar (wet mixing) in the preparation of mixtures of coarse pitch should be administered immediately after administration of mineral materials.

9.13. The mixing of hot tar macadam mixtures in batch paddle mixer circuit with circulating movement of materials shall conform to Table. 11.

Table 11

Mixtures	Duration of mixing, with	
	dry	wet
Coarse	—	20 — 30
Fine	15	30 — 45
Sandy	15	45 — 60

Notes: 1. Duration stirring mixture in the mixer circuit with countercurrent movement of materials should be increased by 1.5-2 times.

2. The mixing coarse mixture in the mixer should be free mixing with 120-180.

3. The mixing of cold mixtures should tarmacadam 1.3-1.5 times greater than the mixing of similar hot mix.

9.14. The temperature of tar macadam mixtures at the outlet of the mixer must comply with GOST 25877-83.

9.15. Tarmacadam cold mixture should be stored in piles under a canopy height not exceeding 2 m. Retention cycle of cold tarmacadam mixtures should comply with GOST 25877-83.

9.16. Surface and the base of the hot and cold tarmacadam mixture should hold in dry weather and temperatures above 5 ° C. In autumn should finish laying tarmacadam cold mixtures for 15-20 days before the onset of sustained negative temperatures.

9.17. Before laying the mixture must treat the surface layer, which will be laid tarmacadam mixture tar brand D-3 or D-4 based 0.5-0.8 litre/m2 when processing base and 0.2-0.3 litre/m2 the processing of the lower layer coating. When placing the mixture into the fresh underlying layer of materials treated with tar, this process should not be astringent surface.

9.18. The thickness of the layer of hot mixture tarmacadam uncompacted state using stacker should be 15-25% greater design thickness for manual installation - by 25-35%.

When laying tarmacadam cold mixture thickness LUT uncompacted state should be 50-60% more than the project.

9.19. Compaction of layer of tar macadam is to be done according to requirements to paragraphs . 10.26—10.34.

9.20. Layers of cold mixes tarmacadam Rollers weighing 6-8 tons. Final density of these layers were assumed from traffic. During the first two weeks of the speed of traffic on the layer of cold tarmacadam should be restricted to 40 km / h.

9.21. In the production process works must keep records of mixing, temperature tar, laboratory quality control of ready mix, laying and compaction of the mixture by shifts**.**

ARRANGEMENT OF BASE AND SURFACE FROM BLACK CRUSHED STONE AND MIXTURE, TREATED BY BITUMEN EMULSIONS IN MIXER

9.22. To prepare the black crushed stone it should be used bitumen BND 40/60, BND 60/90, BN 60/90, BND 90/130, BN 90/130, BND 130/200, BN 130/200, BND 200/300, BN 200 / 300, MG 130/200, the CSM 130/200, SG 130/200, MG 70/130, IHO 70/130, SG 70/130 and tars grades D-6, D-5.

Black crushed stone should be prepared in a blender forced mixing. Duration of crushed stone mixing with a binder in a mixer circuit with circulating movement of materials with 20-40. In the mixer circuit with countercurrent movement of materials mixing time should be increased by 1.6-2 times.

9.23. To prepare the black crushed stone should also apply direct emulsion EBK-1, EBK-2, EB-1, EB-2 and inverse emulsion and inverse coupled with direct. Stirring rubble with direct emulsion should be stopped after the full implementation of the required amount of emulsion mixer.

Mixing Time rubble reverse emulsion is determined by trial mix.

9.24. For the treatment of mixtures of anionic and cationic apply emulsions EB-2 EB-3 EBK-2, EBK-3. When processing the mixture of anionic emulsions (EB-2 EB-3) necessary to administer the active additives (1.2% lime to the weight of mineral material or 3-4% of cement) in the mineral material prior to mixing it with the emulsion. Mineral materials and the emulsion is not heated. Mixing time is determined by trial mix.

9.25. The temperature of black crushed stone at release from the mixer and placing it in a constructive layer shall be as specified in Table. 12.

9.26. Surface and the base of the hot and cold black crushed stone on bitumen should hold at temperature not below 5 ° C. Crushed stone, prepared with tar D-5 and D-6, should be laid at the same time ¬ temperature below 0 ° C.

9.27. Freshly prepared mixture of black crushed stone and treated with an anionic emulsion, should be laid at a minimum air temperature of 10 ° C, the cation - not less than 5 ° C, together with the direct inverted, or one of the inverse - not below 5 ° C. Black crushed stone and mixtures of stacks must be placed at temperature not below -5 ° C.

Table12

Binder brand	Temperature of black crushed stone, °C			
	At release from the mixer		At laying on surface, Not less	
	Without surfactants	With surfactants	Without surfactants	With surfactants
BND 40/60, BND 60/90, BN 60/90, BND 90/130, BN 90/130	140 — 160	120 — 140	120	100
BND 130/200, BN 130/200,	110 — 130	100 — 120	80	80

BND 200/300, BN 200/300				
SG 130/200, MG 130/200	90 — 110	80 — 100	70	70
SG 70/130, BG 70/130, D-5	80 — 110	80 — 110	Весной 5, осенью 10	—
D-6	100 — 120	—	80	—
EBA-1, EBA-2, EBK-1, EBK-2	Без нагрева	—	Весной 5, осенью 10	—
Inverted emulsion	40 — 50	—	Минус 5	—

9.28. Work on the arrangement of surface and bases of black crushed stone should be made in the following order: the distribution of the main fraction 20-40 mm gravel layer is 25-30% more than the design thickness; compaction roller weighing 6-8 m (4-6 passes on one track), the distribution of wedging fraction 10-20 mm; seal roller weighing 10-13 tons (3-4 passage on one track), the distribution of the second wedging 5-10 mm fraction , seal roller weighing 10-13 tons (3-4 passage on one track). It is allowed to use a foundation for the basic layer of crushed stone fraction 40-70 mm and 20-40, respectively, for wedging and 10-20 mm.

9.29. If for preparation of black crushed use a mixture of fractions 5-40 or 5-20 mm, the constructive layer arrange at once from this mixture without wedging.

9.30. Before laying the black crushed stone mixtures and surface of the underlying layer on which they are placed, should be treated astringent (cutback bitumen, tar emulsion) at the rate of 0.5-0.8 litre/m2.

9.31. Cold black rubble and mixtures should be stored in stacks of height not exceeding 2 m freshly prepared material should shovel excavator bucket to cool it. Shelf life of cold gravel on bitumen and tar SG class should not exceed 4 months, on bitumen emulsions and class MG - 8 months. Retention cycle of mixtures emulsions should not exceed 4 months..

ARRANGEMENT OF BASE AND SURFACE BY PENETRATION METHOD

9.32. Arrangement of surface and base of the crushed stone, processed according to the method of impregnation with bitumen, tar or emulsions should be in dry weather and temperatures above 5 ° C. When using the emulsions at temperatures below 10 ° C should be used in the form of heat (temperature 40-50 ° C) .

9.33. Surfacing by the method of impregnation is necessary to arrange the crushed stone of igneous brand at least 800 or sedimentary and metamorphic grade not lower than 600. Chippings used for device bases must be not less than 600 brand.

9.34. At arrangement of structural layer by impregnation method should be used crushed stone of four fractions 20-40 (or 25-40), 10-20 (or 15-25), 5-10 (or 3-15) mm.

At layer thickness of less than 8 cm is used only the last three fractions. The latest, most small fraction designed to create a protective layer, a foundation should not be used.

9.35. The volume of crushed stone of main (first) fractions 40-70 or 20 (25) - 40 mm should be determined taking into account the factor 0.9 to design thickness of base or surface and increase this amount by 1.25 times to seal. The volume of each fraction followed by gravel should be equal to 0.9-1.1 m3 per m2 of the base 100 or cover . Consumption of binder should be taken as 1.0-1.1 l/m2 per centimeter thickness and further 1.5-2.0 litre/m2 surface . In of using emulsions its concentration should be 50-55 % with limestone gravel and 55-60 % with crushed granite , and the consumption increased accordingly.

9.36. Work on the arrangement of surface and base impregnation by bitumen or tar should be made in the following order : the main distribution (fraction of crushed stone ; seal roller weighing 6-8 m (5-7 passes on one track); filling 50% of the total flow of binder ; distribution wedging fraction of crushed stone ; seal roller weighing 10-13 tons (2-4 passage on one track), 30% binder hatred of the total flow , the distribution of the second wedging fraction of crushed stone ; seal roller weighing 10-13 tons (3-4 passage on one track) , filling 20% binder ; distribution closing fraction of rubble ; compaction with roller weighing 10-13 tons (3-4 passage on one track).

When used as a binder emulsions first bottling binder (70% emulsion of the total flow) should be done after the first distribution of wedging fraction and compaction. The remaining 30% of the emulsion is poured after sealing second wedging fraction.

9.37. At temperatures up to 20 ° C, the main fraction of crushed stone should be compacted, usually without humidification. When the air temperature above 20 ° C it should be watered crushed stone in an amount of 8-10 litre/m2. In this case, pour bitumen or tar should only crushed stone after drying and emulsion should pour the wet gravel.

9.38. All work on the scattering of wedging fractions and their compaction should be done after filling knitting machine up to cool.

When used as a binder in bituminous emulsions arrange a protective layer on the surface with the latest, most fines crushed stones, and also to arrange surface for the base should be prepared in 10-15 days when impregnated with anionic emulsions and after 3-5 days - when impregnated with cationic.

9.39. Movement of site transport is permitted only after the end of the last rolling, most of the fine fraction of crushed stone. Within 10 days, the movement should be controlled by surface the entire width limiting its speed to 40 km / h.

When using emulsions movement should opened after 1-3 days after the distribution of seals and penultimate wedging fraction of crushed stone when the surface arrangement and the last fraction of crushed stone at the arrangement of base.

ARRANGEMENT OF MACADAM BASE AND SURFACE, WITH GRAVEL AND SANDY MIXTURES, TREATED BY ORGANIC BINDING MATERIALS MIXED IN THE ROAD

9.40. Macadam base and surface, gravel and sandy mixtures, treated by organic binding materials mixe on the road, should be arranged at air temperature not less than 15 °C and finished within 15—20 days before the rainy period or steady air temperature not lsess10 °C.

9.41. Bitumen or tar should be treated stone materials humidity not more than 4%. At higher humidity mixture should be dried by stirring motor grader.

Humidity of crushed stone and gravel mixtures and processed emulsion. in dry and windy weather, and when the air temperature is above 15 ° C shall be not less than 5%, and sand and gravel and sand-gravel mixtures - 1-2% higher than the optimal.

Before the treatment of mixtures of anionic emulsion in them should be preliminary introduced 1-2% powder lime or 2-4% of cement.

9.42. For mineral materials mixing on the road should be, as a rule, apply bitumen grades SG 40/70, MG 40/70, SG 70/130, MG 70/130, tars grades D-3, D-4, as well as bitumen emulsion EBA - 3, 3-EBK. More viscous bitumen and tars should be used in areas with hot climates.

9.43. Number of passes by grader for stirring should be used depending on the amount of mixed material and temperature.

9.44. The finished mixture should be distributed across the width of the carriage way. Mixture should be compacted by Rollers weighing approximately 6-8 m 3-5 passes on one track.

Movement of site transport is allowed to open immediately after compaction. Thus it should be adjusted over the entire width of the carriageway, and the speed limit of 40 km / h Compaction factor must be at least 0.96 after 30 days of the arrangement of surface or base.

9.45. Establish of surface or protective layer on the mixture base prepared by mixing method on the road should be only after the formation of the base.

Quality control

9.46. In preparation of emulsion it is necessary to control:

permanently —the temperature of bitumen and water solution of emulsifier;

not less than one time in shift — the quality of emulsion according to GOST 18659—81.

9.47. At preparation of coated macadam it should be controlled:

permanently —the temperature of coated macadam and mineral materials;

in each dump-truck — the temperature of coated macadam mixture;

not less than one time in shift — quality of mixture according to GOST 25077—83.

9.48. In arrangement of base and surface from coated macadam mixture it should be controlled:

In each dump-truck — temperature of coated macadam mixture;

Density of coated macadam in surface on 3 core sampling per 1 km according to GOST 25877-83.

9.49. In arrangement of base and surface with black crushed stone and mixtures, treated by bitumen emulsions in mixer, it should be controlled:

In each dump-truck — the temperature of black crushed stone;

permanently — visually uniformity of mixture and quality of compaction according to requirements on paragraphs 8.26;

quality of mixture by indicators of 3 samples per 1 km.

9.50. In arrangement of base and surface by impregnation method should be controlled:

In each pouring — the temperature of binding material;

permanently —visually smoothness of material distribution and quality of compaction according to requirements of paragraph . 8.25.

9.51. In arrangement of base and surface by mixing method on the road it should be controlled:

In each pouring — the temperature of binding material;

Not less one time in shift (and at fallout) — moisture of mineral materials according to GOST 5180—84.

permanently — visually uniformity of mixture and quality of compaction according to requirements on paragraphs . 8.25;

quality of mixture — on indicators of 2 samples per 1 km according to GOST 12801—84;

density of material on surface by 3 core samples per 1 km according to GOST 12801-84.

10. ARRANGEMENT OF ASPHALT SURFACE AND BASE

10.1. Asphalt mixtures should be designed depending on kind, type and destination of asphalt according to requirements of GOST GOST 9128-84.

10.2. For refinement of asphalt, the method of physicochemical mineral materials, surfactants and polymers should be applied.

PREPARATION OF ASPHALT MIXTURE

10.3. Asphalt mixtures should be prepared in asphalt mixing equipment, equipped by mixers of forced mixing sample action or continues operation..

10.4. Bitumen heated up to working temperature, should be used within 5 hours. If necessary to keep more, the temperature of viscous bitumen should be down to 80 °C, liquid — to 60 °C and store not more than 12 h.

10.6. Bitumen with the addition of surfactants, polymers, diluents (plasticizers) or structure-forming components should be mixed to obtain a homogeneous mixture in a separate container, equipped with steam-electric or oilheating and pump installation. The finished binder is pumped into the storage container and is heated to working temperature.

10.6. Bitumen temperature entering the mixer, gravel, sand, crushing screenings at the outlet of the dryer drum and the asphalt mix at the outlet of the mixer depending on the grade of bitumen shall be as specified in Table. 13. Mineral powder for asphalt mixtures allowed to enter into the mixer without heating.

10.7. In the application of activated mineral powders or surfactants the temperature of bitumen, crushed stone, gravel, sand, crushing screenings and finished asphalt mix should be reduced compared to that appearing in Table. 13:

to 20 °C with using bitumen brand BND 40/60, BND 60/90, BND 90/130, BN 60/90, BN 90/130;

to 10 °C with using bitumen brand BND 130/200, BND 200/300, BN 130/200, BN 200/300.

10.8. In the process of preparing mixtures in batch mixer, usually, you must first enter the weighted fractions mineral materials and mix them together, and then - bitumen.

10.9. Dispensing error components of asphalt concrete mixture shall meet the requirements GOST 9128-84.

10.10. The mixing of hot, warm and cold asphalt mixes is set in accordance with technical data of mixing plant.

10.11. Asphalt mix after mixing should be unloaded from the mixer into a storage hopper or trucks.

10.12. Capacity of storage bin should be at least the volume of the hourly output mixer. Time Spent for mixtures for the binder coarse and type A for the surface coarse in the bunker must be no more than 1.5 parts of a mixture of other types should be in the bunker is not more than 0.5 h.

For mix of surfactants and activated powders time may be increased correspondingly by 2 or 1 h.

10.13. Transportation duration of asphalt mix should be set according to ensure of temperature in paving, showed in the Table. 14.

Table 13

Type of mixture	Bitumen grade	Temperature, ° C		
		Of bitumen entering to mixer	Crushed stone (gravel), sand, crushing screenings at outlet of dry drum	Mixes at release of mixer
Hot	BND 40/60, BND 60/90, BND 90/130, BN 60/90, BN 90/130	130 — 150	165 — 185	140 — 160
Warm	BND 130/200, BND 200/300, BN 130/200, BN 200/300	110 — 130	145 — 165	120 — 140
	SG 130/200	80 — 100	115 — 135	90 — 110
	MG 130/200, MGO 130/200	90 — 110	125 — 145	100 — 120
Cold	SG 70/130, MG 70/130, MGO 70/130	80 — 90	115 — 125	80 — 100

Table 14

Type of mix	Bitumen grade	Temperature of mix at the beginning of compaction, °C, for	
		Dense asphalts, A and B, porous or high porous asphalts with contents of crushed stone (gravel) more 40 % weighing	Dense asphalts type C, D and E, porous and high porous asphalt with contents of crushed stone (gravel) less 40 % weighing and high porous sandy
Hot	BND 40/60, BND 60/90, BND 90/130, BN 60/90, BN 90/130	120 — 160	100 — 130
Warm	BND 130/200, BND 200/300, BN 130/200, BN 200/300	100 — 140	80 — 110
	SG 130/200, MG 130/200, MGO 130/200	70 — 100	
Cold	SG 70/130, MG 70/130, MGO 70/130	Not less than 5	

10.14. It is allowed to laying of cold asphalt mix directly after preparation, that is in hot.

10.15. Cold mix should be stored in summer in opened area, but in autumn-winter period –in closed stores or under shed within 4 month on using of bitumen brand SG and 8 months — brand MG и MGO.

When storing cold asphalt mixes should take the height of stacks of not more than 2 m. Freshly prepared mixture should be shoveled with excavator bucket to its cooling.

LAYING OF ASPHALT MIXTURE

10.16. Surface and base of asphalt mixes should arrange in dry weather. Laying of hot and cold mixtures should be made in the spring and summer when the ambient temperature is not lower than 5 ° C, in autumn - not below 10 ° C, warm mix - at or below minus 10 ° C.

It is allowed to carry out work using hot asphalt mixtures with air temperature below 0 ° C under the following conditions:

Arrange a layer thickness should not be less than 4 cm;

It is necessary to apply asphalt mixture with surfactants or activated mineral powders;

It should be arranged, as a rule, only the binder coarse of a dual layer of asphalt pavement, and if the winter or spring of this layer will move vehicles, it is necessary to arrange a dense asphaltic mixtures;

the surface coarse is allowed to arrange only on the freshly binder coarse before it cools (maintaining the temperature of the binder coarse is not less than 20 ° C).

Laying of cold asphalt mixes should end approximately by 15 days before the beginning of the period of autumn rains, except for mixtures with activated mineral materials.

10.17. Before laying the mixture (for 1-6 hours) is necessary to make a surface treatment of the binder coarse with bitumen emulsion, or a viscous liquid bitumen which has been heated to the temperature indicated in Table. 13.

The norms of material cost l/m2 should be set:

At bitumen treatment of base — equaled to 0,5—0,8, binder coars — 0,2—0,3;

At treatment of 60 %- bitumen emulsion of base — 0,6—0,9, binder coarse — 0,3—0,4.

Treatment the binder coarse may be omitted if the time interval between arrangement of surface and binder coarse is not more than 2 days, and no movement of site transport.

10.18. Laying of asphalt mix should be carry out with paver, and as a rule, on full width.

In exceptional cases it is allowed laying of mix on binder coarse and base with motor grader. At the same time along the edges of the layer should be installed thrust bars.

In places, inaccessible for paver, it is allowed manual laying.

10.19. In laying of hot, warm and cold mixture (in hot condition) by paver, the thickness should be 10-15% more than designed, but in laying with grader or manual to 25-30%.

In laying of stack by paver (with switch off compaction) and in laying by motor grader or manual thickness should be 60-70% more than designed.

10.20. In structural layer with thickness more 10 cm, should use paver with active compaction organs.

10.21. In using of paver with ramming bar and passive finishing plate, also in using of paver with ramming bar and slab vibrator in laying of mixture for dense asphalts type A and B and for porous and high porous asphalt with content of crushed stone more than 40% speed of layer should 2-3m/min..

When laying a dense asphalt mixtures for types B, D and E, as well as porous and highly porous asphalt with crushed stone content less than 40% and a highly porous sandy laying speed can be increased to 5.4 m / min. Modes of compacted working organs shall be as follows: the engine speed shafts Tamper 1000-1400 rev / min; shaft vibrator plates - 2500-3000 rev / min.

10.22. Temperature when laying asphalt mixtures in pavement structural layers shall conform to the requirements of GOST 9128-84.

Compaction of mixtures should begin immediately after laying, while respecting the temperature range specified in the table. 14.

10.23. When using pavers with tamper screed and passive (type DS-126A, CP-143) should be compacted:

dense asphaltic concrete mixture of types A and B, as well as porous and highly porous asphalt with gravel content greater than 40% first pneumatic tire roller weighing 16 tons (6-10 passes), or smooth roller weighing 10-13 tons (8-10 passes), or vibratory roller weighing 6-8 tons (5-7 passages) and finally - smooth roller weighing 11-18 tons (6-8 passages);

dense asphaltic concrete mixture of types B, D and E, as well as porous and highly porous asphalt with gravel content less than 40% and a highly porous sandy at first with roller weighing 6-8 tons or vibratory roller weighing 6-8 tons with off vibrator (2-3 passage), then roller pneumatic tire weight of 16 t (6-10 passes) or smooth roller weighing 10-13 tons (8-10 passes), or vibratory roller weighing 6-8 tons enabled vibrator (3-4 pro-stroke) and finally - smooth roller weighing 11-18 tons (4-8 passes).

Speed of roller in the early rolling shall be no more than 1.5-2 km / h, and after 5-6 passages speed can be increased up to 3-5 km / h - for smooth rollers, 3 km / h - for vibrating rollers and 5 - 8 km / h – Roller with pneumatic tires.

10.24. When using pavers with tamper and vibratory plates (type DS-155) should be compacted:

dense asphalt mixture of types A and B, as well as porous and highly porous asphalt with crushed stone content over 40% at first smooth roller weighing 10-13 tons, pneumatic tire roller weighing 16 tonnes or vibratory roller weighing 6-8 m (4-6 passages) and then - smooth roller 11-18 weight (4-6 passes);

dense asphalt mixture of types B, D and E, as well as for highly porous sandy, porous and highly porous gravel content with less than 40% first smooth roller weighing 6-8 tons or vibrating roller 6-8 t with off vibrator (2-3 passage), and then - smooth roller weighing 10-13 tons (6-8 passages), pneumatic tire roller weighing 16 tonnes or 8.6 tonnes vibratory roller enabled vibrator (4-6 passages) and finally - smooth roller weighing 11 -18 m (4 passes).

Speed skating rinks in the early rolling shall not exceed, km / h: smooth-roller - 6, vibration - 3, with pneumatic tires - 10.

In the first pass with smooth-rollers, moving rolls should be ahead.

10.25. Cold asphalt mixture should be preliminary compacted with roller on pneumatic tires (6-8 passes) or smooth roller with weighing 6-8 m (4-6 passes) , and the final compaction achieved from vehicular traffic , which should regulate the entire width of the roadway, limiting speeds up to 40 km / h Precompaction of cold asphalt mixtures with activated mineral materials is also allowed to produce rollers weighing 10-13 tons , but the appearance of cracks should stop rolling.

10.26. When laying asphalt mixes thickness of 10 - 18 cm, compaction should be done at first with self-propelled roller with pneumatic tires (6 - 8 passes), then smooth roller weight of 11 - 10 m (4 - 6 passes).

Operating speed rollers compaction layer thickness increased during the first 2 - 3 passes should not exceed 2 - 3 km / h, with a further 12 - 15 km / h Tire air pressure at the beginning of the roller rolling should be not more than 0.3 MPa, in the end - 0.8 MPa.

10.27. Compaction of asphalt mixtures containing polymers should be started only with smooth rollers weighing 6 - 8 or 10 - 13 tons

10.28. When laying mixtures with interfaced bands it should be applied two (or more) pavers to produce heating stacker or edges of the previously laid strip with infrared emitters, and in their absence produce heating strip edges of the previously laid by laying it on a hot mixture of a width of 10 - 20 cm After the warm edge mixture should be shifted to arrange strip to it’s compaction.

10.29. When laying asphalt mixes with interfaced bands in the first compaction, rolls of rollers should not approach more than 10 cm to the edge of interface.

Compaction of next band it is necessary for longtitudal interface. Interface of bands should be smooth and dense

10.30. Cross-coupling bands, arranged from asphalt mixtures should be perpendicular to the axis of the road.

At the end of the work shift compacted edge strip should chop off vertically on the cord and the resumption of work to warm up in accordance with the requirements of § 10.28 or coat bitumen or bitumen emulsion. When laying at the end of hard compacted strip board edge should not be cut.

10.31. Found on the surface or base after rolling area with defects (cavities, areas with excessive or insufficient bitumen content, etc.) must be cut down, edge of locations is lubricated with bitumen or bitumen emulsion, filled with asphalt mixes and Compacted.

10.32. Before the arrangement of asphalt layer on the existing surface in the reconstruction process is necessary to eliminate defects (cracks and potholes) the old surfacing, traet the surface in accordance with the requirements of § 10.17 of this section. When the depth gauge on the old surface than 1 cm it should be leveled with mixture and compacted

10.33. When carrying out work, directed for raising of adhesion tire of vehicles with asphalt pavement, black crushed stone in unconsolidated layer of asphalt mix is heated.

10.34. For heating should apply mainly cold and hot and warm black crushed stones fractions 5 - 10, 10 - 15 or 15 - 20 mm.

10.35. Laid layer of hot and warm asphalt mix must be compacted with one-two passes by roller weighin 6—8 t, then sprinkle black crushed stone with uniform layer in one crushed stone.

The application rates of black crushed stone in using of fractions:

5—10 mm ..... 6—8 kg/m^2
10—15 " ..... 7—10 "
15—20 " ..... 9—12 "

10.36. Temperature of the mixture at the moment of distribution of the layer of black crushed stone should be within the range 90-110 ° C for the hot mix and 60 - 80 C - for warm.

10.37. After the distribution of black crushed stone, should be laid in a layer with smooth rolls rollers weighing 10-13 tons or pneumatic tire rollers simultaneously post-compaction of asphalt mix.

10.38. During the work on the construction of asphalt pavements should maintain a laboratory quality control of raw materials and finished asphalt mixes, bitumen temperature, temperature of the mixture in place of preparing and laying and log of laying and compacting the mixture in shifts.

QUALITY CONTROL

10.39. In the preparation of asphalt mixture should be controlled:

permanently — temperature of bitumen and mineral materials, but the temperature of ready mix in body of each dump-trucks.

Not less than one time in shift — quality of mix according to GOST 9128—84 and GOST 12801-84 and bitumen on GOST 11501-78 and GOST 11503-74;

Not less than one time in 10 shifts — quality of crushed stone, sand and mineral powder according to GOST 9128-84.

Work of doser of mineral materials, butimen and additives must be controlled in established order

10.40. In the process of construction of surface and base additionally to P. 1.14 must control:

Temperature of hot and warm asphalt mixture in each dump-truck;

Permanently — quality of longitude and transversal interface of laid lines;

Quality of asphalt on indicators of core samples in three places per 7000 $м^{2\ of}$ surface according to GOST 9128-84 and GOST 12801—84, and also strength of adhesion layer of surface.

Cutting or cores should be collected in layers of hot and warm asphalt through 1 — 3 days after compaction, but from cold mix— through 15—30 days in the distance of not less than 1m from edge of pavement.

10.41. Coefficient of compaction of structural payer of road bed should be not less than:

0,99 — for dense asphalt from hot and warm mixtures with types A and B;

0,98 — for dense asphalt from hot and warm with types C, D and E, porous and high porous asphalt;

0,96 — for asphalt of cold asphalt mixture.

11. ARRANGEMENT OF SURFACE TREATMENT OF PAVEMENTS

11.1. Work on the arrangement of surface treatment of pavements should be performed at temperature not below 15 ° C. When using a cationic emulsion for surface treatment arrangement - at temperature not below 5 ° C.

ARRANGEMENT OF SURFACE TREATMENT WITH USING OF FRACTIONATED CRUSHED STONE

11.2. When the arrangement of surface treatment, should be applied crushed stone grade not lower than 1200 difficult grinding of igneous and metamorphic rocks fractions 5-10, 10-15 or 15-20 mm predominantly cuboid shape of grains. Crushed stone must be clean, free of dust and clay.

11.3. In arrangement of surface treatment with using of bitumen as binder, the bitumen grades BND 60/90, BND 90/130, BND 130/200, BN 60/90, BN 90/130 or BN 130/200 should be applied.

Bitumen must withstand the test of adherence to crushed stone that will be applied for arrangement of surface treatment. If poor adhesion of bitumen with crushed stone, should use appropriate surfactant additives and tentative treatment of crushed stone with bitumen.

In arrangement of surface treatment in areas with obstructed roads and hazardous driving conditions as well as in areas with extreme continental climate should be used with the addition of bitumen grade thermoplastic polymers.

11.4. Consumption of binder and crushed stone shall conform to standards, set out in the Table 15

Table 15

Aggregate size, mm	Rate of application			
	aggregate, m^3 /100 m^2	bitumen, л/м^2	emulsion, L/m^2, in concentration of bitumen, %	
			60	50
Single surface treatment				
5—10	0,9—1,1	0,7—1,0	1,3—1,5	1,5—1,8
10—15	1,1—1,2	0,9—1,0	1,5—1,7	1,8—2,0
15—20	1,2—1,4	1,0—1,3	1,7—2,0	2,0—2,4
Double surface treatment				
15—20	First spreading 1,1—1,3	First pouring 0,9—1,1	1,5—1,8	1,8—2,2
5—10	Second spreading 0,7—1,0	Second pouring 0,7—1,0	1,3—1,5	1,5—1,8

Note. In using of black aggregate application rate is declined at 22-25%

11.5. Work on the arrangement of surface treatment should be carried out on a clean, dust-free surface treated, dry when applying bitumen and hydrated (0.5 litre/m2) in the application of bituminous emulsions.

11.6. The temperature of bitumen pouring should be: for grades BND 60/90, BND 90/130, BN 60/90, BN 90/130 — 130 — 160 –oC; for grades BND 130/200 and BN 130/200 —100 — 130 °C.

Crushed stone should be distributed immediately after the mechanized method of pouring a layer of bitumen in crushed stone and roll with roller 4-5 passes on one track.

During the first 2 - 3 days of operation necessary to limit the vehicle speed to 40 km / h and adjust it to the width of the carriage way. Non-adhering crushed stone must be removed from the surface.

11.7. In arrangement of surface treatment with using of bitumen emulsion, preferable cationic emulsionof EBK-1, EBK-2 and anionic EBA-1, EBA-2 should be applied.

Emulsion should pass a test for adhesion of binder film with crushed stone according to GOST 18659—01.

In the arrangement of surface treatment with a cationic bituminous emulsions should use crushed stone, not treated with organic binders, for using anionic emulsions - predominantly black crushed stone.

11.8. Surface treatment using bitumen emulsion should be performed in the following order:

Pouring of emulsion on the surface in amount 30 % of normal;

Spreading of crushed stone in amount 70 % of normal;

Pouring remaining solution;

Spreading remaining crushed stone;

rolling.

11.9. At temperatures below 20 ° C should be used at a concentration of bitumen emulsion of 55-60% and a temperature of 40 -50 ° C. When the air temperature is above 20 ° C, the emulsion should not be heated, and the concentration of the bitumen can be reduced to 50%.

Distribution and rolling of crushed stone should be made in accordance with paragraph 11.6. Rolling should be done to complete collapse of the emulsion. When using anionic emulsions movement of vehicles in accordance with the requirements of clause 11.6 may be opened no earlier than one day after work.

ARRANGEMENT OF SURFACE TREATMENT WITH USING OF EMULSION MINERAL MIXTURES

11.10. For arrangement of surface treatment use emulsion-mineral mixtures cast consistence based cationic bituminous emulsion EBK-2 and EBK-3.

11.11. In arrangement of surface treatment of the emulsion-mineral mixtures should be used hard polishing crushed stone of igneous and metamorphic rocks of the brand is not below 1,000 fractions 5-10 (5-15) mm, mostly crushed sands of igneous rocks strength of not less than 1000 or a mixture of crushed and natural sand in the ratio 2:1 or 1:1. If surface treatment only serves as a protective layer may use one natural sand.

11.12. Surface treatment of the emulsion-mineral mixtures can be arranged with the help of a single-pass machine on tentative cleanse and moisturize surfacing by layer 5 - 10 mm (20 - 25 kg/m2) for sand mixtures and 10-15 mm (25 - 30 kg/m2) for crushed stone.

Compaction of spread mixture not be applied by rollers.

Movement of site transport may be opened immediately after completion of works with limit speed 40 km/h in a day.

ARRANGEMENT OF SURFACE TREATMENT WITH USING OF BITUMEN ASPHALT EMULSION SLURRY SEAL

11.13. In arrangement of surface treatment with asphalt emulsion slurry seal should be applied crushed stone and sand in accordance of p. 11.11. Mineral powder, used as an emulsifier for preparation of paste, shall meet the requirements on GOST 16577—78.

11.14. Preparation of asphalt emulsion slurry seal should be performed in fixed plant and distributed on surface area with layer 5 — 15 mm (20—25 кg/m^2).

Arranged surface treatment prior to drying should be shielded from movement of site transport. During the first day the traffic speed does not exceed 30 km / h, hereinafter - 40 km / h until the layer is not formed yet so that the grains of the mineral material are not escaped from there when moving.

QUALITY CONTROL

11.15. In arrangement of surface treatment should be controlled:

The temperature of bitumen in each bitumen tanker;

Permanently — uniformity, purity and spreading smoothness crushed stone, spreading smoothness of binder material;

At least once per shift - clutch binder to the surface of the grains according to GOST 12801-84 and GOST 18659-81, that the composition of emulsion-mineral mixtures and slurries of project, application rates of materials by weighing spread materials on area of 0.25 m2.

MINISTRY OF HIGHWAYS RSFSR

NOTES

ON DEVELOPMENT AND APPROVAL OF TECHNICAL DOCUMENTATION FOR AVERAGE REPAIR OF ROADS

VSN 48-86

MINAVTODOR RSFSR

Most 1985

Guidelines were developed by the Project Bureau of the Central road R / o "Rosavtomagistral" and are mandatory for all design, construction and repair and maintenance of road organizations of the Ministry of Highways RSFSP.

On amendments to the BCH 48-86

Additions are effective from 12/01/87. Estimates prepared before 12/01/87, the, are not subject to refinement.

(Letter Minavtodora RSFSR of 03.11.87 № NA-4/557).

Ministry of Road RSFSR (Minavtodor RSFSR) Departmental building codes BCH 48-86

Guidance for the development and approval of the technical documentation for the average repair of roads Minavtodor

RSFSR

introduced for the first time

Content

1. GENERAL PROVISIONS

1.1. These instructions set the composition, content, procedure development, coordination and approval of design and estimate documentation, on which the average repair highways operated economic way.

1.2. Development of design estimates for the average repair of roads is carried out according to annual inspections and compiled on the basis of their statements of defects with regard to the existing maintenance periods.

1.3. Average repairs are usually designed according to a complex design estimates. The scope of work must comply with the "Instructions for the classification of repair and maintenance of public roads."

Extract from the "Instructions" on the composition of works performed at medium repair of roads contained in the annex number 1 " Guidance "

INCLUDED

Central design bureau of the road R / o "Rosavtomagistral" Minavtodora RSFSR approved

Minavtodorom RSFSR

April 23, 1986 deadline for the introduction

October 1, 1986

1.4. In the development and approval of design and construction documents for the average repair of roads, should be based on the need to maintain transport and operational and technical performance of the road laid down in the existing approved design and as-built documentation, and in its absence in the data sheet of the road.

1.5. Technical documentation on the average repair should be considered requirements for environmental protection and traffic safety, both during the operation of the road, and during the repair work.

1.6. Technical documentation for the average repair of roads developed, as a rule, design office (bureau of design estimates) at AUTODOR (roads) .

1.7. Project documentation should be designed without excessive detail in a minimum volume and composition sufficient to justify decisions and determine the scope of work, the average cost of repair, and the need for major road- building materials.

Development of working drawings and bills as part of the design-budget documentation for medium repairs should be carried out in the performance provided by paragraphs And I- 2 - f, h , 3 - a, b , d and 4-in , informative Annex 1 of these " Guidelines " .

In other cases, project documentation is developed in the form of estimates compiled on the basis of statements of defects. In all cases, the design-budget documentation should be repaired road scheme (object) with an indication of the state of her borders and adjacent areas.

The need to develop working drawings specified in the "tasks" for the development of design estimates claim 10 (Annex 2) .

1.8. Developer gives the customer (Avoider, highway) the technical documentation in triplicate. Terms of development of technical documentation set design task.

1.9. When developing technical documentation, but the documents specified in paragraphs 1.3, 1.4. Should be guided by the applicable regulations for the design, construction and operation of highways, with reference to conditions of medium repair.

1.10. Design and construction documents for the average repair is projected as follows:

a) inspection of the object ;

b) an introduction to the available technical documentation characterizing the object (executive technical documentation, product data , etc.);

c) preparation of specification for development of design estimates ;

g) production in a minimum volume of field survey work ;

d) preparation of documentation in accordance with p.1.7 these " Guidelines " ;

e) coordination of design and estimate documentation ;

g) Approval of documentation Avtodor (highway) .

2 . The task for the development of design and estimate documentation and source data

2.1. Basis for the development of design estimates for the average repair the road is approved the assignment in accordance with the mandatory Appendix 2 , these " Guidelines " . Developer design estimates participate in the preparation tasks and coordinate it.

2.2. The task of designing is approved in the manner prescribed for the approval of design and estimate documentation AUTODOR (roads) .

2.3. Changes to the approved job only AUTODOR (roads) to approve the task.

2.4. Autodor (highway) said to constitute a statement of sources of, means of transportation and distance carriage of basic building materials, components and semi-finished products in the prescribed form.

2.5. Form tasks sources of statements , modes of transportation and distance carriage of basic building materials, components and semi-finished products and statements are defects in the mandatory annexes 2 , 3 and 4 of these " Guidelines " .

3 . Design estimates

3.1. Project documentation on average repair road is developed based on a field survey performed by developers documentation to the reference data for design (task the development of design and estimate documentation , passport road) .

Particular attention in the field survey should be given as sub grade, drainage , artificial structures , ensure traffic safety conditions , identify the causes of the deformation and fracture , condition and comply with the valid elements of road furniture .

3.2. The structure of design and estimate documentation should only include text and graphics documents directly required for repairs justify their size and funding.

Auxiliary calculations, diagrams and lists, as well as graphic and text materials contained in the applicable standard projects, generally not included in the design and estimate documentation .

3.3. Explanatory note to the draft should concisely and clearly justify the adopted technical solutions.

3.4. Project documentation is available in the form of entangled in one volume.

4 . Composition and documentation

4.1. Composition of design estimates for the average repair of roads , developed in accordance with the present p.1.7 "Note" to the complexity of the design decisions and claim 10 " Quests " .

4.2. As part of the design-budget documentation for the average repair of roads includes the following documents :

a) job ;

b) explanatory note ;

a) A statement of defects;

g) a statement of sources and methods of obtaining transportation of building materials;

d) necessary to support the projected volume of work drawings and diagrams referred to in clause 10 of the job to the development of design estimates for the average repair the road ;

e) the estimated portion according to section 6 of the " Guidelines " .

4.3. Project documentation on average repair roads must be framed by the following signatures:

a) on the title pages - chief, chief engineer of the project organization, Head of Department, Ch. Project engineer;

b) the remaining documents - Ch. Project Engineer, Head of Department, and compiler checking.

5 . Coordination and approval documentation

5.1. Design and construction documents for the average repair of roads approved by the customer (Avtodor, highway) .

5.2. Project documentation should be consistent with the traffic police authorities, if provided a partial change in the type or placement of technical resources of the organization and regulation of movement.

5.3. Document approving the design and construction documents for the average repair roads and structures on it is a protocol or other administrative document provided under the provisions of the approving authority and the unified state system office (EGSD) .

5.4. The basic design materials (explanatory note, summary estimate cost catalog individual unit prices) must have the signature of their approval, certified by the signature and seal of the court affirms.

5.5. Project documentation together with the instrument of its approval shall be kept by the customer and the project organization.

6. Estimated part

6.1. The estimated cost of the average repair of roads and structures on them is determined by the summary estimate for the project estimates for the average repair.

Summary estimate the cost of the average repair of roads and structures on them is the basic document on the basis of which the plan allocation for the average repair and financing operations.

In drawing up the estimates for the average repair is advisable to use existing forms adopted refurbishing.

6.2. To determine the estimated cost of the average repair of roads and structures on them are the following documentation.

As part of the design-budget documentation :

- Summary estimate form number 1 (mandatory Appendix 5) ;

- Objective estimates for individual objects and types of work in the form number 2 (recommended Annex 6)

- Local estimates for repair work (mandatory annex 7) ;

- Catalog unit prices (mandatory Appendix 8)

- Calculation of direct costs when binding ERER -84 to local conditions (mandatory Appendix 9) ;

- Calculation of the additional costs of the work in the winter time (recommended Annex 10) ;

- Unit prices (recommended annex 11) ;

- Costing of materials , products and structures (mandatory annex 12) ;

- Calculation of transport costs (mandatory Appendix 13) ;

- Statement of the sources of , and ways of transportation distances carriage materials, components and semi-finished products (mandatory Appendix 3) ;

- Statement of defects (mandatory Appendix 4) .

6.3. Average estimates for repair of roads drawn by current regulations in the manner prescribed Minavtodorom RSFSR.

6.4. In summary estimate average repair cost is at number one form, the funds allocated for the following chapters:

I - development of trails and preparatory work.

II - roadbed.

III - artificial structures.

IV - pavement .

V - setting road safety organization .

VI - other works and costs .

In the absence of facilities , activities and costs under the respective chapter, this chapter is passed without change rooms the following chapters.

6.5. In summary estimate the cost of repairs shows the following outcomes : for each chapter by chapter summary and 1- Y 1 -U1 , after showing the grand total in the next record " Total summary estimate ."

6.6. Included in Chapter VI of the consolidated budget calculation :

a) costs associated with the production of works in the winter time , determined by the collection of NDZ -84 , expressed as a percentage of the estimated cost of construction and installation work on the chapters I to V and are shown in columns 4 , 5, 8 ;

b) the difference in the cost of transportation of imported materials shall be determined in the manner described in the " Guidelines for the use of unit prices on building construction and operation (ERER -84) .

c) additional costs associated with the use of average repair facility of larch timber , determined in accordance with p.2.17 " Guidelines for implementation of the common regional unit prices on building

construction and operation " (ERER -84) of the estimated cost of construction and installation work on Chapter Summary 1-5 without incurring the overhead and planned savings and are shown in c. 4.8 ;

g) Funds for the reimbursement of costs associated with the itinerant nature of work , average repair are provided in amounts determined on the basis of the reported data on actual costs that occurred in the previous year related to the volume of construction works in the same period , where these costs took place, the interest earned is used in setting exposure limits for these purposes from the full value of construction works chapters 1-5 and all costs , Chapter 6 , relating to the construction and assembly work . Means are shown in column 7 and 8;

d) Funds for the reimbursement of costs associated with the payment of additional leave for continuous service shall be determined in the amount of 0.4 percent of the estimated value of construction work following chapters 1-5 and are shown in column 7 , 8;

e) means necessary to recover costs associated with the use of government- USSR interest allowances for work in the Far North and areas equivalent to the Far North , determined on the basis of a certificate of the contractor during the reporting period (year) of the actual costs incurred for these purposes (in percent) , signed by an authorized officer and chief accountant . Funds for these purposes are determined by the value of construction work following chapters 1-5 and all costs , Chapter 6 , relating to the construction and installation work , and are shown in c. 7 , 8 .

(Supplement) .

6.7. Position summary estimate should have a link to a local number (object) or estimates based on certain types of costs.

6.8. In the explanatory note accompanying the summary estimate shall be given :

a) data on the territorial area on division ERER ;

b) data on the availability of special decisions of the Council of Ministers of the USSR , USSR State Committee , ministries and departments on pricing and benefits for the facility;

c) prices and standards , which is made up estimates (which year);

d) name of the organization performing the average repair ;

d) the size of overhead and their justification.

In a case where the calculations are referenced to the data organization , must be accompanied by copies of the relevant documents .

6.9. Object estimates are not prepared in those cases where the object has only one type of work , limited costs are accrued in the local budget.

6.10 . Within each of the local budget in certain types of work can be grouped into sections on structural elements of buildings , structures, types of work . The arrangement works in the estimates and their groups must comply with the process sequence of the work.

6.11 . Estimated cost of materials and construction products is determined by the district collectors average estimated costs of materials , products and structures , and the then-current price lists .

Estimated cost of materials shall be determined taking into account transport costs and harvesting and storage costs (2 %).

6.12 . Points of receipt of materials and their transport distance to the place of work are taken according to the sheet and the sources of the transportation distance of materials issued by the customer and agreed with the organization carrying out the work .

6.13 . The cost of transportation costs for materials , structures and products is determined by the current collections of estimated prices for transportation of goods for construction , part I, II.

6.14 . Overhead for construction works at medium repairs are charged in local estimates for the amount of direct costs in the amount of 10.5 %.

Departmental building codes VSN 24-88
"Technical rules for repair and maintenance of roads "

(approved by the RSFSR Minavtodorom June 29, 1988)

Instead VSN 24-75

Introduction of the term January 1, 1989

In the development of these developed VSN VSN 6-90 " Rules diagnosis and assessment of the state of roads ," approved by the RSFSR Minavtodorom September 5, 1990

Order of the Ministry of Transport of the Russian Federation dated October 3, 2002 IP -840 N - p instead of BCH with 6-90 October 15, 2002 are enacted ODN 218.0.006-2002 " Rules diagnosis and assessment of the state of roads "

See Temporary estimate standards for repairs and maintenance of highways , approved by decree of the Ministry of Transport of the Russian Federation on April 2, 2003 N OS -239- p

General Provisions

1. These technical rules apply to public roads and are mandatory for road maintenance organizations Minavtodorov (Minavtoshosdorov) Union Republics , subject to approval or enactment of the relevant ministry .
2 . Public roads are an integral part of the transport system of the country and represent a complex of

buildings designed to provide year-round , continuous , comfortable , convenient and safe movement of vehicles with rated load and speed you set .
3 . Roads should be equipped service entities and equipped with means of technical regulation and traffic safety in accordance with current standards , rules and regulations , as well as the provisions of this document.
4 . To provide the necessary transport and operational condition of highways organized road service . Types and scope of work performed by Road Service , identified the current classification of repair and maintenance of highways .
5 . The ultimate goal of the road maintenance service is to maintain and continuously improve the technical level and the operational condition of the roads in accordance with traffic growth and the load on the road at a minimum cost of labor , material and technical resources and energy on the repair and maintenance of roads , thereby increasing the rate of increase productivity and efficiency cars , reducing transportation costs needed to transfer road to intensive development .
6. Violation officials conducting work on the repair and maintenance of roads and structures on them , the provisions of " Technical Regulations " entails in force disciplinary, administrative and, in appropriate cases and criminal liability .
7. In addition, development and technical regulation may issue instructions and technical guidelines , manuals, guidelines and other technical standards agreed with NGOs Rosdornii as a leading research organization in the field of repair and maintenance of roads and approved in due course.

Requirements for transport and operation of highways

1.1. The main transport- road performance indicators include: ensuring the speed , capacity, utilization level of its motion , continuity, comfort and safety, the ability to pass cars and trains with an axial load and capacity (or total mass) , the respective categories of the road.
1.2. The main parameters and characteristics, which determine the transport- road performance indicators are:
geometrical parameters , which include the width of the roadway and the boundary fortified zones , the overall width and reinforced shoulders , longitudinal gradients , curve radii and profile , superelevation and sight distance ;
strength and condition of the pavement and roadway shoulders ;
evenness and adhesion of coatings carriageway and shoulders ;
state of subgrade ;
status and health drainage ;
Dimensions , capacity and condition of bridges, overpasses and other man-made structures ;
state of the elements of engineering equipment and construction of roads .
1.3. Vehicle speed is measured at the service factor security K_rse design speed , which is a ratio of the actual maximum speed at each site operated V_fmax to road design speed for this category of roads and terrain V_p, adopted in accordance with SNIP 2.05.02-85 .
1.3.1 . The technical level , the state of public and traffic roads should allow the safe movement of single cars in good weather conditions with maximum velocities close to the calculated (K_rse > = 1) the appropriate category established for roads operated approved technical documentation. In adverse weather conditions may decrease the maximum speed provided in relation to the settlement , but not lower than the values given in Table 1.1 .

1.3.2 . Areas with K_rse from 0.5 to 0.75 in unfavorable seasons roads require extensive maintenance and the subsequent improvement and areas with up to 0.5 K_rse primary subject of a makeover.

Weather condition And lay land	Valid values are provided maximum speed, km for road categories					
	IA	IB	II	III	IV	V
Under favorable weather conditions						
a)on the main stretch of the road	120-150	100-120	100-120	100	80	60
b)on difficult terrain areas	100-120	90-100	90-100	80	60	40
c) on heavy mountain area	60	45	45	40	30	20
In exceptional cases, under adverse weather conditions						
a)on the main stretch of the road	60-75	50-60	50-60	50	40	30
b)on difficult terrain areas	50	50	50	40	30	20
c) on heavy mountain area	40	30	35	25	20	20
Notes. 1. Valid values velocities inferred from conditions reduce the maximum speed provided in relation to estimated at no more than 25% (K_rse> = 0.75) in autumn and spring and winter seasons and as exception no more than 50% (K_rse> = 0.5) during heavy rain, fog, dust storms, gales, depths in the areas, as well as during ice, blizzards and strong snowfall. 2. For difficult areas include terrain relief, cut by deep valleys, often alternating with a difference of marks valleys and watersheds more than 50 m at a distance of not more than 0.5 km from side by deep ravines with unstable slopes. To difficult areas include parts of the highlands passes through bridges and gorges areas with complex strongly indented or unstable slopes						

1.4. Load level road traffic Z defined as the ratio of actual intensity, reduced to a passenger car (N, aut / h), the bandwidth (P aut / h). Z value shall not exceed the values given in Table 1.2.

Characteristics sections of the road	Value Z no more
Entrances to airports, railway stations, sea berths and wharves river (road categories IA, IB and II)	0,5
The entrances to the city, detours and ring roads around cities (road categories IB, II to III)	0,6
Non-urban highways (roads IA)	0,65
Highways of II and III categories	0,7

Note: In unfavorable seasons for roads is allowed to increase the load level, but not more than 15%.

1.4.1. Bandwidth and traffic load level check on the roads and road sections with the actual intensity of more than 4 tys.avt . / Day in physical units in the state of roads and traffic conditions , typical for summer , spring and autumn- winter period . On roads and road sections with less traffic these indicators do not check .

1.4.2 . Condition artificial constructions bandwidth vehicles characterized by the ratio of the actual distance between the border guards or (dimensions for the tunnels) to the normal value established for the road category . Ratio of 0.95 and a characteristic line construction standards bandwidth.

1.5. Security status of the traffic accidents and the estimated coefficients , the accident rate K_a (for road segments in the plain and hilly terrain) and the difference between the coefficients K_a (in neighboring areas in the highlands if the road is paved Perevalnoe progress and deviations of more than 50% and less than the radius 300 m) and a safety factor K_b . Accident rates and safety factors determined separately for summer , spring and autumn- winter period . Characteristics sections of roads for traffic safety and allowable values of the coefficients and , K_a and K_b given in tabl.1.3 . Road segments in the plains and rolling hills K_a > = 20, as well as sections of the road in the highlands to the difference between adjacent areas K_a more than 40% of , or K_b values <0.6 must perform works to improve traffic safety. The repair or reconstruction of such sites are subject to a conversion in the first place.

coefficient	Risk level of road sections			
	Not dangerous	Low-hazard	dangerous	Very dangerous
E	0,4	04-08	08-1,2	1,2
K_a (for sections of roads in the plains and hilly areas)	0-10	10-20	20-40	40
The difference in the coefficients K_a adjacent sections (for mountain areas)	20	20-40	40-100	100
K_b	0,8	0,6-0,8	0,4-0,6	0,4

1.5.1 . Car traffic safety on bridges , overpasses, tunnels and floating bridges is considered secured if their size and condition of the coating comply category roads and fences are in good condition . To further claim tunnels to ensure the necessary level of lighting and ventilation , establish relevant regulations.

1.6. Geometric parameters (longitudinal and transverse profiles , height mound curve radii , carriageway width and shoulder dimensions of artificial structures) must meet the standards established for this category of road (road section) . Deviations of the actual size must not exceed the requirements of relevant regulations.

1.6.1 . Deviations coating width of project size in the smaller side must not exceed: for concrete slabs 5 cm, for asphalt and other types of coatings 10 cm

1.6.2 . Edge coatings carriageway edge fortified zones and reinforced shoulders should be straight in plan, have the right and clear outlines without breaks , destruction and deformation.
1.7. Pavement durability is evaluated K_pr safety factor that is a ratio of the actual modulus of the road structure according to the desired driving conditions during operation and should be equal to or greater than unity (K_pr > = 1).

1.7.1 . In assessing the strength of the required modules of elasticity of non-rigid pavements prescribed with regard to the existing norms overhaul life clothes , calculated load value and the calculated traffic vehicles , coating , road- climatic zone , soil and hydrological conditions , the total thickness of the pavement structure, design and operational reliability at the inspected site in accordance with the current instructions for the design of non-rigid clothes .

See ODN 218.1.052-2002 " Evaluation of the strength of non-rigid pavements ", approved by decree of the Ministry of Transport of the Russian Federation of 19 November 2002 N OS - 1040- p

1.7.2 . For pavements with cement-concrete surfaces may be used as an indicator of the magnitude of the tensile strength of the bending stress of the coating. In this case, the strength condition , taking into account the intensity and composition of the motion is determined in accordance with the operating instructions for the design of rigid pavements .

1.7.3 . Pavements on the roads I - III categories must have strength that during the settlement period unimpeded passage of vehicles with an axle load of 10 ton (100 kN) , Roads IV and V categories paved up to 6 ton (60 kN).

When repairing (strengthening) of roads IV and V categories strength pavements should be brought under a load of 10 ton (100 kN).

1.8. Roadside should be strengthened in accordance with relevant regulations based on local groundwater , hydrological and climatic conditions , have biases to facilitate rapid drainage of surface water . Durability strengthening layers must conform composition traffic flow and provide check-in and stop vehicles without significant deformation and fracture layers of reinforcement. Strength is considered adequate if the ratio of its actual value to the required by traffic conditions during the operation of at least 0.85. Not allowed to form a ledge and ruts at the interface Verge coated roadway.
1.9. Condition of the coating on the roadway roughness coefficient estimated evenness K_r representing the ratio of the maximum allowable values for the actual flatness . Floor flatness satisfies the conditions for operation if K_r > = 1. The limit values are given in Table 1.4

Volume of traffic car/day	Road category	Type of pavement	Maximum allowable state coating evenness		
			Roughness index sm/km		Number of clearances under 3-meter rack, those specified in SNIP 3.06.03-85,%
			With device PKRC-2	With hitgage THK-2	
7000	I	Capital	540	100	6
3000-7000	II	Capital	660	120	7
1000-3000	III	Capital	860	170	9
	III	Light	1100	240	12
500-1000	IV	Light	1200	265	14
200-500		Transitional		340	
Under 200	V				
		The lowest		510	

Note. Permissible values for evenness of device THK given in relation to the vehicle UAZ-452.

Table 1.5

Conditions of movement by SNIP	Coefficient of cohesion with speed 60km/h	The average depth of the roughness troughs, mm, for roads in road-climatic zones	
		I and IV	II-IV
Light	0,35/0,28	0,30	0,35

Complicated	0,40/0,30	0,35	0,40
Dangerous	0,45/0,32	0,40	0,45

Note: Coupling quality coatings are considered satisfactory, subject to both. 2. The denominator gives the values of the coefficient of friction obtained by measuring smooth tire (no tread).

1.10. Coupling quality and roughness of coatings are characterized by the coefficient of adhesion K_s , which is defined as the ratio of the actual ratio of the longitudinal coupling to a permissible value under the terms of traffic safety. Covering linkage meets safety if K_s > = 1. Limit values for the friction coefficient and the average depth of roughness valleys , valid values in the operation of road surfaces should not be below the values specified in tabl.1.5 .

1.10.1 . Difference between the coefficient of friction on the roadway width should not exceed 0.1 . The difference between the coefficients of adhesion of the coating of the roadway and the hard shoulder should not exceed 0.15.

1.11. Slopes of embankments and excavations must be resistant to local climatic factors (local stability) . They should provide rapid drainage of surface water , to be strengthened with the running conditions of soil mounds (seizures) under the provisions of guidance documents . Slopes especially deep grooves and high embankments should have secured the overall stability, which is the ratio of the safe load for R_bez soil mound (recess), located in this state by " density - moisture " to the project R_pr . Overall stability is considered secured if the ratio , ie K_bez > = 1.
1.12. Drainage system of the device , the collection and removal of surface and ground water should always be in working condition , to ensure admission and discharge calculated volumes of water . Do not operate the road in the absence or malfunctioning system catchment and drainage .
1.13. Condition of bridges and floating bridges and ferries carrying capacity is characterized by the ratio of actual to desired load capacity under the current regulations for the design. Compliance is achieved if the ratio is 0.9 or more.

1.13.1 . Bridge crossing or culvert should ensure water flow calculation pass . Ensuring the passage of indicators calculated volumes of water are uniform velocity distribution across the width of the hole , no whirlpools and deposits sediment in areas covered bridge and struenapravlyayuschimi dams , lack of education, new flow on flood plains , flooding and erosion of slopes and embankments have headroom development of gullies .

1.13.2 . Boats and ferries floating support floating bridges must meet regulatory requirements Minrechflota RSFSR.

2 . **Basic rules for assessing the condition of roads , road constructions , work planning for their repair and maintenance**

On the Concept of improvement of bridges on the federal road network in Russia (for the period 2002-2010 .) See order of the Ministry of Transport of the Russian Federation December 25, 2002 N EC- 1146-r

2.1. Key provisions Assessment roads.

2.1.1 . Assess the state of roads and structures is performed to determine the extent to which their transport and operational performance requirements and rational planning types and volumes of works on repair and maintenance .

2.1.2 . Work to assess the state of the roads and road facilities include: current inspections performed by engineering and technical personnel at the lower levels (foremen , masters , etc.);

periodic inspections carried out by the leaders of primary road maintenance services (such as chief engineer DRSU , Daewoo , etc.);

seasonal inspections performed by committees appointed by the leadership of road organizations (AUTODOR , highways , etc.);

special or detailed survey performed by specialized organizations (road test , mostoispytatelnymi stations , design , research organizations , etc.) , as well as committees appointed travel ministries or other higher authorities

2.1.3 . The composition and the nature of work and examinations at roads and structures , as well as their set of road ministry Union republics -specific road network operated , local climatic and other conditions.
2.1.4 . Examinations performed , usually visually , if necessary using a simple measuring tools and hand-held devices . Surveys are using special equipment and mobile laboratories .

2.2. Evaluation of geometric elements of highways.

2.2.1 . The basic geometric elements include the width of the carriageway edge fortified zones and shoulder length straight lines and curves , and the radius in terms of the longitudinal profile , the parameters of transition curves , transverse slopes , the slope of ups and downs , the distance geometric visibility of the road surface , slope shape subgrade .

2.2.2 . Width of the carriageway edge fortified zones and curbs on each characteristic measured stretch of road (on the straights, curves in plan and profile , in places restrictions and change the width , the chimneys , bridges , overpasses , high embankments , in the place of installation restrictions) but not less than one measurement per 1 km .

2.2.3 . To determine the shoulder slope , slope angles of laying the roadbed , longitudinal and cross slopes of pavements using various simple instruments , including Azimuth line (for example, type KP-135).
2.2.4 . For a comprehensive definition of the radii of horizontal and vertical curves , lengths of lines and curves , the longitudinal and transverse slope of the carriageway used settings such as " Route " . With this setting, measurement is carried out in a direct way to the shuttle and (for control) backward sections of 10 - 20 km at a speed of 20 - 30 km / h

2.2.5 . Distance measurement of geometric visibility of the road surface is performed by the installed in the car ranging road (for example, type KP- 213).

2.3. Evaluation and coupling flatness qualities pavements .

2.3.1. In assessing the smoothness and couplings are used as coatings or continuous sampling . Continuous control is designed to survey the road sections over 1 km , selective - less than 1 km . Selective control of smoothness and slipperiness also carried out during the examination dangerous road sections , explaining the reasons of traffic accidents , etc.

2.3.2 . When continuous monitoring is uniformly assessed using a mobile unit PKRS 2y or installed in the car - type laboratory tolchkomera THC-2 .

Evenness estimate passing vehicle laboratory for each lane at a speed of 50 km / h with a tolerance of + - 2 km / h

2.3.3 . To assess the evenness in high risk areas where the safety factor of less than 0.4 , and the resulting accident rate of more than 20 , it is recommended to use a summing tolchkomer Hadi with an attachment for counting the number of shocks or universal tolchkomer RADA . 2.3.4. Selective control of flatness is performed on -bay (areas) of 300 m at the inspected kilometer road by measuring clearances under 3 -meter rack . Zahvatki chosen on the most adverse to the evenness of sites established by visual inspection .

When measurement gaps are placed under the rail latter longitudinally through the road every 30 m in three places: at the axis and 1 m from the edges. Clearance under the rail measured in five control points located at a distance of 0.5 m from each other and from the ends of the rack . 2.3.5. Coupling the quality of paving characterized by the coefficient of adhesion between tire vehicle with a moist surface roadway. Coupling coefficient is determined by setting PKRS 2y or other devices whose testimony should be given to the testimony PKRS -2 . The coefficient of adhesion was measured on each lane when the vehicle speed laboratory 60 km / h by measuring wheel to wheel lock- trailer unit. At the time of measuring the coefficient of friction of the water film thickness of the coating should be at least 1 mm.

2.3.6 . When measured coefficient of friction necessary to fix the air temperature and the obtained values lead to positive estimated temperature of 20 ° C by introducing the following amendments:

Tempurature Air, °C	0	5	10	15	20	25	30	35	40
Correction.	-0,06	-0,04	-0,03	-0,20	0	+0,01	+0,01	+0,02	+0,02

2.3.7. Average depth of the roughness troughs should be evaluated by "sandy spot." 2.4. Evaluation of the strength of road pavement. Restriction of movement of trucks axial loads. 2.4.1. Field testing of pavements performed in accordance with the methodological and normative documents. When tested in the settlement (for the most unfavorable moisture conditions) during the duration of the test period, the T_r (d) of II - IV road climatic zones should be taken in accordance with applicable regulations (for example, with the Instruction on designing pavements non-rigid type). For the billing period in road V-climatic zone take: in irrigated areas - March, May - August (optional with rainy winters and the absence of sustained negative air temperatures - November - February) in

non-irrigated area - March, April (in the absence of further sustained negative Temperature - November - February).

2.4.2. Field tests include linear tests and tests for control points.

Control point is assigned to each characteristic plot belonging to the same type of area on moisture conditions, which has the same structure of the pavement and coating defects, the same soil subgrade and the same vehicular traffic.

Tests carried out on the control points by means of statistical loading wheel of a car, or by short-term loading. Works are carried out every day during the billing period in order to identify patterns of change in the modulus of elasticity of road construction at this time and to bring the results of linear tests performed on different days, compared to the same species.

2.4.3. Linear tests are surveyed at regular intervals along the road on the outer strip rolling (1 - 1.5 m from the edge of the cover) in the most heavily loaded lane in the amount of at least 20 measurements on each kilometer of road and on each characteristic plot of less than 1 km. Test should be performed by dynamic (short-term) loading using laboratory type KP-502MP, UDN-NC MADI UNK-4 RADA, Dean 3 Saratov branch GIPRODORNII ensuring measurement accuracy deflection not less than 5% with a duration of action of the load with 0.02 or more. In the absence of this equipment may use the static loading wheel of a car with the measurement of long-baseline deflectometer deflections of KP-204, or other similar devices that provide accuracy of at least 0.02 mm.

2.4.4. Contact data of linear measurements (using the method of dynamic loading) and measurements on test points are set by the conversion coefficient. For their preparation are performed sequentially test road structure static and dynamic loading three characteristic (see p.2.4.2) for the survey of the road sections of at least 500 m each, differing from each other state coverage. To obtain reliable results at each site perform at least 30 tests.

2.4.5. Test results management and determination of the actual modulus of elasticity are performed in accordance with existing regulations.

2.4.6. Strength evaluation of rigid pavements may be performed by comparing the actual thickness of the coating with a thickness installed operating instructions for the computation of rigid pavements. 2.4.7. These tests are the basis for determining whether the actual modulus of elasticity of the road structure required by traffic conditions.

Required value of the modulus of elasticity is administered in accordance with applicable regulations (for example, with the Instruction on designing pavements non-rigid type) for prospective traffic is reduced to the rated load:

$$N = \text{gamma}\, qN \frac{t}{q^{i} - 1}, \qquad (2.1)$$

pr f q-1

where gamma - parameter received for advanced capital, lightweight and transient coatings respectively equal to 0,12; 0,148; 0,171; q - the actual rate of traffic growth q> 1; t_i - perspective period to gain from the pavement, the field test, years (administered in accordance with applicable regulations overhaul life of non-rigid pavements); N_f - given the actual traffic of vehicles at the time of field testing determined using accounting data traffic on the road:

$$N = N K f \sum_{j=1}^{omega} alpfa P_j, \quad (2.2)$$

f ssp

where N_s - average daily intensity of traffic flow, bus. / day; K_c - seasonality factor (the ratio of the intensity of the settlement movement in the spring to the average daily); f_p - coefficient taking into account the number of lanes on the road surveyed (set according to the current Instructions for designing pavements non-rigid type); omega - the number of types of cars in traffic; P_j - the proportion of j-type car in traffic; alfa_j - reduction coefficient of j-type vehicle (axle) to design loads. For non-rigid pavements values given in Table 2.1 alfa_j.

Accounting for the effects of multi-axle vehicles with connivent done in accordance with current instructions for designing pavements non-rigid type.

2.4.8. In cases where there is no possibility to strengthen the coating immediately on the results of field trials to limit axial movement of cars on load. Permitted traffic design loads for the first year after field-testing

$$N_d = \frac{1}{gamma_{ef}} N \frac{q - 1}{q^t - 1}, \quad (2.3)$$

where N_ef - traffic design load, which should be designed with the required pavement modulus E_tr equal to the actual modulus of elasticity E_f, ie E_tr = E_f; t - time to start the work to strengthen the pavement years.

2.4.9. The volume of traffic restrictions prescribed by the selection of the above formula, achieving equality of actual and allowable traffic by expulsion from the movement primarily heavy vehicles that have the most devastating effect on the pavement.

Table 2.1

Group of assumed load	Type of pavement	Coefficent of alpha_j under axle load, kH										
		20	30	40	50	60	70	80	90	100	110	120
A	Capital			0,01	0,04	0,12	0,23	0,39	0,66	1,00	1,24	1,70
	Light			0,04	0,11	0,23	0,36	0,52	0,75	1,00	1,17	1,50
	Transitional	0,01	0.06	0,14	0,26	0,41	0,55	0,68	0,85	1,00	1,09	1,24
B	Light	0,01	0,08	0,26	0,56	1,00	1,57	2,25	3,04	3,92	4,88	5,90
	Transitional	0,07	0,22	0,44	0,71	1,00	1,31	1,63	1,95	2,27	2,58	2,90

Table 2.2

N p/p	Control characteristics of soil	Subgrade element		
		Under carriage way	Shoulder	Slope
1	Modulus of elasticity of soil	+	+	-
2	Ground strength (shear strength, angle of internal friction, cohesion)	+	+	+
3	Filtration coefficient	For drainage layer	-	-
4	Graduation	+	+	+
5	Moisture	+	+	+
6	Density	+	+	+

2.4.10 . To limit traffic on the roads organize checkpoints equipped with barrier, demonstrative , and prescriptive warning signs, information boards, a platform for weight control passing vehicles . Monitoring the load on the wheel of a vehicle is performed using the weights of portable hydraulic (e.g., model CP -205) or other similar means .

2.4.11 . Checkpoints is recommended to have at the intersection of roads that are convenient for the organization detour transit traffic. Throughout the bypass should be installed information signs showing the direction of the detour , and at the beginning and end of the bypass - bypass circuit .
2.5. Assessment of the roadbed and drainage systems .

2.5.1. Nomenclature instrumental examinations subgrade elements given in Table 2.2 . In addition to the specified in the table depending on the characteristics of the subject item , the nature of its deformation or destruction of materials can be determined by the strength of the strengthening layer on roadsides or

slopes , frost used for fortification works and materials , etc. Full range of indicators defined regulated current regulations on the evaluation of the subgrade .

According to the results of instrumental surveys establish causes damage or deformation of subgrade and promotional activities prescribed repair such sites .

2.5.2 . Defined in claims 1 - 2 Table 2.2 Soil characteristics are determined in accordance with existing regulations for evaluating the technical performance of highways, characteristics claims 3 - 6 –

according to current state standards for appropriate soil testing .

2.5.3 . Assessment of drainage facilities includes an assessment of the integrity of the devices , the degree of preservation defined geometric shapes , strengthening the structural integrity , ability drain . In this space are identified siltation , debris or overgrown with grass and bushes , the fracture drainage facilities , water stagnation in reserves .

In assessing drainage devices mark the places clogging estuaries oplyvshim the slope ground , potholes and cracks in drains , clogged drains and place their possible destruction , space debris sumps .

Particular care should be inspected issues of all drainage facilities in order to detect early stages of soil erosion .

2.6. Assessment of elements arrangement highways.

2.6.1 . In assessing the state of the road signs reveal their presence in the specified places in the scheme of dislocation , mechanical damage racks and plates , the presence of small breaks or separations reflective sheeting from the sign panel , check the strength of the attachment of the sign to the front panel and the degree of contamination.

2.6.2 . Status check mark on the degree of wear primarily on the most dangerous sections (road crossings , areas with limited visibility , climbs and descents , pedestrian crossings , railway crossings , etc.).

2.6.3 . In assessing the state of guardrails check their availability, existing mechanical damage , reliable installation of racks and fixing all elements of fencing , the degree of contamination.

2.6.4 . In assessing the state of the elements of improvement of roads (stop Auto Pavilion , rest areas , specific platforms , parking , etc.) reveal damage and other defects that impede their operation.

2.7. Technical evaluation of artificial structures .

2.7.1 . Work on the technical assessment of artificial structures include current and periodic inspections , and special examinations (examination) . The composition and the nature of work for each type of examination is administered in accordance with applicable regulatory and technical documents . Current inspections carried bridge (tunnel) wizard, and periodic and special examinations (surveys) - Commission organized in due course. Surveys bridges length of 100 m and more , as well as experienced and technically sophisticated designs of bridges and tunnels perform specialized organization.

2.7.2 . At current and periodic inspections establish general condition of the structure and identify defects requiring elimination. Where necessary, carry out control and instrumental measurements .

Results of current and periodic inspections are the basis for planning repairs destination preparations structures to pass ice and floods , the organization extended observations on the development of individual defects , temporary traffic restrictions , the organization of protection structures and to determine the need for special inspections.

2.7.3 . Current examinations performed at least the dates indicated in Table 2.3 .

2.7.4 . Periodic inspections of facilities produce , as a rule, after the passage of flood waters , as well as after the earthquake more than 5 points , and other natural disasters that could cause major damage. Moreover, such inspections performed after repair structures. Tunnels inspect the spring and fall , and after an earthquake more than 5 points .

2.7.5 . In order to determine the actual carrying capacity of the structure or the reliability of its individual components perform special inspections (surveys) , which may include testing facilities conducted with compulsory specialized organizations .

Table 2.3

Structure	Term of current inspections
Wooden bridges, ferries, floating bridges	1 time per quorter
Concrete, concrete and stone bridges and pipes	1 time in half year
Metal bridges and bridge construction (welded, rivet-welded, welded connections with mounting high-strength bolts, welded and reinforced composite) at: positive temperature	1 time in half year
negative temperatures down to -20 °	1 time a month
is the same as below -20 °	Daily
Tonnels	1 time a month

2.7.6 . Special examinations (examination) is performed on the basis of the conclusions on the results of ongoing or periodic inspections and routinely in the following terms : 1 wooden bridges once every 5 years , and metal , concrete , concrete and stone bridges , overpasses and pipe 1 time in 10 years ; tunnels 1 time in 5 years.

2.7.7 . Buildings that have been identified as a result of inspections faults that do not allow further exploitation (ie, requiring a total ban on the movement of vehicles or pedestrians mass of security conditions) should be considered emergency .

Faults that can be eliminated as soon as possible , should not constitute grounds for declaring the emergency facilities

2.7.8 . All major construction characteristics and data on its technical condition should be reflected in the documentation for technical accounting structures, as well as information retrieval system "Bridge" (IPA - Bridge) is an automated data bank of road bridges . The documentation on technical accounting structures defined standard instructions for registration and certification of public roads , 2.8. Rating convenience and safety.

2.8.1 . Comprehensive assessment of the convenience and safety on the road operated operate on the basis of linear graphs seasonal service factor security design speed K_rse safety factor and the final coefficient K_b K_a accident . For roads and sections of roads with traffic of more than 4 tys.avt . / Day schedule also build capacity and the load of P Z. All these graphs are plotted for three characteristic periods : summer , autumn and spring and winter . In road V -climatic zone can determine these parameters for two periods - the summer and autumn and spring .

2.8.2 . Listed in p.2.8.1 graphics develop road maintenance organization on its own or with the help of design, engineering and technological, scientific and other organizations. Graphs build once, using a computer or manually, certification or special surveys of roads and subsequently corrected at least 1 time per year, capturing all the changes in the condition of roads and traffic conditions .
2.8.3 . Necessary for plotting and operational security coefficients estimated speed and the actual values of the safety factors maximum speed single car V_fmax can be obtained by measuring the velocity at each section of the road under real climatic conditions or clearance and analytical way . In data processing speed measurements for cars only take a maximum rate of 85 % probability , and the processing of measured data speeds of all vehicles - 95 % probability .

Maximum speed is obtained by calculation and analytical formulas of determining basic geometric elements and characteristics of the road , putting their data on the actual parameters and the road condition in the characteristic times of the year and in typical weather conditions (friction coefficient , the coefficient of rolling resistance , smoothness , visibility , etc.) .

The schedules can be constructed on a computer program Wai - C-1 and C- wai - 2 developed in GIPRODORNII , dialogical or other programs.

2.8.4 . How to build seasonal schedules coefficients accident powered Guidelines for the organization and ensure safety on the roads .

2.9. Planning for repairs of roads .

2.9.1 . When planning the repair and maintenance of highways are two kinds of plans - prospective and current (annual) . Leading role in the planning of future plans play designed for several years and defining directions in the task of repair and maintenance of roads. The main form of long-term plans are five-year plans , drawn up by travel agencies.

9.2 . # When planning a five-year and annual volumes of repairs, allocations and logistical resources to carry them out on a scale of regional, provincial , autonomous national offices , roads governed by the applicable regulations overhaul life pavements and coatings (Table 2.4 and 2.5) and individual buildings .

Table 2.4

Road category	Intensity movement of traffic flow	Type of pavement	Road climatic zone					
			I,II		III		IV,V	
			K_n	T_o, year	K_n	N_o, year	K_n	T_o, year

	car/day							
1	2	3	4	5	6	7	8	9
I	7000	Capital	0,95-0,90	14-18	0,93-0,88	15-19	0,90-0,86	16-20
II	3000-7000	Capital	0,94-0,89	11-15	0,92-0,87	12-16	0,89-0,85	13-16
III	1000-3000	Capital	0,92-0,87	11-15	0,90-0,85	12-16	0,87-0,83	13-16
		Light	0,88-0,84	10-13	0,86-0,82	11-14	0,84-0,80	12-15
IV	500-1000	Capital	0,85-0,82	11-15	0,83-0,80	12-16	0,80-0,78	13-16
		Light	0,87-0,83	8-10	0,85-0,81	9-11	0,82-0,80	10-12
	100-500	Transitional	0,82	3-8	0,80	3-9	0,77	3-9
V	Under 100	Light	0,83-0,80	8-10	0,80-0,78	9-11	0,78-0,75	10-12
		Transitional	0,65	3-8	0,60	3-9	0,58	3-9
		Lowest	0,65	2-4	0,60	2-4	0,58	2-4

Note: Intermediate values - by interpolation. 2. When calculating the capital gain layers and lightweight pavements may be reduced to 15% of normal life of the maximum values, while maintaining the reliability standards K_n.

Road climatic zone	Traffic volume on the busiest line car/day, with lifetime T_p, year				
	8	6	4	3	2
I, II	Under 200	From 200 to 2500	From 2500 to 4500	From 4500 to 6500	Over 6500
III	Under 200	From 200 to 2000	From 2000 to 4000	From 4000 to 6000	Over 6000
IV, V	Under 200	From 200 to 1500	From 1500 to 3000	From 3000 to 5000	Over 5000

Note: Rate of lifetime coverage allowed lower by 20% when using the tars and resins as a binder for surface treatments and by 30% when using limestone rubble. 2. In cases where the overhaul life of the pavement and cover not differ by more than 30%, overhaul life coatings take equal 50% of the normal life of the pavement 3. Compensation of wear coatings transition pavements provide no later than 3 years

Lifetime pavement T_p evaluated by coupling properties of wear or surface coatings. Service life of the pavement T_o evaluated by deflection designs from the action design load. Normative values of tenure is also used for solving problems related to increased load carrying capacity (strengthening) of road constructions, Gain performed when the pavement calculated level of reliability and the corresponding limit state coating evenness.

2.9.3. Planning a five-year and annual volumes of repairs and provision of material and technical resources at the grassroots road repair or maintenance organizations (DRSU, Daewoo, etc.) should be based on an assessment of the actual state of the roads, with specific areas (addresses repairs), and species volumes necessary repairs.

When assigning specific types and quantities of repairs use the data given in tabl.2.6.

Table 2.6

Index	Road maintenance	Road repair
Operating ratio of its design speed K_rse	0,75-1,0	<0,75
safety factor K_pr	>=1	<1

Evennes pavement ratio K_P	>=1	<1
Ratio of Coupling quality of pavement K_c	>=1	<1
Accident summirized ratio K_a	<=20	>20

2.9.4 . The future plans of road repairs can be set targets regional, provincial , autonomous republican offices , roads and subordinate organizations to higher capital pavements , replacement of wooden bridges on the capital man-made structures , the strengthening and broadening of the bridges, to improve the safety and convenience of traffic (widening of the carriageway , the devices of additional bands , strengthening shoulders , coarse surface finish , installation of fences and other engineering equipment) .

2.9.5 . Future plans are realized by composing and performing ongoing (annual, quarterly and monthly) plans is a step in solving the problems identified within the perspective plan allocations for a given year.
The main document of current planning , which is reflected in the plan 's operational and financial service road for the planned year is remstroyfinplan . He made according to the forms of grassroots units of road service , reviewed and approved by higher offices which based remstroyfinplanov farms constitute summary remstroyfinplany in general management .

2.9.6 . Based remstroyfinplana develop quarterly monthly, decadal , DSA plans. Operational planning should bring targets to all parts of the grassroots road maintenance services .
With an annual plan for the sustainable use of resources allocated specific amounts of road repairs set on the basis of the feasibility analysis.

2.10 . Planning of road maintenance .

2.10.1 . Road maintenance is carried out based on the current operational and production planning .
2.10.2 . Current plans are up for the year and quarter. It contains the following key indicators : job quality road maintenance and road construction; plan costs for the year with quarterly breakdown , annual work plan with quarterly breakdown .

2.10.3 . Quest for quality maintenance of roads and road facilities plan in accordance with existing regulations .

2.10.4 . When planning the content when determining the volume , the demand for labor , equipment and materials as a whole on the road organization, and its grassroots units can take a ring system in which each type of work is repeated periodically on this stretch of road after a certain period time.
2.10.5 . Using cyclic system requires a stable organization in the road range of works, which takes into account all the species included in the work of road maintenance .

2.10.6 . For each type of operation is determined by: P cycle and cycle K_ts factor . Cycle time describes the time period after which this work should be repeated on the same stretch of road , and is measured in years. Cycle factor indicates how many times the total amount of the element of the road (or what his share) need to fix (restore) , and is determined by the reciprocal of P, ie K_ts = 1 / P.
2.10.7 . Scope of work for the year , quarter, month on the site and highway generally determined taking

into account the binding of cyclic indicators for the calendar schedule of production of a particular type of work.

2.10.8 . Work schedule road maintenance up on the basis of calendar terms of technological operations . The schedule takes into account the effect of weather conditions on the performance of all types of work and it is determined by the duration of certain works for the year (in hours) depending on monthly working time.

2.10.9 . The basis for the monthly plans are annual plans , survey data plots serviced roads, comments and suggestions quality control services , planned norms labor and other resources.
2.10.10 . Plan drawn up for a month works senior producer (foreman) , reviewed and approved by the leadership of the organization and the road for 5 days prior to the planned month brought to the performers. In reviewing the work program for the maintenance of roads linking them made for road repairs .
2.10.11 . The plan includes a list of works on maintenance of roads with an indication of the planned volumes , complexity , expense wage cost. This provides a linkage between operational planning with annual and quarterly .

2.11 . Evaluating the effectiveness of road repairs.

2.11.1 . The effect of the implementation of road repair work is expressed in increasing performance of transport- road , convenience, speed and safety of cars and , as a consequence, to reduce transportation costs . In this case the repair costs should be offset by savings of the resulting costs of road transport .

Optimal variant works is provided on condition that

$$E = \{\text{summ} \frac{C_a(t) \quad \text{Delta } C_{ai}}{(1+E_{ip})^t} - [\frac{C_a(t)}{(1+E_{ip})^t} + \text{Sum} \frac{Д_i}{(1+E_{ip})^t}]\} - \frac{}{} = \max, \qquad (2.4)$$

where E - the effect size of the repair work , rub. , C (i) _a (t), S_a (t) - annual fare before and after the repair of the road (ft); S_ai Delta - the boost transport costs during the repair ; t - term summation costs ; t_i - year repairs ; D_i - repair costs ; E_ip . - Normative coefficient at different times to bring costs to the base year (E_np = 0.08) .

2.11.2 . To facilitate the efficiency calculations , expression (2.4) is given in the following form :

$$E = [365N_0 \text{ pci omega } S_E (\Pi^0_{cp} - \Pi^i_{cp}) \text{ sum}_1^{t-1} \frac{q^t}{(1 + E_{ip})^t}] - \quad (2.5)$$

where N_0 - average daily traffic on the road in the year of repairs; psi - parameter taking into account the share of commercial vehicles as part of the motion , the average load of cars, trucks and utilization ratio of run (psi = 1.62), omega - coefficient reflecting the decline savings in transport costs as a result of deteriorating traffic conditions during the repairs (omega = 0.98) ; S_e - the cost of transportation on the road taken as the standard cop / (tkm), P (0) _sp , P (i) _sp - transport cost figures before and after repair ; q - rate of traffic growth ; D - repair costs related to 1 km section of road to be repaired , rub.

2.11.3 . Indicators transportation cost F (0) and P _sp (i) _sp in formula (2.5) is determined based on the data analysis objective assessment of the road on the following four criteria:
P_gamma speed determined by the ratio of the actual average speed of vehicles in these road conditions to the average speed on the road , meeting the requirements of the motion;
safety P_b corresponding value of the final coefficient K_a accident ;
strength pavement P_pr determined by ratio of the actual modulus of pavement to the desired modulus of elasticity under the terms of the motion;
fluidity P_n , determined by the ratio of the actual number of days in a year , during which secured passage on the road (the site) , to the normative number of days which must be secured passage on the road (the site) .

Table 2.7

	Meaning lambda at $(N \frac{q^t - 1}{Po\, q - 1})$ flat		
	100-398	399-1000	1001-2512
0,70	1,024	1,024	1,024
0,75	1,021	1,024	1,024
0,80	1,016	1,019	1,022
0,85	1,010	1,012	1,014
0,90	1,009	1,010	1,011
0,95	1,007	1,007	1,008
1,00	1,000	1,000	1,000

Knowing the values of the four indicators, define transportation cost index

$$P_{cp} = 0{,}004K_a + \frac{0{,}52\ p_p}{\gamma_n} + \frac{0{,}162\ p_p}{p_p - 0{,}3} + \frac{0{,}113}{14} + \lambda + \frac{1{,}024 - \lambda}{f}(T - 1) - 0{,}328,$$

where lambda - parameter defined according to the values of the strength of the estimated traffic P_pr N_ro and growth rate on the intensity q tabl.2.7 ; T_f - the actual life of the pavement on the year of the strength assessment, counting from the time of delivery of the road (or part thereof) commissioned after construction (reconstruction) or last overhaul associated with strengthening the road .

2.11.4 . Efficiency of road repairs were evaluated for stage design and estimate documentation , whose composition is determined in the prescribed manner.

3 . Road Service Organization

3.1. Basic tasks, structure and functions of the road service .

3.1.1 . In accordance with the ultimate goal of the service road to its subsidiaries have the following responsibilities :
technical accounting and certification of roads and road facilities, traffic count , creation and development of an automated data bank on the state of roads and bridges;
development and implementation of long-term and annual plans to raise the technical level and the operational status of roads and structures , safety of traffic and pedestrians ;

organization of work for maintenance and repair , architectural design and improvement of roads ; content in constant working order and ensure efficient use of funds earmarked for road maintenance ; take the necessary measures to prevent interruptions and traffic restrictions , seasonal deformations and destruction of roads and buildings , in the aftermath of natural disasters, timely information to road users and stakeholders on traffic conditions on the roads ;

software in conjunction with the Ministry of Internal Affairs of the USSR and the executive committees of local Soviets protection roads and structures , monitoring of compliance with the Terms of Use and protection of roads and road facilities.

3.1.2 . Guide service road in the Union republics carried Ministry highways, the Ministry of Construction and operation of highways , the Ministry of Road Transport and Highways .

3.1.3 . Grassroots production unit * Road Service (1) on public roads are road maintenance and construction and management of land (DRSU) , road maintenance areas (DEU) Highway Administration (ADM) , operating linear Highway Administration (ELUAD) , repair and construction management (CSF) production road sections (RC and rajavtodor) , road maintenance construction sites (desu) , district road maintenance construction sites (RDES) road sections (control). In some cases, repair of roads can be performed by contractors of road construction companies .
3.1.4 . For road organizations roads fixed in a linear or territorial principle. Length of road section , serviced road organizations , is set depending on the road category , the climatic characteristics and types of coatings , typeface road network , etc. Delimit areas fairway mountain roads , large bridges and river crossings between adjacent road organizations not recommended.
3.1.5 . The composition may include road organizations prorabstva , workshop areas , transport units , repair shops , laboratories, asphalt plants and other production units are not independent enterprises .
3.2. The organization works to repair and maintenance of roads.
3.2.1 . The following forms of organization of repair and maintenance of roads : foreman and workshops sections built on the principles of territoriality , complexity and specialization. The composition foreman and workshops include sites brigade units that can be complex and specialized . Integrated teams (links) are organizing tend to perform simple low-volume work on the maintenance and repair of all structural elements of the road. Specialized teams (links) provide for the maintenance and repair of a separate structural element or perform certain types of work volume .
3.2.2 . Repairs carried out in-line , precinct and district - in-line - parallel methods. When work is recommended to apply through the team contract . Remuneration and financial incentives working brigades carried out in accordance with the applicable provisions of national ministries in pay and bonuses .
3.2.3 . For large and complex repairs to perform complex operations on the subgrade , engineering structures , setting the path and develop a plan of work organization (ERP) .
3.3. Should Patrol .

3.3.1 . Road Patrol Service (DPS) is created as a unit (s) as part of a road organization. It is used for regular patrol roads to take prompt measures to prevent possible causes of interruptions and traffic restrictions , road traffic accidents .

3.3.2 . DPS unit equipped with a special car, a necessary tool and equipment, and means of the organization of movement .

3.3.3 . To organize the DPS developed routing scheme (schedule) , which specifies the sequence and patrol roads, marked particularly dangerous place to go.

Patrolling the roads daily and round the clock in extremely dangerous periods associated with bad weather conditions . Where necessary, the order of patrol roads agreed with the parent organization .
3.3.4 . DPS link on the following responsibilities:

Keeping the roads and structures , monitor the implementation of all requirements of the Rules of road users use and protection of roads and road construction; elimination of minor damage road elements , eliminating any barriers to normal movement , while the impossibility of immediate execution of these works - fencing of these places with the installation of

appropriate temporary signs with simultaneous notification to the organization of road obstacles encountered for action to resume normal movement ;

identification of areas with high slipperiness cover with snow drifts and report on service road ; in case of emergency on the road - a temporary reduction or cessation of traffic with simultaneous notification of the organization and management of road traffic police ;

providing first aid to victims in the event of an accident, as well as assistance to drivers of motor vehicles .

3.4. Service repair and maintenance of artificial structures .

3.4.1 . Structure of the service repair and maintenance of artificial structures (bridges, tunnels, ferries) is formed as a part of road organizations as a dedicated unit based on the number , extent ,

composition and condition of man-made structures .

3.4.2 . Service repair and maintenance of artificial structures may consist of specialized organizations prorabstv , workshop areas , crews repair specialized teams or units on the content of artificial structures .

3.4.3 . Specialized teams (links) for repair and maintenance of artificial structures created as a permanent form , and the nature and scope of their work depends on the composition and length of artificial structures , their technical condition and climatic factors.

3.5. Equipment service road by means of mechanization .

3.5.1 . Road service units must be equipped with machinery and equipment , allows to carry out repair and maintenance of roads in a mechanized way to the modern technical level .
3.5.2 . Picking Park mechanized means of production, repairs and maintenance of highways at the level of ministries, associations, AUTODOR and highways for current and future planning is recommended , with aggregate , taking into account repairs , types of pavements , category snegoborby difficulties .
3.5.3 . In Table 3.1 shows the composition of mechanization , tentatively designed for the repair and maintenance on the section of road I - V categories 100 km long , is located in the temperate climate zone moisture.

3.5.4 . Composition of mechanization to perform winter maintenance of roads (Table 3.2) roughly calculated to do work on a stretch of 100 km of roads of different categories depending on the type and difficulty snegoborby recorded road. For areas with periodic (category Ia) and especially difficult character snegoborby (V category) the composition of mechanization is determined in accordance with the specific terms of performance.

Table 3.1

No	Item	Quantity per 100km in type of pavement		
		Capital and light	Transitional	Lowest
1	2	3	4	5

1	Autohydraulic raiser payload 300kg	2	1	1
2	Heavy Grader	1	2	2
3	Grader medium (including trailer tractor 3 t)	1	1	1
4	Binder districbutor (4-6 t)	1	-	-
5	Asphalt paver (capacity under 150 t/h, width of lstrip to be laid to 3,75 m)	2	-	-
6	Concrete mixer (65 liter)	1	-	-
7	Mobile bitumen heater	1	-	-
8	Bulldozer on tractor (3-6t)	2	3	2
9	Vibrator superficial, electrical	According to scope of work		
10	Vibration strip (width 1,5-4,5)			
11	Pourers seams concrete slabs (up 500m/smenu performance, boiler capacity 600 liters)			
12	Vibration Roller small type Du-60	2	-	-
13	Self-moving roller type DU-52	2	-	-
14	Self-moving 3- rolling roller DU-51	2	-	-
15	Self-moving pneumatic Roller DU-55	3		
16	Semi-trailer Roller on pneumatic tyres (max 15t, width compaction strip 2,6m, towing class tractor 3 t) type DU-37B	1	1	1
17	Clipper(clipping width 1,5m, working speed up to 4,6km/h	2	1	1
18	Boiler for heating of thermoplast(capacity 1,2m3)			
19	Auto crane (load capacity up to 10 t)	1	1	1
20	Side ditch recover device	1	1	1
21	Road machine for removal minor damages	2		
22	Road machine for maintenance(washing, water srpay) based on Zil 130	1	1	1
23	Machine for inspection and repair of bridges	Depend on volume		
24	Machine for marking the road laquer paint	1 per 200km		
25	Machine for marking the road with thermoplast	1 per 200km		
26	Special machine for road service			
27	Equipment for washing of road facilities	1	1	1
28	Equipment for repair of bridge surface	By request of special departments		
29	Equipment for repair of bridge	By request of special departments		

3.5.5 . Nomenclature and the need for mechanized means of production work needed to equip grassroots units of road service , determined based on the actual composition and volume of work and annual operational production mechanization . For small tools and power tools are encouraged to develop normokomplekty , dockable by link or brigade.

3.5.6 . Main machinery and equipment for production work on road maintenance is recommended to deploy in the grassroots units of road service .
3.5.7 . Composition of mechanization for the production of large and complex works of repair is recommended to determine on the basis of project work organization.
3.5.8 . Nomenclature and the total number of mechanization when equipping units performing repair and maintenance of roads , determined on the basis of linking machines to the specific conditions of the work.

3.6. Organization of communication on the roads .

3.6.1. For operative management of road maintenance works to improve the safety of vehicles on the roads and organized technological emergency takeout contact.

3.6.2 . Technological communication - communication traffic controls with their member organizations , the latter among themselves and their subordinate units for operational monitoring of the progress of road repairs and ensure safe movement of vehicles on the roads . Technological communication organized by the use of network -wide or departmental construction wire , microwave radio links and communications.
Choice of communications equipment , number of channels , the organization of a particular type of communication are determined by the specific design of technological communication .

To carry out the maintenance of technological communication and automation in road organizations create communication services , the number of which depends on the technical equipment of these organizations means of communication.

3.6.3 . Emergency takeout link - linkage of persons directly on the road, with the attendant operational control tower to alert the latter of accidents , call for medical , technical assistance, police , as well as address issues related to the maintenance of roads and traffic safety on them.
Emergency takeout communication should be considered for roads of national importance category I and inturistskih routes.

This type of connection must provide :

Feedback of any person being on the road with negotiating speakers mounted on either side of the road after 2 - 5 km to the duty operational control tower ;

unilateral (from negotiating column) call;

exit through the operational control center for technological communication channels and public communication .

4 . Traffic Safety

4.1. General Provisions .

4.1.1. When carrying out repairs and maintenance of highways road maintenance organizations should carry out activities aimed at ensuring the safety and improved traffic management .
4.1.2 . Planning for ensuring safety and improving traffic management should be implemented on the

basis of accounting and analysis of the causes of road accidents , of surveys and inspections of roads , as well as the analysis of the effectiveness of the earlier events.
4.1.3 . Measures to ensure safety should be carried out primarily at the most accidents and dangerous roads.
4.1.4 . The main activities to ensure safety and improve its organization include: maintaining desired flatness coating , eliminating surface defects in the form of dents , holes, cracks and other deformities;

maintaining the required roughness coating provides the necessary friction coefficient wheel vehicles with coated , maintaining the road surface clean the timely removal from it of dust, dirt , sand, and prevent the possibility of going on the road in vehicles not intended for this purpose ; preventing the formation and elimination of winter slipperiness ;

strengthening shoulders , preventing exposure of the edge coating , ensuring water drainage from the roadside , prevention of erosion on roadsides , ditches , ruts and other irregularities ;

providing visibility all over the road , including in places where the roads in the recesses at the crossroads , at the railway crossings , by removing from the ROW trees and shrubs , snow banks ,

voiding placing her booths , stalls , fences, not relating to the improvement of road elements , as well as the removal of previously installed ;

improvement in the process of repairs characteristics of geometric elements of roads by increasing curve radii , the device turns and transition curves , widening narrow bridges; implementation by channeling traffic safety devices islands at junctions , the device additional lanes on the climbs and descents , acceleration and deceleration lanes in areas of intersections and bus stops , building sidewalks and bike paths in the areas of human settlements , pedestrian crossings, underpasses , parking device , rest areas ;

improve traffic management and enhance its security by installing road signs, fences, traffic lights and road marking devices trembling bands , emergency congresses and use other technical means and methods , including automated traffic control system and remote control system of signs ; apparatus and equipment intersections and junctions in one and different levels.
4.1.5 . To solve the above problems in road maintenance organizations can create security services for
4.1.6 . When carrying out work on the road should be taken to ensure traffic safety in accordance with the instructions on the organization of movement and fencing the working places and paragraph 4.7 of these rules.

4.2. Accounting and analysis of traffic accidents .

4.2.1 . In road organizations to be accounted for all road traffic accidents (RTA * (2) arising serviced by roads. These include accidents with victims and victims with no material damage .
4.2.2 . Not subject to registration :

accidents with tractors , other self-propelled machines and mechanisms during the exercise of basic production operations for which they are intended. Under this exemption does not fall into the cases when these machines and mechanisms for transportation purposes ;

Accidents resulting from deliberate actions aimed at the deprivation of life or personal injury or property;
Accidents resulting from the victim attempts to commit suicide ;

Accidents caused by natural disasters, if the driver was not able to prevent this incident ; Accidents caused by violation of safety rules and operation of vehicles in the absence of the driver behind the wheel ;

fires on moving vehicles , not related to their technical malfunction .

4.2.3 . Road traffic accidents are classified by type : collision , rollover , hit a standing vehicle , hitting an obstacle , hit a pedestrian , hit a cyclist hit a horse-drawn carts , impact on animals , other accidents .
4.2.4 . By road accidents with severe consequences include:

accidents on the roads , including any attached with travel organizations and enterprises vehicles and self-propelled machinery, leading to the deaths of 3 or 5 or more victims;

Accidents with by buses regardless of the number of dead and wounded at 5 or more people.
4.2.5 . Information about the accident that occurred on roadways maintained this road maintenance organization , registered in the Record Book accident on a form approved by ministries of the Union republics . Magazine filled according to law-enforcement bodies , supplemented by the results of the analysis of road conditions that contributed to accidents , and information about road organizations adopted measures to prevent accidents. For each of the roads under the authority of the organization , as a rule, constitute separate logfile accident.

4.2.6 . Particular attention should be given to organizations of road accidents account for which , according to the materials for the DPT in the internal affairs were reported poor road conditions contributed to the commission of accidents. According to the official classification , these conditions include : slippery and uneven coating , the poor state of the curb ; mismatch envelope bridge roadway width ; discrepancy railway crossing requirements , location of trees and poles lamps at a distance of less than 6 m from the edge of the roadway , the lack of sidewalks and pedestrian tracks in the village , the lack of protections on dangerous sections of roads and insufficient coverage of the carriageway , the absence of fences and alarms where road work , the lack of road signs or incorrect use ; fault traffic or poor visibility; lack of horizontal markings on the carriageway or bad it visibility; other unsatisfactory conditions .
4.2.7 . In the register of accidents must record the date and time of the accident reports , which have contributed to the emergence of poor road conditions, and accidents with serious consequences . Executives road organizations are obliged to report on the subordination of an accident with serious consequences and victims of accidents , which were the sole cause of poor road conditions, within 12 hours of receipt of the reports of such incidents. Form reports and the procedure for transfer of traffic established ministries of the Union republics .

4.2.8 . Month should perform checks on the available information about an accident on the roads serviced sites with data of the Interior, in which logbook accident supplement the information on accidents , road organizations which have not been previously informed. Reconciliation of accident data produced in the internal affairs (DPS combatant units , municipal and district authorities of the Interior)

. When reconciling data on accidents related to poor road conditions , it is necessary to clarify and specify the Log record accident specific circumstances of these incidents with a view to their subsequent analysis. Given that the previously established data on accidents can be adjusted according to the results of the investigation by internal affairs bodies , subsequent reconciliations in the Journal of Accounting accident should be amended accordingly. In cases when reconciling the accident , reports of which should be presented in an order determined p.4.2.7 , but were not present in the parent organization promptly sent reports indicating the reasons for the delay.
4.2.9 . Accident analysis is performed in order to improve the effectiveness of organizations to ensure road safety and consists of a comprehensive study of accounting and compilation accidents , establishing the influence of individual factors on road conditions and accident trends. Based on the analysis of the accident , plans measures to improve traffic safety , assigned priority and evaluated the effectiveness of their implementation.

4.2.10 . During a thorough study of each accident , associated with poor road conditions , it is necessary to establish specific deficiencies in content and engineering infrastructure of roads that contributed to their emergence . The result of the analysis should be measures to prevent accidents related to poor road conditions , as well as solutions that increase the level of organization of work on road maintenance (except when addressing the conditions that contributed to the accident , is not a direct function of the road organizations , such as accidents , associated with the absence or malfunction of the barrier at railway crossings , traffic lights malfunction , etc.). If surgical removal of the causes of accidents by correcting road conditions in full is not possible, in conjunction with the SAI developed and implemented measures for the organization of movement and identifies promising measures to improve traffic safety in hazardous areas that are included in the work plans of road organizations .
4.2.11 . To identify areas of concentration of an accident on the road network served in road maintenance organizations compiled linear graphics accidents per km for each road separately, which in the form of symbols is applied to reported accidents and incidents coefficients , as well as information on the activities undertaken to improve safety . Based on the calculated values of the coefficient of incidents involving use of information about the accident for a period of not less than 3 years must perform a comparative assessment of the danger areas of concentration accident (see item 1.5) to the destination queue of work to reduce accidents . For a more detailed analysis of accidents line graphs accident recommended to combine with seasonal schedules final factor accident , guided as for activities aimed at reducing the final factor .

4.2.12 . For each site, the concentration of the accident in order to establish the reasons for its occurrence must perform analysis of the distribution of incidents by type, time of day and time of year, given the causes and conditions of accidents recorded in the Journal of Accounting accident. The result should be identified general regularities of accidents on the test site and on the basis of the available information on traffic conditions and direct inspection of the concentration of accidents assigned measures to reduce its level.

4.3. Traffic signs.

4.3.1 . Road signs consider means of safety for vehicles and pedestrians , designed to inform road users about the conditions and modes of movement , positioning them on the journey and meet the requirements of GOST 10807-78 " Road signs " .

Dimensions are given in Table 4.1 marks .

Table 4.1

Типоразмер знака	Основные размеры, мм		Условия применения знаков	
	треугольные (сторона знака)	круглые (диаметр знака)	вне населенных пунктов	в населенных пунктах
I	700	600	Дороги с одной полосой движения	Дороги местного значения
II	900	700	Дороги с двумя и тремя полосами	Магистральные дороги
III	1200	900	Дороги с четырьмя и более полосами и автомагистрали	Скоростные дороги
IV	1500	1200	Ремонтные работы на автомагистралях, опасные участки на других дорогах	

4.3.2. Installation and placement of signs on roads must comply with the requirements of GOST 23457-79 "Technical means of traffic. Application Rules" and "Guidelines for the use of road signs."
4.3.3. Types of marks, their number and location on specific roads defined dislocation, which is being developed in conjunction with the Inspectorate of road maintenance workers organizations and

approved by the heads of the traffic police in coordination with the heads of road maintenance organizations.
4.3.4. Installing or removing additional previously installed signs are also in agreement with the State Automobile Inspectorate.

4.3.5. Road signs installed, repaired and maintained road organizations, and on some routes - specialized organizations of the USSR.

All signs relating to the intersections and junctions (except Advance direction to cross the road), establishes a road organization serving street luxury, and when the same category - organization serving road traffic on which more than crossed (adjacent) road.
4.3.6. Signs seasonal or short-term action is set only at the time when they are needed, and immediately removed after removing the causes of their installation.

4.3.7. To ensure a clear understanding of traffic signs and to exclude their misinterpretation prohibited: to put on a sign or a rack characters not relevant to road sign, to establish the ROW is not related to the road information, as well as posters and billboards that can be mistaken for road signs, install signs not covered by the current standard.

4.3.8. Road signs should be set so that the distance of visibility in the daytime is not less than 150 m
4.3.9. Signs with reflective surface should be applied on sections of roads that do not have a stationary lighting, signs with an internal or external lighting - in the areas of roads, equipped with lighting systems.
4.3.10. Road signs, except as otherwise expressly provided the current standard should be placed on the right side of the road on prisypnyh berms. In places of work are allowed to install signs on the carriageway and verges on portable supports.

In one cross-section of the road shall be permitted no more than three characters, excluding duplicate Trademark and additional information (labels).

Signs placed: on poles, columns and pillars (masts) horizontally (which is preferred) or vertically, on the ropes, banners, and within brackets, located above the roadway horizontally on the same level.
4.3.11. Placing signs on poles should be made in accordance with the scheme shown in Figure 4.1.

Figure 4.1 . "Settlement scheme supports for installation of road signs "

When mounted on the same support multiple characters on horizontal or vertical order of their placement in relation to the edge of the carriageway, or top-down shall be as follows : signs priority; warning ; prescriptive ; prohibiting ; or indication ; service.

When placed on a support group marks one order of their location determined by the number sign in the group.

If you join the road one-way set several characters, signs 5.7.1 and 5.7.2 have under other signs .
4.3.12 . The distance between adjacent marks placed on the same support , except for characters , formed in one body , should be from 50 to 200 m

4.3.13 . Distance from the edge of the carriageway , and if the curb - from the edge of the roadbed to the nearest edge of the sign to her , set on the side of the roadway, should be from 0.5 to 2 m, and to the edge information signs 5.20 . 1 5.21.1 - 5.27 , 5.31 - from 0.5 to 5 m

4.3.14 . Roads I and II categories pointers driving directions recommended to install on the roadside on the L-shaped towers , above the road - on the U-shaped supports. Support bearing structures must be placed on berms at a distance of not less than 0.5 m from the edge of the road or the edge of the dividing line . Berms for signs arranged in such a way that the distance from the racks to the brim with characters berm was not less than 0.75 m

4.3.15 . Roads in mountainous areas may be installed supports road signs on roadsides . In the cramped conditions (at the cliffs, rocky outcrops , parapets , etc.) the distance between the edge of the carriageway and the nearest edge of the sign it should be at least 1 meter mounting height of the sign - at least 2 m supports recommended to install behind the parapet with side slope , embedded in blocks parapet or set of individual blocks of the parapet . In areas where installed fencing is recommended to have the support of Marks guards from the slope closer to the supports fencing or fixed directly on supports fencing.

4.3.16 . Advance direction and distance indications should be mounted on poles located on the roadside berms sprinkled in , the slopes of embankments and excavations or ROW for side ditch . In areas where the fencing installed , bearing signs should be placed closer to the supports fencing so that the distance between the edge of the sign and the support was not less than 0.75 m
4.3.17 . Distance from the bottom plate (unsigned 1.4.1 - 1.4.6 and tablets) to the road surface (mounting height) must be :

1.5 to 2.2 m during the installation side of the road outside the settlements , from 2 to 4 m in the settlements ;
from 5 to 6 m when placed over the roadway or roadside when placing signs on Spans artificial structures , with distance from the road surface to the bottom of the span structures at least 5 m signs must not protrude beyond the lower edge of their ;

not less than 0.6 m when installing on an island and on the roadway .

4.3.18 . Racks road signs can be made of wood, concrete , metal waste pipes, asbestos cement pipes and other materials that provide sufficient stability under the influence of the wind load calculated at washing signs manual and mechanized methods. The entire length of the rack are made of expensive homogenous material and should have the same shape. Rack Requirements road signs are regulated by Soviet standards support road signs .

4.3.19 . Necessary support length for different schemes of traffic signs (see Figure 4.1) must satisfy the condition

$L = h + h + h + d$, (4.1)

1 2 3

where h_1 - the height of the mast , the closed sign (signs), with the top edge of the sign must extend above the top of the support is not more than 0.15 m , the distance between the edges of adjacent characters , placed vertically, was taken to be 0.05 m ; h_2 - height of the support from the bottom of the sign to the top edge of the carriageway of the road taken by at least 1.5 - 2 m ; h_3 - the difference in height between the surface of the edge of the carriageway and the installation of support adopted Raina 0.2 m for single-post supports , 0, 3 m - for two - and 0.35 m for the supports tricycle ; d - the penetration into the ground support of 1.5 m (except for the supports 3,5 m for which d = 1 , m 2) .

Length poles for placing signs on them various sizes under the schemes specified in Figure 4.1 , is given in Table 4.2 .

4.3.20 . Mounts designed for the installation of signs on the side of the road outside the settlements , should be painted black to 500 mm from the ground , the rest - in white.
Support for the installation of signs on the side of the road in the settlements , support for the installation of signs over the roadway , regardless of their locations , as well as arms and brackets designed for mounting on masts lighting signs , walls, buildings, etc. , painted in gray color .
4.3.21 . Work on the maintenance and repair of road signs operate throughout the year . Road-maintenance organizations must maintain constant monitoring presence on the road signs .
To assess the state of their characters should be inspected in the spring, at the beginning of autumn and winter. Signs with independent lighting should be checked in the dark for at least 1 time a week to promptly replace the burnt-out or have lowered the light output of the lamp.
4.3.22 . Supporting and fixing signs should be painted .

To protect against corrosion of metal studs their surface in direct contact with the ground, coated with hot bitumen .

Table 4.2

4.3.23. When routine inspection marks straighten racks and pads, if necessary, tighten or replace fixtures. Scratches, paint layers, deformed at the joints, and other minor damage to paint over without removing the sign.

Slight damage to the reflective sheeting can be eliminated without removing the shield plate.
Coloring racks and rear side flaps characters as possible should be done on the spot.
In the case of removal for repair to mark his place immediately set defective character.
4.4. Layout of roads.

4.4.1. Markings should be considered lines, lettering and other symbols on the roadway, road constructions and elements of setting roads, establishing the order of traffic, showing dimensions of road construction or to indicate the direction of the road, made in accordance with GOST 13508-74 "Road marking."

Layout is divided into two groups: horizontal and vertical.

Horizontal markings applied to the roadway with improved pavement width of not less than 6 m in heavy traffic 1000 and more transport units per day.

In a vertical layout includes line and symbols applied to the support element bridges, overpasses, tunnels portals end faces on embankments, curbs, signal posts and other road facilities in places of possible collision with them vehicles.

4.4.2. It should first be applied to the marks on the most dangerous sections of road (crossing roads and junctions, curves with unsecured visibility, climbs and descents, bridges and viaducts, level crossings, etc.) allocated for the scheme. While initially applied axial line boundary in places where the boundary between the hard shoulder and carriageway poorly distinguishable, and then designate lanes, causing a transverse layout, islands, etc. Partitioning scheme must fully comply with the dislocation of road signs and traffic lights.

4.4.3. Markup of durable materials should be used on road sections with advanced type of coating in good condition, not requiring repair before the end of the life of the markup.
4.4.4. In places road works, as well as in places where the coating must be repaired as soon as may be applied temporary markings of materials with low wear.

4.4.5. Markings made with paint, should be resumed if its wear anywhere on the length of 30 m is more than 50%, and thermoplastic - more than 10% of the area, as well as less wear and, if it is impossible to determine the type of markup.

4.4.6. When the schema of the organization of movement in any part of the road extra marking lines should be removed.

4.4.7. The marking of roads should be considered especially its application in specific areas.
4.4.8. Partitioning straight horizontal sections of roads and road sections in which longitudinal gradients and radii of vertical and horizontal curves are not below the recommended building codes, should provide separation of traffic in opposite directions without limitation overtaking and denote the edge of the carriageway, and on multi-lane roads denote lane and edge of the carriageway, prohibit leaving the lanes for oncoming traffic. With the width of the carriageway 6m prohibited applied boundary line 1.1 * (3).

4.4.9. Road markings on sections of ups and downs should be done so as to ensure the possibility of overtaking towards recovery, except in areas with limited visibility. This is achieved by applying a two-lane road along the axis of the barrier line 1.11, and on three-lane roads - release for movement in the direction of lifting the two bands. In areas of protracted length rises more than 1,200 m in 700 - 800 m must be capable of overtaking vehicles moving in the direction of descent.

4.4.10. Layout road sections on convex vertical and horizontal curves with unsecured visibility is applied so as to exclude the possibility of overtaking vehicles moving in the area of restricted visibility. In areas where the zone with limited visibility for the opposite directions overlap, the prohibition of overtaking is done in both directions with a solid center line 1.1. In areas where the zones are not the same, the prohibition of overtaking produce only for the direction of motion, for which limited visibility. This is done through the barrier line 1.11, which is the solid line should be towards the stream flowing in an area with limited visibility.

In all cases the curves with limited visibility to the centerline of the 1.1 or 1.11 must be applied line approximation 1.6.

4.4.11. In areas with horizontal curves provide a visible separation of traffic in opposite directions is carried out with a solid center line 1.1, when they limited speed or overtaking prohibited. In other cases, flow separation is carried out by axial dashed line 1.5.

Designation on the edge of the roadway curves using lines produce 1.1 on both sides, if the lines are similar to the parts of the road adjacent to the curve.

In the case when adjacent road segments is not performed roadway edge marking, it is necessary to perform the curve only in the region from the outside.

4.4.12. Marking intersections and junctions of roads in one level should clearly allocate motion paths to ensure continued speed on the main road. On a minor road markings shall warn the driver about the upcoming maneuver and reduce speed.

In the area of intersections and junctions transit, high-speed and turning streams should be separated by islands and grid lines. Dedicated lanes for them should contribute to a clear flow of vehicles through the site and ensure smooth merging them.

Deceleration and acceleration lanes for turning flows at intersections and junctions are separated from the main traffic lanes by a dashed line 1.8. Deceleration and acceleration lanes in the area of intersections and junctions on curves and at least 20 m beyond using markup should be separated from the main traffic lanes dividing strip width of 0.75 m for roads Category I and II, and 0.5 m for roads Category III, which indicate the boundaries with a line 1.1.

On the approaches to intersections and junctions of two-lane roads are not equipped with directional islands, along the axis of the carriageway shall be applied solid line 1.1 prohibiting overtaking moving into oncoming traffic. Prohibition of overtaking zone length should be at least 20 m 1.1 solid line must be preceded by a broken line approximation 1.6 length of at least 50 m In the case when a minor road before crossing or adjoining the sign 2.4 "Give way" and there is no acceleration lane, then it must bear the transverse marking 1.13 and 1.20 delta approximation. In the case before the intersection or on a minor road adjoining the sign 2.5 "Movement without stopping smoking," then it is applied to the brake line and markup 1.12 1.21 - the word "Stop". Lines 1.12 and 1.13 requires close as possible to apply the carriageway main road so as to ensure that non-urban road visibility from the stop at a distance of 120 m to the right and 80 meters to the left, and in localities 80 and 50 m, respectively.

Marking roadway intersections and junctions must include mark pedestrian crossings and pointing arrows 1.18 used alone or in combination with a 5.8.1 "The direction of movement of the bands" and 5.8.2 "The direction of movement along the strip."

4.4.13. On bridges, overpasses and tunnels on two roads and three-lane carriageway with a width of 10 meters is necessary to prohibit overtaking by applying a continuous line along the axis of 1.1 roadway of the bridge and at least 200 meters beyond.

Solid line must precede the broken line approximation of 1.6 at 50 (100) m
If the width of the roadway on the bridge is equal to or greater than the width of the carriageway on the approaches, its markings shall conform to the markup on the approaches to the bridge.
4.4.14. In areas crossings must prohibit overtaking by applying the approaches to them at a distance of not less than 100 m from the outer rails solid center line 1.1.

1.1 line must precede 1.6 dashed line length not less than 50 (100) m
At level crossings equipped with traffic light signaling, 5 meters before the barrier, and in his absence to the traffic lights on the lane in the direction of the railroad applied markup 1.12 - line "Stop."
At a railway crossing not equipped with traffic light signaling, the line "Stop" is put in front of him in the presence of a traffic sign 2.5 "Movement without stopping smoking." The distance from the line of "stop" to the nearest rail must not be less than 10 m

In the presence of moving sign 2.5 markup can be supplemented with the word "Stop" to be applied to the lane at a distance of 2 to 25 meters from the line, "Stop."

4.4.15. In the case of local materials for marking (porcelain baby, porcelain fight shlakosital, chalcedony, etc.) their formulation should be agreed with the authorities Glavavtoinspektsii.
4.4.16. Paint and thermoplastic markings applied by marking machines in accordance with the attached instructions, observing the recommended application rate of materials.
When thermoplastic road markings indicative consumption rate of the thermoplastic material is 600 kg per 1 km of the solid line with its width of 10 cm for the same case, the rate of application nitroepoxy enamel is 40 kg.

4.4.17. Drawing on cover inscriptions and symbols is carried out using a specially made for this purpose templates.
4.5. Fencing and vanes.

4.5.1. Fence Roads set when other technical solutions to ensure the safe movement (Flattening slopes of embankments, reducing the height of embankments, removal of a sufficient distance from the edge of the roadway massive obstacles) can not be implemented under the terms of the relief situation, economic and structural reasons.

4.5.2. Guardrails are divided into two groups. Fencing of the first group (barrier, parapet, composite structures) are designed to prevent accidental Congresses vehicles on dangerous stretches of road with roadbed, bridges, overpasses, collisions with oncoming vehicles when crossing the median, hit a massive objects and structures located ROW road (rack information signs, lighting columns, pillars of overpasses, etc.) (Figure 4.2).

Figure 4.3. "Fences second group"

Fencing of the second group (mesh railing design type, etc.) are designed to regulate the movement of pedestrians and avoid entering the roadway livestock and wildlife (Figure 4.3).
4.5.3. Fencing of the first group must be installed on the roadside road sections I - IV categories: passing on the mound with a slope of 1:3 slope and more in accordance with the requirements given in Table 4.3;

arranged parallel to the railway lines, swamps and streams depth of 2 m or more, ravines and mountain gorges up to 25 m from the edge of the carriageway at the prospective traffic of at least 4000 priv.ed. / day and up to 15 m with promising intensity less than 4000 priv.ed. / day;
lies on the slopes of terrain steeper than 1:3 (from the slope) for prospective traffic is not less than 4000 priv.ed. / day;

complex intersections and junctions at different levels;

with poor visibility when the direction of the road in the plan.

Should include fencing poles overpasses, console and frame information signs, lighting poles and ties spaced at least 4 m from the edge of the carriageway.

Roadside fencing first group should be located at a distance of not less than 0.5 m and not more than 0.85 m from the edge of the subgrade according to the rigidity guardrails.

Table 4.3

On the verges of roads recommended to arrange fencing:

Barrier unilateral, metal, energy absorbing struts increments of 1 m - with the outer side of the curve in the plane with a radius of less than 600 m road categories I and II;

Barrier unilateral, metal, energy absorbing struts pitch 2 m - road category I and II, except for the inner side of the curve with respect to a radius of less than 600 m;

Barrier unilateral, metal, energy absorbing struts steps 4 m - with the inner side of the curve with respect to a radius of less than 600 m road categories I and II;

Barrier unilateral, metal, hard - road category I and II, except for the inner side of the curve with respect to a radius of less than 600 m, and the straight sections and the curves in the plane with a radius of more than 600 m road category III;

barrier, one-sided with metal lath on reinforced concrete pillars - the inside of the curve in terms of a radius less than 600 m of roads Category I and II and Category III Roads;

barrier, one-sided with metal lath on reinforced concrete pillars on the inside of curves in the plane with a radius of less than 600 m of roads Category I and II and Category III Roads;
barrier, one-sided, concrete steps rack 1.25 m on the inside of curves in terms of the radius of less than 600 m of roads and category IV;

Table 4.4

barrier , one-sided , concrete steps racks 2.5m - on straight sections and curves in plan with a radius of more than 600 m of roads Category III and IV category on the roads ;

barrier , one-sided , rope - on the inside of curves in the plane with a radius of less than 600 m of roads Category III and IV on the roads are located along its axis , and the presence of dangerous obstacles -

along
parapet fencing type - in the highlands to the road sections I - IV categories , while the feasibility study and road sections V category.

4.5.4 . On the dividing strip roads fencing category I need to install the first group subject to the conditions specified in Table 4.4 .

On the dividing strip fencing first group should be located along its axis , and the presence of dangerous obstacles - along the dividing line at a distance of not less than 1 m from the edge of the carriageway. With the width of the median of more than 3 m is recommended to apply bilateral barrier , metal fencing , and with a width of 3 m or less - reinforced concrete parapet fencing type , including specially shaped side surfaces .

4.5.5 . When installing guardrails used estimated traffic on a five-year term.

4.5.6 . Not allowed to use fencing barrier type using ropes on the roads I and II categories.

Not allowed parapet fencing device type in the form of separate units .

4.5.7 . When pairing the road barrier metal energy absorbing barriers of the bridge railings shall be provided gradually bring step racks guardrails to 1 m lengths of sections This same pitch racks should be 8 m

Notes . 1. Within adapter plates at the joints superstructures of bridges and overpasses with roadbed road fencing should be used the same design as on the span.

2 . In places joints joints beams fencing should be performed teleskopiruyuschim device.

Pairing two -sided metal fences , barrier-type , arranged in parallel on the median strip of the road or on the sidelines in the intersections and junctions , should be performed with a radius of at least 1 m 4.5.8 . When a deviation in terms of fence line should be done with distilled off at least 10:1. 4.5.9 . Fencing of the second group requires :

installed on the median strip opposite the road I category of bus stops with pedestrian crossings (or ground) over the entire length and stop for at least 20 m in each direction beyond its borders; positioned along the axis of the dividing line , and in the presence of supports overpasses, lighting , console and trestle information signs - along the dividing line at a distance of not less than 1 m from the edge of the carriageway for the grids and not less than 0.5 m for fencing railing type . 4.5.10 . Highways I category , as well as dangerous road sections II and III of the categories that do not require artificial lighting and the installation of fences first group shall be equipped with guide devices as stand-alone signal posts height of 0.75 - 0.8 m

4.5.11 . Signal bars on roadsides II and III of the categories should be established : within the curves in the longitudinal profile and the approaches to them (by three columns on each side) at the height of the mound at least 2 m and the traffic is not less than 2000 priv.ed . / day at the distances specified in Table 4.5 ;

within curves in plan and on the approaches to them (by three columns on each side) at the height of the mound is not less than 1 m distances specified in Table 4.6 ;

Table 4.5

on straight stretches of road at the height of the mound at least 2 m and the traffic is not less than 2000 priv.ed. / day over 50 m;

within curves at intersections and junctions of roads in one level at distances specified in Table 4.6 for the outside rounding;

Roads, located at a distance less than 15 meters from the wetlands and watercourses depth of 1 to 2 m, 10 m;

at bridges and overpasses on three columns before and after the construction on both sides of the road in 10 m;

culverts have one post with each side of the road along the tube axis.
4.5.12. Roads category I signal bars should be installed:

between interchanges throughout the sections of roads without enclosing devices carriageway, 50 m;
within radii on both sides of Congresses at distances specified in Table 4.6.
Signal bars should be installed within the unfortified parts Verge at a distance of 0.35 m from the edge of the roadbed. The distance from the edge of the roadway to the column should be at least 0.75 m
4.5.13. On snegozanosimosti areas and areas with longer winter period (I - III road climatic zones) guide bars must be installed on the slope of the mound at a distance of 30 cm from the edge of the roadbed, or arrange them in the form of inclined bars with a cross section 15 x 10 cm limb (Fig.4.4).
4.5.14. Authorized to install fencing and guide bars only on the outside of curves on the left turn congresses intersections and junctions of roads in different levels, located in areas with strong snegozanosimosti.
4.5.15. Refuges to separate traffic flows at intersections directions satisfied when the total traffic on the intersecting roads or adjacent at least 1,000 authors. / Day, when the number of turning vehicles is at least 10%.

4.5.16. The duties of the service road on the content of enclosing and guiding devices includes:
fencing installation in hazardous areas;

periodic cleaning and painting fences, fix minor defects appeared, pulling ropes and anchorages;
strengthening and modernization of installed fences;

replacement of damaged elements fencing.

4.5.17. Cleaning and painting fences perform as required, but at least two times a year. Minor defects detected and eliminated immediately when inspecting fences, fences damaged items should be restored not later than 24 hours after their discovery.

4.6. Lighting of roads.

4.6.1. On the roads should cover areas of roads within settlements, and if possible, use existing electrical distribution networks also large bridges, bus stations, junctions I and II categories with each other and with the railways, all the approaches to them at a distance of not less than 250 m and the access roads to industrial sites or sites with an appropriate feasibility study.
4.6.2. Installation, maintenance and repair of lighting systems by specialized service companies operating regional power grid.

Road Service should initiate coverage of dangerous road sections and can take equity participation in financing or carrying out certain types of construction and maintenance works.

Fig.4.4. "Guiding tables or columns with Limb"

4.6.3. The duties of the road service includes:

Identification of hazardous road sections on which to arrange coverage of stationary; representation of organization designing lighting systems, data required for design work; coordination of the project and the installation of electric pads lighting columns on the road; broadening (if necessary) the subgrade or device prisypnyh berms for installation of supports, as well as their protection guards against possible collision of cars;

creating conditions for maintenance of lighting installations.

4.6.4. Road maintenance service ensures that regional power grid enterprises conduct regular measurements of illuminance and luminance carriageway performed work on the modernization of lighting installations, if necessary, increase the brightness levels of the carriageway - replaced with more powerful lamps, network elements are repaired, cleaned lamps and support from the dust and dirt stained masts and brackets, replace defective lamps and fixtures, enable and disable lighting.
4.6.5. The average brightness of the carriageway sections of roads outside urban areas, including large and medium bridges, should be on the roads I category 0.8 cd/m2, Roads category II 0.6 cd/m2, and on the connecting branches within the transport interchanges 0.4 cd/m2.

The ratio of maximum brightness coating carriageway to a minimum should not exceed 3:1 on road sections I category and 5:1 for other categories of roads.

Glare factor for lighting systems should not exceed 150.

4.6.6. Lighting sections of roads within settlements should be performed in accordance with the requirements of SNIP II-4-79 and lighting road tunnels - in accordance with the requirements of SNIP II-44-78.
Lighting installation intersection of highways in one level must comply with the artificial lighting system regulated safety standards for rail transport.

4.6.8. If the distance between adjacent illuminated areas less than 250 m, it is recommended to arrange continuous illumination of the road, exclusive alternation lit and unlit areas.
4.6.9. Lighting poles, usually should be placed in curve of the subgrade. At the installation sites roadside

lighting poles should broaden a berm so that the distance between the supports and barriers to be installed along the edge of the subgrade was not less than 1.2 m

Assumed to dispose of lighting on the median strip at its width less than 5 m in this case, they must be protected from cars hitting fences, which are mounted on the median strip at a distance of not less than 1 m from the edge of the carriageway.

On July 4. Ensuring safety during repair.

4.7.1. During repair work, the organization conducting the work should take the necessary measures to ensure that in such places safety. To this end, at the site of the work before they begin establish temporary traffic signs, signals and traffic lights, protecting and guiding device, make temporary markings roadway, and where necessary, arrange a detour repair area.

Fencing place of work carried out by means of enclosing shields shtaketnyh barriers, racks, veshek, cones, ropes with colored flags, signal lights.

4.7.2. Installation of engineering equipment movements are produced in accordance with the schemes (Fig.4.5), the activation instructions on the organization of movement and fencing locations in road work. In the case where the conditions of work and movement of vehicles do not comply with any of the types of schemes available in the instructions, make the individual scheme of the organization of movement.
work.

INTERSTATE STANDARD

Asphaltic Mixtures for Roads & Airfield and Asphalt Bitumen. Specifications

GOST 9128-2009

Date of Effectiveness 2011-01-01

Introduction

Goals, main principles and main arrangement for work execution in accordance with interstate standardization is established in GOST 1.0-92"Interstate system of standardization: Basic provisions" and MSN 1.01-01-96 "System of interstate normative documents in construction: Basic provisions".

Standard information

1. DEVELOPED by OJSC "Road Scientific-Research Institute"
2. INTRODUCED by Technical Committee on standardization in construction TK 465 "Construction"
3. ACCEPTED by Interstate scientific-technical commission on standardization, technical normalization and certification in construction (recorded No 36 on October 21 2009)

Following countries accepted the revision

Countries on (ISO3166) 004-97	Code of countries on (ISO 3166) 004-97	Short name of state organizations on construction
Azerbaijan	AZ	Ministry of Construction
Armenia	AM	Ministry of Municipal Engineering
Kazakhstan	KZ	Agency on construction and communal services& housing
Kyrgyz	KG	Ministry of Construction
Moldova	MD	Ministry of Construction and Territory Development
Russian Federation	RU	Ministry of Regional Development
Tajikistan	TJ	Agency on Construction and Architecture under the Government

4. INTRODUCED IN ACTION as a national standard in Russian Federation as of January 1, 2011.
5. IN SUBSTITUTION OF GOST 9128-2007

1 Application area

This specification covers asphalt mixtures used for surfacing and bases of highways, airports, city streets, squares and roads of industrial enterprises with acting construction norms. Application of asphalt bitumen for surfacing of highways, city streets and airport is shown in annexes A, B and C.

2 Normative references

The following standards are used for this specification:

GOST 12.1.004-91 Standard system of labor safety. Fire safety: General requirements.

GOST 12.1.005-88 Standard system of labor safety: General sanitary-hygiene requirement to the air environment of working areas

GOST 12.1.007-76 Standard system of labor safety: Harmful substance. Classification and general safety requirement

GOST 12.3.002-75 Production process :General safety requirements.
GOST 17.2.3.02-78 Nature protection. Atmosphere: Rules of establishing permissible emissions of harmful substances by industrial enterprises.
GOST 3344-83 Crushed stone and slag sand for road construction: Specifications
GOST 8267-93 Crushed stone and gravel from dense rocks for construction works: Specifications
GOST 8269.0-97 Crushed stone and gravel from dense rocks and waste of industrial productions for construction works. Test method on physical and mechanical property
GOST 8735-88 Sand for construction works: Test method
GOST 8736-93 Sand for construction works: Specifications
GOST 11501-78 Oil bitumen: Method of determining penetration value
GOST 11503-74 Oil bitumen:Determination of viscosity
GOST 11504-73 Oil bitumen: Method of determining of evaporated diluents of liquid bitumen
GOST 11505-75 Oil bitumen: Method of ductility determination.
GOST 11506-73 Oil bitumen: Method for determination of softening point on ring and ball
GOST 11507-78 Oil bitumen: Method of determination of brittleness
GOST 11508-74 Oil bitumen: Method for determination of adhesion of bitumen with marble and sand testing method
GOST 11955-82 Liquid road bitumen: Specifications
GOST 12801-98 Materials on the basis of binding for road and airport constructions: Test methods
GOST 16557-2005 Powder for asphalt mixtures: Specifications
GOST P 52129-2003(Specification used in the territory of Russian Federation)
GOST 18180-72 Oil bitumen: Method for determination of mass change after warming
GOST 22245-90 Road viscous bitumen: Specifications
GOST 23735-79 Sandy gravel mixture for the construction works: Specification

3 Terms and Definitions

In this specification following terms are used with corresponding definitions:

3.1 asphalt mixture**:** Rationally chosen mixture of mineral materials [crushed stone (gravel) and sand with mineral powder or without it] with bitumen, combined in certain proportions and mixed in a heated state

3.2 asphalt concrete: Compacted asphalt mixture.

4 Classifications

4.1 Asphalt mixture (hereinafter - the mixture) are classified into crushed stone type , gravel type and sand type.

4.2 Mixtures are divided into following types depending on the viscosity of bitumen and conditions of use:

Hot Type - produced using viscous bitumen and applied immediately after production at temperature not below 120 ^{o} C;

Cold Type - produced using liquid bitumen accepted for long-term storage and applied at temperatures not below 5 ^{o} C.

(註:Warm Type 削除)

4.3 Mixtures are divided into following types depending on the maximum size of the mineral materials(aggregate):

Coarse- graded Type - with maximum aggregate size of 40 mm;
Fine -graded Type - with maximum aggregate size of 20 mm;
Sandy Type - with maximum aggregate size of 10 mm (註：GOST-84, 5mm)

4.4 Mixtures are divided into following types depending on the Air Void:

Highly Dense Type - with a Air Void of 1 % ～2,5%; （註:追加される）
Dense Type - with a Air Void of 2,5% ～5,0%; (註:GOST-84:2% ～7%)
Porous Type - with a Air Void of 5,0% ～10,0%(註:GOST-84:7% ～12%)
Highly Porous Type - with a Air Void over 10% (註:GOST-84: 12% ～18%)

4.5 Crushed stone and gravel Hot mixtures and Dense mixture shall be classified into the following types depending on content of crushed stone or gravel:

Type	Aggregate	Percentage of Aggregate	(註:GOST-84)
A	Crushed stone	50% ~ 60%;	50% ~ 65%;
B	Crushed stone made of gravel	40% ~ 50%;	35% ~ 50%;
C	Crushed stone made of gravel	30% ~ 40%.	20% ~ 35%;
			Type D 削除

Highly Dense Hot mixture shall contain crushed stone from 50% to 70%.(註:追加される)
Highly Porous mixtures are divided into Highly Porous Crushed stone type and Highly Porous Sandy types.
Crushed stone and gravel Cold mixtures depending on content of crushed stone or gravel are classified into type Bx and Cx.
Hot and Cold sandy mixtures depending on type of sand are classified into following types:

D and Dx – using crushed stone screenings;

E and Ex – using natural sand or mixture of natural sands with crushed screenings.

4.6 Mixtures depending on physic-mechanical properties and used materials are divided into following classes as shown in Table 1.

Table 1

Type of mixtures	Class
Hot:	
1.Highly Dense type (註:追加される)	I
2.Dense type:	
Type A	I, II
Type B, D	I, II, III
Type C, E	II, III
3.Porous:	I, II
4.Highly Porous: crushed stone	I
Highly Porous: sandy	II
Cold:	
Type Bx, Cx	I, II
Type Dx	I, II
Type Ex	II
Highly porous: crushed stone	I

5 Specifications

5.1 Main properties and characteristics

5.1.1 Mixtures shall meet the requirements of this specification and shall be produced on technical regulations approved by manufacturer.
5.1.2 Grading of mixtures shall meet the requirements in Table 2 for Base course and Binder courses and Table 3 for surface courses
5.1.3 The physical and mechanical properties of Highly Porous and Dense mixture of different class of Hot mixture in specific climatic zones shall meet the requirements in Table 4.

Table 2 (Binder course & Base course)

Type of mixtures	Percentage by weight Passing sieve										
	40	20	15	10	5	2,5	1,25	0,63	0,315	0,16	0,071
1-1.Dense type:Continues graded											
A	**90-100**	66-90	56-70	48-62	**40-50**	28-38	20-28	**14-20**	10-16	6-12	**4-10**
B	**90-100**	76-90	68-80	60-72	**50-60**	38-48	28-37	**20-28**	14-22	10-16	**6-12**
1-2 Dense type ;Open graded											
A	**90-100**	66-90	56-70	48-62	**40-50**	28-50	20-50	**14-50**	10-28	6-16	**4-10**
B	**90-100**	76-90	68-80	60-72	**50-60**	38-60	28-60	**20-60**	14-34	10-20	**6-12**
2,Porous type											
	90-100	75-100 **(90-100)**	64-100	52-88	**40-60**	28-60	16-60	**10-60**	8-37	5-20	**2-8**
3.Highly Porous type											
crushed stone type	**90-100**	55-75 **(90-100)**	35-64	22-52	**15-40**	10-28	5-16	**3-10**	2-8	1-5	**1-4**
Sandy-type	-	-	-	-	70-100	64-100	41-100	**25-85**	17-72	10-45	**4-10**

Note:

1. In bracket it is shown the requirements for the grain composition of the mineral part of mixtures by limiting the design documentation size of used crushed stone.
2. For highlighted in bold, grading may be determined during acceptance tests on control sieves in accordance with properties.

Table 3 (surface course)

Type of Mixture	Percentage by weight Passing sieve									
	20	15	10	5	2,5	1,25	0,63	0,315	0,16	0,071
Hot type:										
1. Highly Dense	**90-100**	70-100 **(90-100)**	56-100	**30-50 (90-100)**	24-50	18-50	**13-50**	12-50	11-28	**10-16**
2.1. Dense type:Continues graded										
A	**90-100**	75-100 **(90-100)**	62-100 **(90-100)**	**40-50**	28-38	20-28	**14-20**	10-16	6-12	**4-10**
B	**90-100**	80-100	70-100	**50-60**	38-48	28-37	**20-28**	14-22	10-16	**6-12**
C	90-100	85-100	75-100	**60-70**	48-60	37-50	**28-40**	20-30	13-20	**8-14**
D	-	-	**100**	**70-100**	56-82	42-65	**30-50**	20-36	15-25	**8-16**
E	-	-	**100**	**70-100**	60-93	42-85	**30-75**	20-55	15-33	**10-16**
2.2 Dense type: Open graded										
A	**90-100**	75-100	62-100	**40-50**	28-50	20-50	**14-50**	10-28	6-16	**4-10**
B	**90-100**	80-100	70-100	**50-60**	38-60	28-60	**20-60**	14-34	10-20	**6-12**
Cold type:										
Bx	**90-100**	85-100	70-100	**50-60**	33-46	21-38	**15-30**	10-22	9-16	**8-12**
Cx	**90-100**	85-100	75-100	**60-70**	48-60	38-50	**30-40**	23-32	17-24	**12-17**
Dx & Ex	-	-	**100**	**70-100**	62-82	40-68	**25-55**	18-43	14-30	**12-20**

Note:

1. In bracket itis shown the requirements for the grain composition of the mineral part of mixtures by limiting the design documentation size of used crushed stone.
2. For highlighted in bold, grading may be determined during acceptance tests on control sieves in accordance with properties.

(註:ハイライト部変更有))

Table 4

Description	class of mixture								
	I			II			III		
	Climatic zone								
	Z_I	$Z_{II, III}$	$Z_{IV,V}$	Z_I	$Z_{II, III}$	$Z_{IV, V}$	Z_I	$Z_{II, III}$	$Z_{IV, V}$
1-1Compressive strength (MPa) at temperatures not less than 50 °C:									
- Highly Porous	1,0	1,1	1,2	-	-	-	-	-	-
- Dense types:									
A	0,9	1,0	1,1	0,8	0,9	1,0	-	-	-
B	1,0	1,2	1,3	0,9	1,0	1,2	0,8	0,9	1,1
C				1,1	1,2	1,3	1,0	1,1	1,2
D	1,1	1,3	1,6	1,0	1,2	1,4	0,9	1,0	1,1
E	-	-	-	1,1	1,3	1,5	1,0	1,1	1,2
1-2Compressive strength(MPa) at temperatures not less than 20 °C for all type of mixture									
	2,5	2,5	2,5	2,2	2,2	2,2	2,0	2,0	2,0
1-3Compressive strength(MPa) at temperatures not more than 0 °C for all type of mixture									
	9,0	11,0	13,0	10,0	12,0	13,0	10,0	12,0	13,0
2.Water resistance, not less than:									
- dense asphalt concretes	0.95	0,90	0,85	0,90	0,85	0,80	0,85	0,75	0,70
- highly dense asphalt concretes	0.95	0,95	0,90	-	-	-	-	-	-
- dense asphalt concrete with prolonged water saturation	0.90	0,85	0,75	0,85	0,75	0,70	0,75	0,65	0,60
- Highly dense asphalt concrete with prolonged water saturation	0.95	0,90	0,85	-	-	-	-	-	-
3.Displacement resistance on:									
- Coefficient of internal friction, not less than for asphalt concrete types:									
Highly dense	0,88	0,89	0,91	-	-	-	-	-	-
A	0,86	0,87	0,89	0,86	0,87	0,89	-	-	-
B	0,80	0,81	0,83	0,80	0,81	0,83	0,79	0,80	0,81
C	-	-	-	0,74	0,76	0,78	0,73	0,75	0,77
D	0,78	0,80	0,82	0,78	0,80	0,82	0,76	0,78	0,80
E				0,64	0,65	0,70	0,62	0,64	0,66
- cohesion on displacement at temperature not less than 50 °C(Mpa) for asphalt concretes type:									
Highly dense	0,25	0,27	0,30	-	-	-	-	-	-
A	0,23	0,25	0,26	0,22	0,24	0,25	-	-	-
B	0.32	0.37	0.38	0.31	0.35	0.36	0.39	0.34	0.36
C	-	-	-	0,37	0,42	0,44	0,36	0,40	0,42
D	0,34	0,37	0,38	0,33	0,36	0,37	0,32	0,35	0,36
E	-	-	-	0,47	0,54	0,55	0,45	0,48	0,50
3.Fracture strength on tensile strength on rive at temperature 0 °C and deform speed 50 mm/min for all kind of asphalt concretes(MPa):									
- not less than	3,0	3,5	4,0	2,5	3,0	3,5	2,0	2,5	3,0
- not more than	5,5	6,0	6,5	6,0	6,5	7,0	6,5	7,0	7,5
Note: 1. For Coarse grained asphalt concretes the properties of displacement resistance and fracture strength are not standardized 2. Physical and mechanical properties of asphalt concretes used in specific conditions of operation may be identified in project documents for construction.									

5.1.4 Water saturation of highly dense and dense asphalt concretes of Hot mixtures shall conform to the Table 5.

Table 5

Water saturation Percentage by volume

Type of asphalt concrete	Water saturation for	
	sample, mixture mold	Core sample of prepared pavement, not more than
Highly dense type	1,0 (0,5)~2,5	3,0
Dense type:		
A	2,0 (1,5)~5,0	5,0
B, C and D	1,5 (1,0)~4,0	4,5
E	1,0 (0,5)~4,0	4,0

Note :

1.Figure in parentheses shows water saturation of remold core samples.

2. Properties of water saturation of asphalt concretes used in specific climatic zone may be identified in project documents for construction.

5.1.5 VMA(%) of asphalt concrete of Hot mixtures shall be as follows

Type of mixture	VMA value
1. Highly Dense:	Not more than 16 %;
2 Dense :	
Type A and B	14 - 19
Type C, D and E	Not more than 22
3. porous:	Not more than 23
4-1 Highly porous: crushed stone	Not less than 19
4-2 Highly porous :sandy	Not more than 28.

5.1.6 The physical and mechanical properties of Porous and Highly Porous of Hot asphalt mixtures shall conform to the Table 6.

Table 6

Description	Class of mixture	
	I	II
Compressive strength not less than MPa at the temperature 50 °C,	0.7	0.5
Water resistance, not less than	0.7	0.6
Water resistance with prolonged water saturation, not less than	0.6	0.5
Water saturation(%) by volume, for:		
- Porous mixture	4.0~10.0	4.0~10.0
- Highly Porous mixture	10.0~18.0	10.0~18.0

Note:

1. For coarse grained asphalt concrete, value for compressive strength at the temperature 50 °C and water resistance properties are not standardized.

2. Water saturation are not standardized for the samples taken from core at the lower part and by breaking asphalt concrete

5.1.7 The physical and mechanical properties of Cold Mixtures of different classes shall meet the Table 7.

Table 7

Description	Class and type			
	I		II	
	Bx, Cx	Dx	Bx, Cx	Dx, Ex
Compressive strength (Mpa)not less than at the temperature 20 °C:				
1-1 before warm-up:				
Dry	1,5	1,7	1,0	1,2
Water saturated	1,1	1,2	0,7	0,8
After prolonged water saturation	0,8	0,9	0,5	0,6
1-2 after warm-up				
Dry	1,8	2,0	1,3	1,5
Water saturated	1,6	1,8	1,0	1,2
After prolonged water saturation	1,3	1,5	0,8	0,9

5.1.8 VMA of Cold mixtures shall be not more than the following figure (%) for each type:

Type Bx	20%	
Type Cx	20%	(註 GOST 84: 18%)
Type Dx and Ex	21%	

5.1.9 Air Void of Cold mixture types Bx, Cx, Dx and Dx shall be of 6.0% ~ 10.0% and water saturation shall be of 5% ~ 9% by volume.

5.1.10 Index of strokes obtained by testing of hardening after dry (Caking) for cold mixtures in accordance with GOST 12801 shall be less than 10 times.

5.1.11 Temperature of Hot and Cold mixtures during shipping depending on particular of bitumen shall meet the requirements mentioned in Table 8.

Table 8

Type of mix-ture	Temperature of mixture(°C) depending of bitumen brand						
	Penetration at 25 °C(0.1 mm)					Relative viscosity by viscometer with opening of 5mm at 60 °C, c	
	40/60	61/90	91/130	131/200	201/300	70/130	131/200
Hot	150～160	145～155	140～150	130～140	120～130	-	110～120
Cold						80～100	100～120

Note:

1. During use of surfactants and activated mineral powders, it is allowed to reduce the temperature of hot mixtures by 10 °C ～ 20 °C.
2. During use of special additives, the temperature of mixtures is assigned according to documents for its usage.
3. Depending on weather and for highly dense asphalt concretes, it is allowed to increase the temperature of mixture by 10 °C ～ 20 °C following the requirements mentioned in GOST 12.1.005 .

5.1.12 Asphalt mixtures shall withstand the adhesion of the bitumen with mineral part of mixtures.

5.1.13 Mixtures should be homogeneous. The absolute value of the deviation of bitumen content in the mixture from the project shall not exceed ± 0.5% by weight.
The homogeniousness in one lot of compressive strength in Hot mix is evaluated by the ratio of deviation. Cold mixes is evaluated by the raio of deviation of water saturation. The ratio of deviation shall be not more than that given in Table 9.

Table 9

Description	Maximum ratio of deviation for mixture class		
	Class I	Class II	Class III
Compressive strength at 50 °C	0.16	0.18	0.20
Water saturation	0.15	0.15	-

(註:5.1.3 追記される)

5.2 Material requirements

5.2.1 Crushed stone of dense natural rocks, gravel and crushed stone of slags including in mixture shall comply to the requirements of GOST 8267 and GOST 3344. It is allowed to use crushed stone and gravel produced with foreign standards, provided that the quality shall conform to this specification.
Percentage of containing lamellar (flaky) shape in aggregate shall not exceed:

15% for mixture Type-A and highly dense
25% for mixture Type-B & Bx and highly porous
35% for mixture Type –C & Cx and porous (註:黄色ハイライト追加)

Grain composition of gravel-sandy mixtures must be complied to the GOST 23735, GOST 8267 and GOST8736
Production of mixture shall use crushed stone or gravel with following fractions:

5 ~10mm, 10~ 20mm and 20~40mm.

Strength and frost resistance of crushed stone and gravel for mixtures shall conform to the Table10.

Table10

Description	Class and type of mixture												
	Class I					Class II						Class III	
	Hot type		Cold type		Porous and Highly porous	Hot type			Cold type		Porous	Hot type	
	A, highly dense	B	Bx	Cx		A	B	C	Bx	Cx		B	C
1.Strength(kgf/cm2) not less than													
a) Crushed stone of igneous and metamorphic rocks													
	1200	1200	1000	800	800	1000	1000	800	800	600	600	800	600
b) same for the aggregates of sedimentary rocks													
	1200	1000	800	600	600	1000	800	600	600	400	400	600	400
c) Crushed stone of metallurgic slag													
	-	1200	1000	1000	800	1200	1000	800	800	600	600	800	600
d) Crushed stone of gravel													
	-	1000	1000	800	600	1000	800	600	800	600	400	600	400
e) Gravel	-	-	-	-	-	-	-	600	800	600	400	600	400
2.Abrasion :													
a) Crushed stone of igneous and metamorphic rocks													
	Ab-1	Ab-1	Ab-2	Ab-3	Not standard-rized.	Ab-2	Ab-2	Ab-3	Ab-3	Ab-4	Not standard-rized.	Ab-3	Ab-4

b) same for the aggregates of sedimentary rocks													
	Ab-1	Ab-2	Ab-2	Ab-3	То же	Ab-1	Ab-2	Ab-3	Ab-3	Ab-4	То же	Ab-3	Ab-4
c) of gravel or crushed stone from gravel													
	-	Ab-1	Ab-1	Ab-2	same	Ab-1	Ab-2	Ab-3	Ab-2	Ab-3	same"	Ab-3	Ab-4
3.Characteristics on frost resistance for all types of crushed stone and gravel:													
a) for climatic zone I, II, III													
	F50	F50	F50	F50	F25	F50	F50	F25	F25	F25	F15	F25	F25
b) for climatic zone IV, V													
	F50	F50	F25	F25	F25	F50	F25	F15	F15	F15	F15	F15	F15
Note : To increase the coefficient of grip of wheels, it is not recommended to use crushed stone made of carbonated rocks in highly dense and dense mixtures Type A of Class I													

5.2.2 Natural sand and screening products of rocks shall conform to the GOST 8736.
Properties of crushed sand and screening products from rock crushing and content of clay particles identified by swelling method shall comply with the Table 11.

Table 11

Description	Norm for mixture class							
	I			II			III	
	Hot and Cold		Porous and Highly porous	Hot and Cold		Porous and highly porous sandy	Hot	
	A, B, Bx, Cx, highly dense	D, Dx		A, B, Bx, C, Cx	D, E, Ex		B, C	D, E
Tensile strength of screening products of rocks and gravel, not less than								
	800	1000	600	600	800	400	400	600
Contents of clay particle, determined by swelling method, % by weight, no more than								
	0.5	0.5	0.5	0.5	0.5	1.0	1.0	1.0
Note: For mixtures Type D of Class I, it is necessary to use screening sand of igneous rocks according to GOST8736 where grain size 0.16 mm is not more than 5 % by weight.								

5.2.3 Mineral powder of mixtures shall conform to GOST 16557.
5.2.4 Bitumen requirements
5.2.4.1 For preparation of mixtures, the viscous bitumen is used according to GOST22245 and liquid bitumen is used according to GOST11955. Other kind of bitumen is used according to approved documents.
5.2.4.2 Application of bitumen brand is shown in Annex A, B and C.
For production of cold mix class I, liquid petroleum road bitumen SG and modified liquid bitumen shall be applied. It is allowed to use bitumen MG and MGO if use activated mineral powder or preliminary treated the mineral materials of bitumen mixture with surfactants.
For Cold mixture of Class II, liquid bitumen SG, MG and MGO shall be used.

6 Safety and Environment protection

6.1 For production and laying of mixtures, general safety requirement shall be followed according to GOST 12.3.002 and fire safety according to GOST 12.1.004.
6.2 Materials for the preparation of asphalt mixtures (gravel, sand, mineral powder and bitumen), the nature of hazard and the degree of impact on the human body are low-hazard substances according to GOST 12.1.007.

6.3 The air in working area for preparation of mixture shall be satisfied according to GOST 12.1.005
6.4 Specific effective activity of natural radionuclides in mixtures and asphalt concrete shall not exceed the values specified in GOST30108.

7 Rule of acceptance

7.1 Mixtures shall be accepted lot by lot.

7.2 When receiving and delivering hot and warm mixture, a lot consist of the weight of mixture of the same mix proportion produced at one plant during oneday or one shift's production, but quantity shall not be more than 1000 tons per lot(註：GOST－400ton)
7.3 As for the acceptance of Cold mixture a lot shall not exceed 300 tons. If after acceptance of mixture, it is placed in store, it is allowed to mix with other cold mix of the same lot. (註：GOST- 84:200ton)
When cold nixture is delivered from the warehouse by automobiles , the amount of mixture of the same composition , same consumer and within a same day shall be numerated.
When delivering cold mixture from the warehouse into rail or water craft ,the amount of mixture, shall be numerated based on the same train or barge(craft).
7.4 Quantity of supplied mixture is determined by weight.
Mixture delivered by wagons or trucks shall be weighed on rail or by truck scales. Weight of cold mixture delivered by ship shall be determined by the draught
7.5 For checking of conformation of quality of mixture to the requirement of this specification, the periodic and hand-over tests shall be applied.
7.6 Quality control is determined according to GOST12801 with following characteristics:

- temperature of produced mixture;
- Grading and content of bitumen;
- water saturation;
- compressive strength at 50 °C, 20 °C and water resistance for hot mixtures;
- compressive strength at 20 °Cas well in water saturation and caking (2 times in shift) for cold mixtures.

7.7 Periodic monitoring shall be conducted at least once a month, also in each changing of materials used for preparation of mixtures. Uniformity of mixtures evaluated by coefficient variation in 5.1.13, designed on monthly bases or before volume chooses according to GOST 12801.
7.8 During periodic quality control mixtures are identified by the following characteristics:

- VMA;
- Air void;
- Water resistance after prolonged water saturation;
- Compressive strength at 20 ^{o}C after warm-up and prolonged saturation for cold mixes and at 0 ^{o} C for Hot mixture;
- Adhesion of bitumen with mineral mixture part;
- Index of displacement resistance and fracture strength;
- Uniformity of mixtures.

7.9 For each lot of mixture, the document on quality is issued for user, where the designation of standard and test results are mentioned, including:

- description of manufacturer;
- number and date of issued document;
- description and address of user;
- name, type and class of mixture;
- weight of mixture;
- retention cycle of cold mix;

- water resistance for hot mixtures;
- caking for cold mixtures;
- water saturation;
- water resistance after prolonged water saturation for hot mixtures;
- compressive strength: at 20 °C before warm-up and after warm-up for cold mixtures, at 50 °C and 0 °C for hot mixtures;
- air void and VMA ;
- displacement resistance with coefficient of internal friction and adhesion in displacement;
- fracture strength by tensile strength in rive at 0 °C and straining speed 50 mm/min;
- Specific effective activity of natural radionuclides.

When delivering of mixture to consumer, each vehicle shall be accompanied by the document, where mentioned:

- name of manufacturer;
- address and name of consumer;
- date and time of production;
- temperature of shipping mixture;
- type and quantity of mixtures.

7.10 Consumers have the right to control checking of mixture in compliance with this standard , while observing the sampling procedure established by standard GOST 12801-84 and using the test methods specified in GOST 12801.

8 Test methods

8.1 Mixtures are tested according to GOST 12801.
8.2 Quality of highly dense mixtures with crushed stone contents more than 70% are evaluated by grading and mixture components.

8.3 Crushed stone of gravel and rocks, crushed stone made of black and color metallurgy slag are tested ac
8.4 Natural sand and rock screenings are tested according to GOST 8735
8.5 Mineral powders are tested according to GOST 16557.

8.6 Bitumen is tested according to GOSTs 11501, 11503, 11508, 18180.

9 Transportation and storage

9.1 Hot and warm mixture is transported to the paving area by truck with docket accompanied in each trucks
9.2 Cold mixture is transported by trucks, rail wagons or barges with docket accompanied in each vehicle.
9.3 In summer, the cold mixture may be stored in the open air , in the autumn and winter - in losed warehouses or under a canopy in stacks

Storage period:

2 weeks – for mixtures prepared with bitumen SG 130/200, MG 130/200 and MGO 130/200;
4 months – for mixtures prepared with bitumen SG 70/130;
8 monthe – for mixtures prepared with bitumen MG 70/130 and MGO 70/130.

Annex A: Recommended asphalt Brand for surface course of highways and city streets

Climatic zone	Type of asphalt concrete	Road category					
		R_I& $_{II}$		R_{III}		R_{IV}	
		Class of mixture	Bitumen Brand	Class of mixture	Bitumen Brand	Class of mixture	Bitumen Brand
Z_I	Dense and Highly Dense	I	BND 90/130 BND 130/200 BND 200/300	II	BND 90/130 BND 130/200 BND 200/300 SG 130/200 MG 130/200 MGO 130/200	III	BND 90/130 BND 130/200 BND 200/300 SG 130/200 MG 130/200 MGO 130/200
Z_{II}& $_{III}$	Dense and highly dense	I	BND 40/60 BND 60/90 BND 90/130 BN 90/130	II	BND 60/90 BND 90/130 BND 130/200 BND 200/300 BN 60/90 BN 90/130 BN 130/200 BN 200/300	III	BND 60/90 BND 90/130 BND 130/200 BND 200/300 BN 60/90 BN 90/130 BN 130/200 BN 200/300 SG 130/200 MG 130/200 MGO 130/200
	Cold mixtures	-	-	I	SG 70/130 SG 130/200	II	SG 70/130 SG 130/200 MG 70/130 MG 130/200 MGO 70/130 MGO 130/200
Z_{IV}& $_V$	Dense	I	BND 40/60 BND 60/90 BND 90/130 BN 40/60 BN 60/90	II	BND 40/60 BND 60/90 BND 90/130 BN 40/60 BN 60/90 BN 90/130	III	BND 40/60 BND 60/90 BND 90/130 BN 40/60 BN 60/90 BN 90/130
	Cold mixtures	-	-	I	SG 70/130 SG 130/200	II	SG 70/130 SG 130/200 MG 70/130 MG 130/200 MGO 70/130 MGO 130/200

Note:
1. For highways and city streets mixture recommended for road category I and II shall be used; for roads of industrial districts road category III; for other streets and roads –recommended road category IV.
2. Bitumen of particular BN is recommended in mild climatic conditions, characterized with medium temperature of the coldest month above minus 10 °C.
3. Bitumen of particular BN 40/60 shall comply with the approved technical documentations.

Annex B: (recommended). Brand of asphalt used for construction of runway, taxiways and airfields

Climatic zone	Type of asphalt concrete	Road category					
		$R_{I, II, III}$		R_{IV}		R_V	
		Class of mixture	Bitumen particular	Class of mixture	Bitumen particular	Class of mixture	Bitumen particular
Z_I	Dense and highly dense	I	BND 90/130	II	BND 90/130	III	BND 90/130
Z_{II}&$_{III}$	Dense and highly dense	I	BND 60/90 BN 60/90 BND 90/130	II	BND 60/90 BN 60/90 BND 90/130	III	BND 60/90 BN 60/90 BND 90/130
Z_{IV}&$_V$	Dense	I	BND 40/60 BND 60/90 BND 90/130 BN 40/60 BN 60/90	II	BND 40/60 BND 60/90 BND 90/130 BN 40/60 BN 60/90	III	BND 40/60 BND 60/90 BND 90/130 BN 40/60 BN 60/90

Note:
1. Bitumen of particular BN is recommended in mild climatic conditions, characterized with medium temperature of the coldest month above minus 10 °C.
2. Bitumen of particular BN 40/60 shall comply with the approved technical documentations.

Annex C (recommended): Brand of asphalt used for construction and reconstruction of the Surface layers of taxiways, parking areas and apron of airfields

Climatic zone	Type of asphalt	Road category					
		$R_{I, II, III}$		R_{IV}		$R_{V, VI}$	
		Class of mixture	Bitumen particular	Class of mixture	Bitumen particular	Class of mixture	Bitumen particular
Z_I	Dense	I	BND 90/130	II	BND 90/130 BND 130/200	III	BND 90/130 BND 130/200
Z_{II}&$_{III}$	Dense	I	BND 60/90 BND 90/130 BN 60/90 BN 90/130	II	BND 60/90 BND 90/130 BND 130/200 BN 60/90 BN 90/130	III	BND 60/90 BND 90/130 BND 130/200 BN 60/90 BN 90/130 BN 130/200
Z_{IV}&$_V$	Dense	I	BND 40/60 BND 60/90 BND 90/130 BN 40/60 BN 60/90	II	BND 40/60 BND 60/90 BND 90/130 BN 40/60 BN 60/90	III	BND 40/60 BND 60/90 BND 90/130 BN 40/60 BN 60/90 BN 90/130

Note:
1. Bitumen of particular BN is recommended in mild climatic conditions, characterized with medium temperature of the coldest month above minus 10 °C.
2. Bitumen of particular BN 40/60 shall comply with the approved technical documentations

（註:ハイライト追加される）

Annex D (recommended): Rough content of bitumen in mixtures

Type of mixture	Content of bitumen(%)by weight
1 Hot mixture	
1-1 Highly Dense	4,0-6,0
1-2 Dense:	
A	4,5-6,0
B	5,0-6,5
C	6,0-7,0
D and E	6,0-9,0
1-3 porous	3,5-5,5
1-4-1 highly porous: crushed stone	2,5-4,5
1-4-2 highly porous: sandy	4,0-6,0
2. Cold mixture:	
Bx	3,5-5,5
Cx	4,0-6,0
Dx and Ex	4,5-6,5
- highly porous sandy	2,5-4,0

PD-4

Project for Improvement of Road Maintenance

Introduction to VIMS

01 April 2014
Prepared by the JICA Experts Team

CTI Engineering International Co., Ltd.
Consulting Engineers

The Importance of Road Condition Evaluation

Deterioration of pavement => accidents, inefficiency and time-loss
Road management based on pavement "ratio" => "quality"

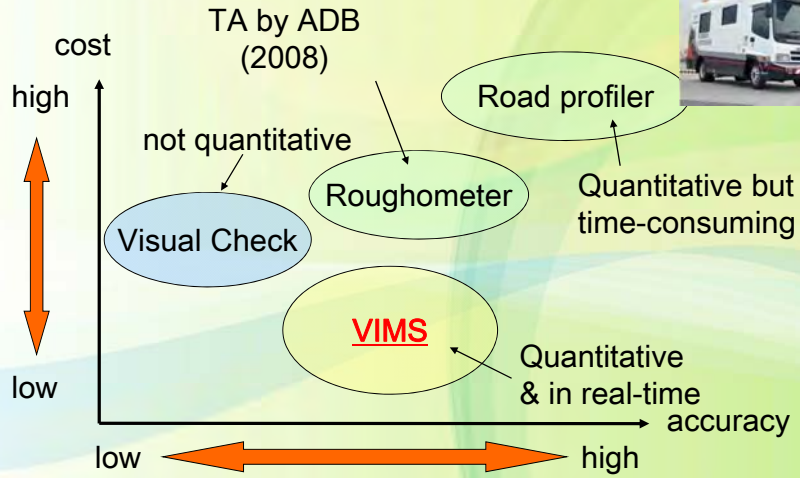
Current status of quality assessment: Subjective & Expensive
In Japan: visual inspection + profile measurement
In Tajikistan : mainly visual inspection

Subjective

Objective and inexpensive evaluation system for pavement condition are needed.

CTI Engineering International Co., Ltd.
Consulting Engineers

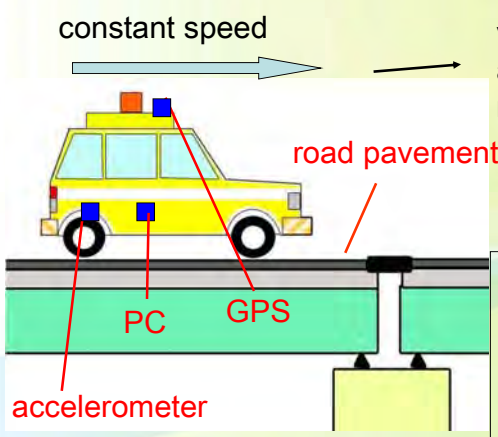
Vehicle Intelligent Monitoring System (VIMS)



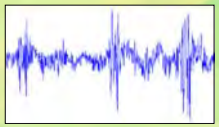
CTI Engineering International Co., Ltd.
Consulting Engineers

Vehicle Intelligent Monitoring System (VIMS)

VIMS is simple and inexpensive road monitoring system.



vertical acceleration response



IRI
(International Roughness Index)

- Proposed by World Bank in 1986.
- Quantitative measure of the comfort of ride in the vehicle
- Employed in road projects for quality evaluation
- Possible inputs for asset management & budget planning

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Consulting Engineers

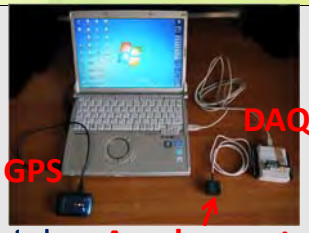
International Roughness Index

- One of the most popular statistics on road roughness evaluation is the international roughness index (IRI), which was developed and recommended by the World Bank to evaluate pavement roughness.
- IRI has been a widely used indicator for evaluating the ride quality of pavement.

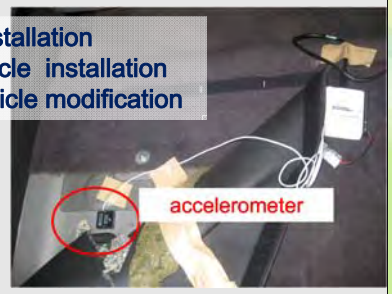
VIMS Configuration


Ordinary vehicle

- Compact
- Inexpensive
- Battery-operated



- Easy installation
  - in-vehicle installation
  - no vehicle modification



2. Basic Idea of VIMS

- How is IRI estimated? -

IRI Estimation

IRI : International Roughness Index

IRI can be estimated by using VIMS

Amplitude ratio function

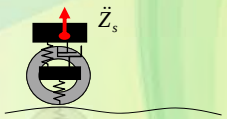
Linear regression

Acc. response → $TF(\omega)$ → **Acc RMS of quarter car** → Definition :

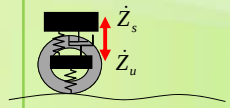
$$IRI = \left\{ \int_0^{L/V} \left| \dot{z}_s - \dot{z}_u \right| dt \right\} \Big/ L$$

L : evaluation road length
V : driving speed (80km/h)

Calibration
- Vehicle
- Drive speed

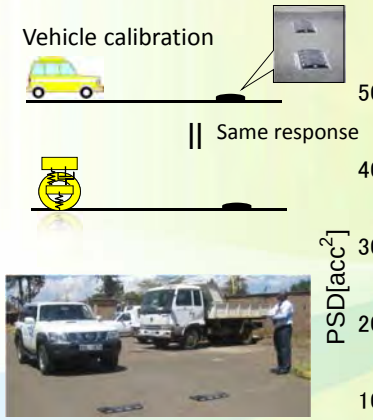


Standard Quarter Car

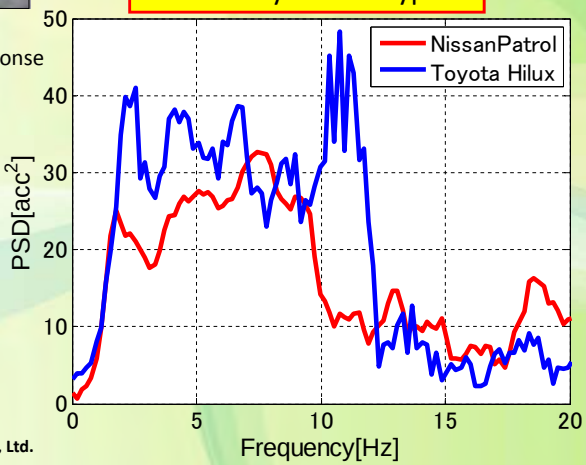


Standard Quarter Car

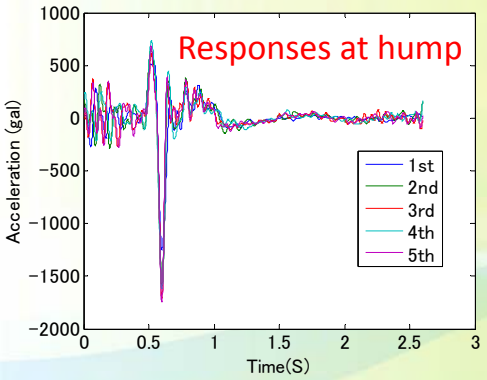
[Issue]
Difference of Vehicle response by Vehicle Type



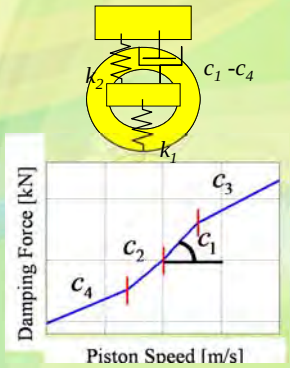
Vehicle response is quite different by vehicle type.



[Solution]
Hump Calibration (To Clarify Mechanical Properties of the Vehicle)



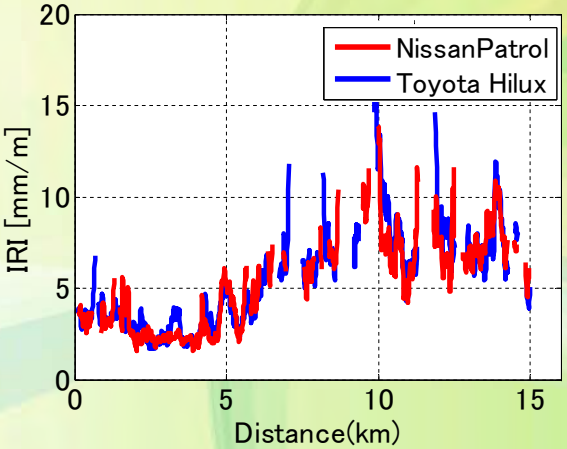
Non linear quarter car model



To enable any vehicles to be used for IRI estimation, hump calibration is conducted.

Mechanical properties of the vehicle

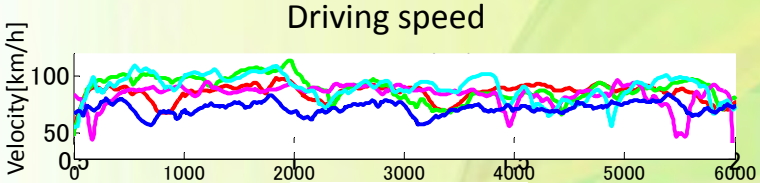
[Result]
Regardless of vehicle type, IRI can be estimated.



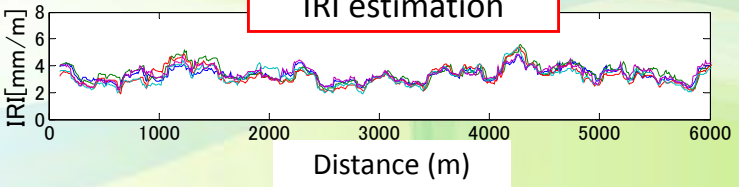
IRI estimation after hump calibration is almost same.

[Result]
Regardless of driving speed, IRI can be estimated.

Driving speed



IRI estimation



The variation in estimated IRI values is small.

IRI estimation by using VIMS is sufficient accuracy.

Performance Summary

	VIMS
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
Calculation time	<10 min for 100km

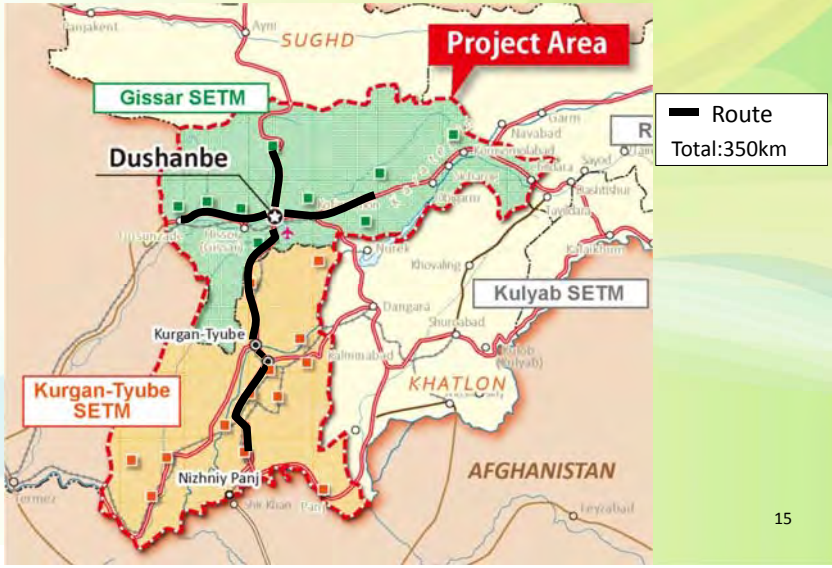
VIMS has been introduced to Kyrgyz, Viet Nam, Kenya and South Sudan.

2. VIMS Demonstration

CTI Engineering International Co., Ltd.
Consulting Engineers

VIMS Demonstration (11th ~ 15th March 2014)

VIMS demonstration was conducted and visit to introduce VIMS at Gissar SETM, Kurgan-Tyube SETM and 15 SEHMs



VIMS Demonstration (11th ~ 15th March 2014)




CTI Engineering International Co., Ltd.
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Vims sistem

GPS →

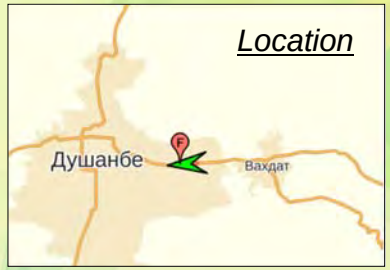
Accelerometer →

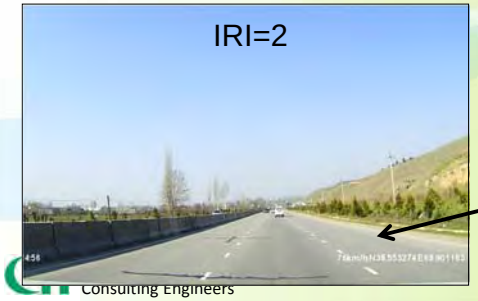
Data Acquisition Module DAQ →

Hump →

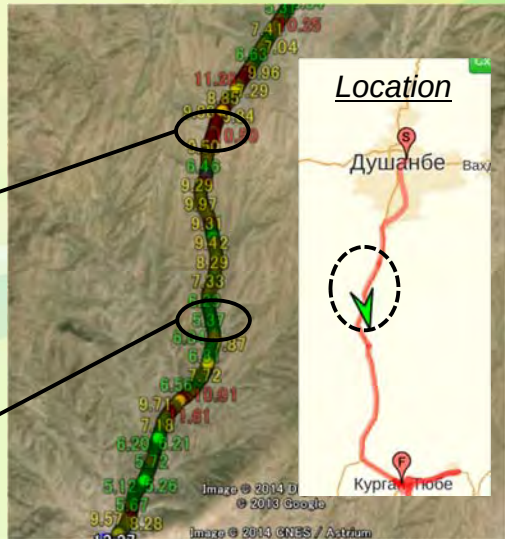
VIMS Output #1 (Vahdat Road)

IRI Value	Road Condition	
2.0<		Excellent
2.0 to 3.99		Good
4.0 to 6.99		Fair
7.0 to 10.0		Poor
>10.0		Bad
NaN or white No.		Out of Speed Range



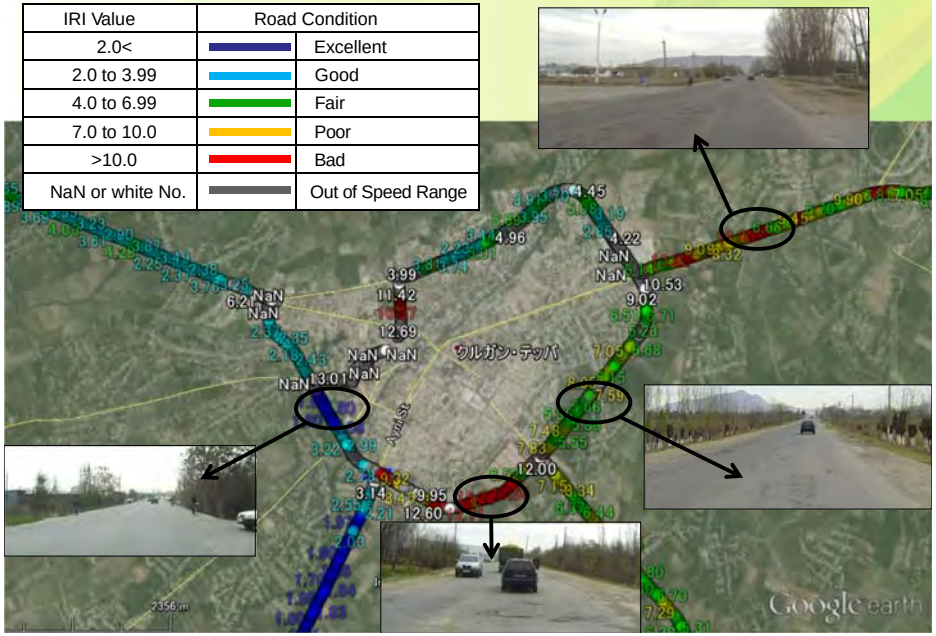


VIMS Output #2 (Kurgan Tube Road)



VIMS Output #3 (Kurgan Tube City)

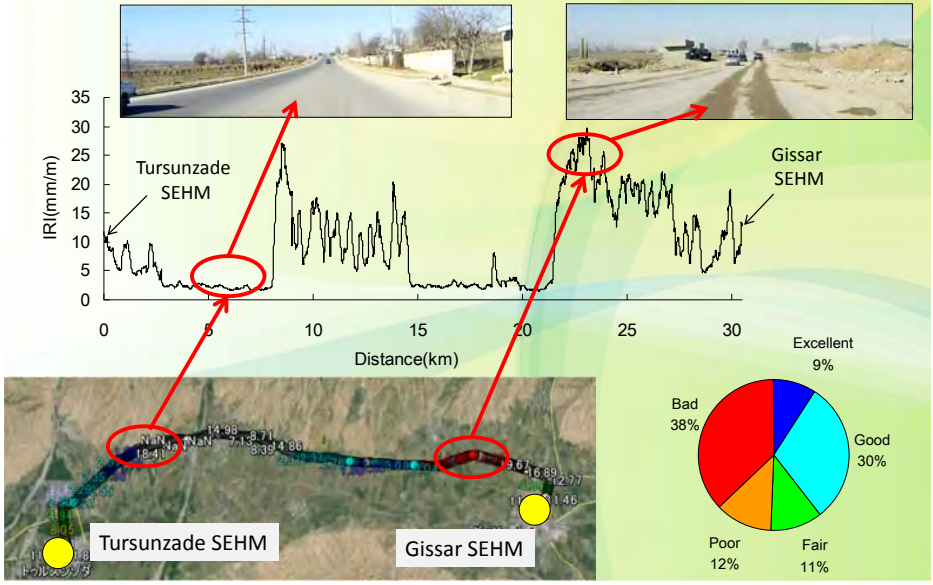
IRI Value	Road Condition	
2.0<		Excellent
2.0 to 3.99		Good
4.0 to 6.99		Fair
7.0 to 10.0		Poor
>10.0		Bad
NaN or white No.		Out of Speed Range



VIMS Output #4 (Tursunzade Road)

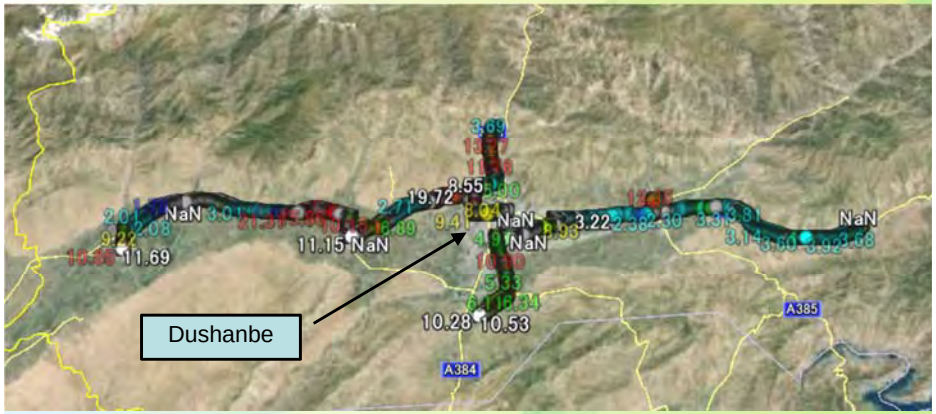
IRI Distribution

Gissar SEHM~ Tursunzade SEHM (L=32km)



VIMS Output #5 (Around Dushanbe)

IRI MAP



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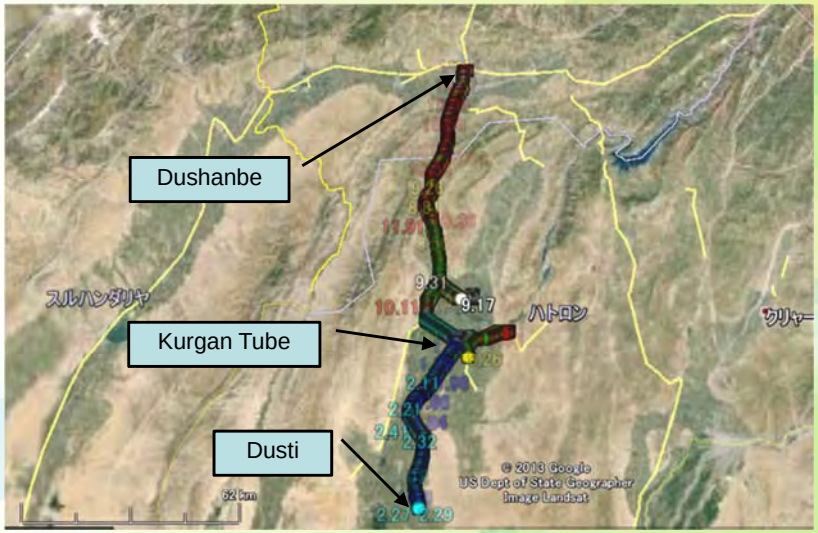
VIMS Output #6 (Dushanbe-Dusti Road)

IRI MAP



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Thank you for your attention!

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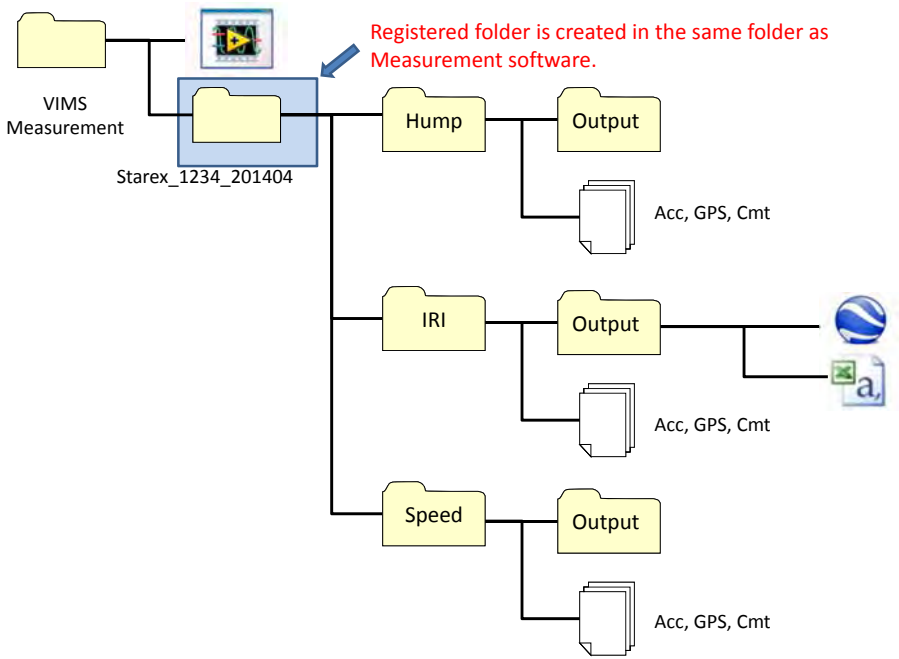
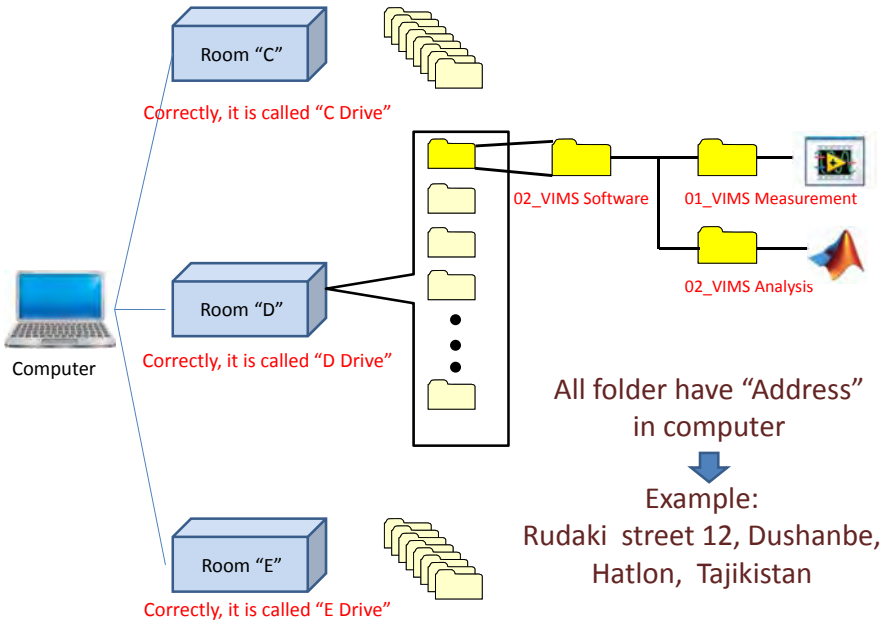


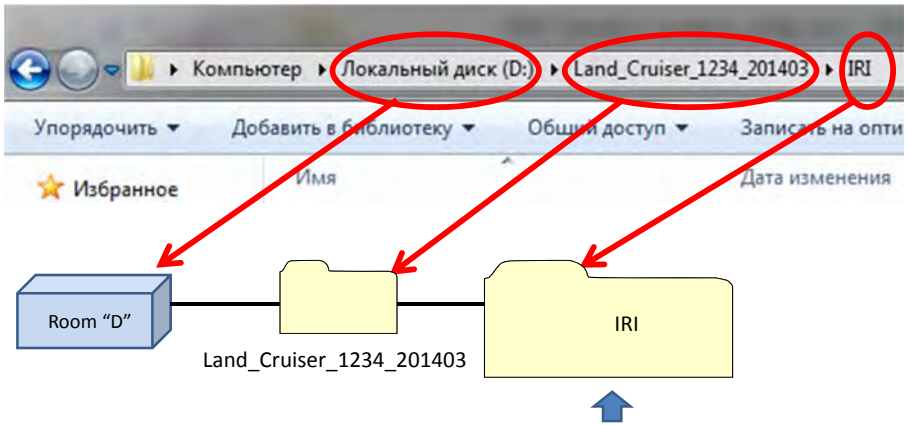
Computer Structure : That is to say, Computer is “Library”!!!!



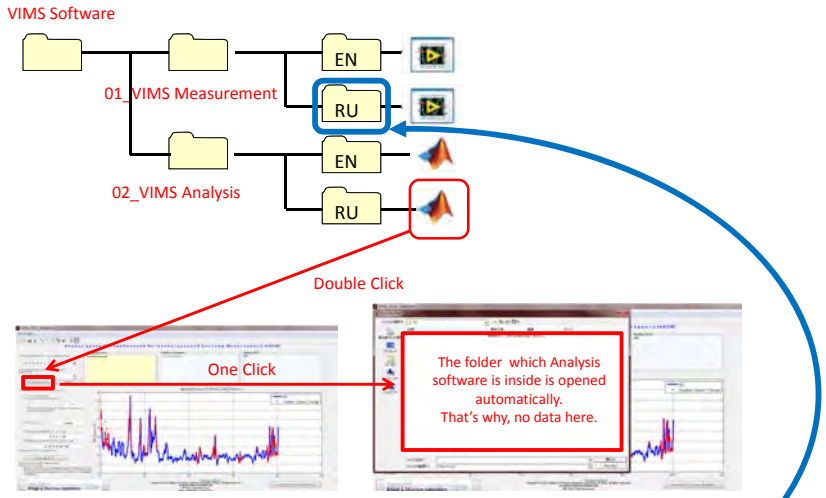
All folder have “Address” in computer

Example:
Rudaki street 12, Dushanbe,
Hatlon, Tajikistan

Address of folder is written here!



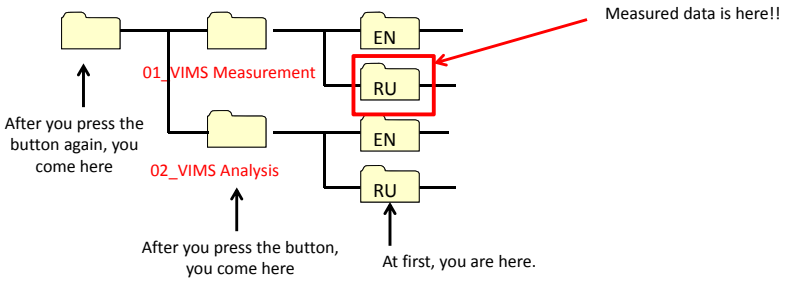
Now, you are looking inside “IRI” folder.



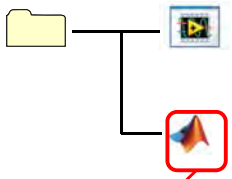
You can not find any data files here,
because this location is
“D/VIMS 02_VIMS Analysis/RU”.
Measured data files are saved in
“D/VIMS 01_VIMS Measurement/RU”
(Same as VIMS Measurement software!)

To move to data folder, use below button.

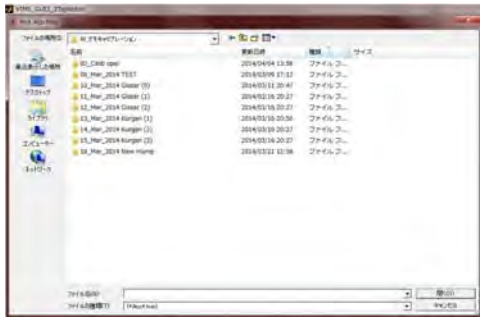
Once you select this button, you can move up to one layer



If you arrange the software files like below…



Double Click



In this case, no need go to another folder because measured files are in the same folder as Analysis folder.

Проект по улучшению содержания дорог

Visual Inspection Training

5 June 2014

Prepared by the JICA Experts Team

Use of Form 1

Form 1 combines information from IRI measurement and visual inspection. Visual inspection covers Crack Rate and Pothole Rank.

General Information

100 Interval Form | Average IRI | Visual Inspection Result | Other Information

Проект по улучшению содержания дорог

Why, cracking ratio, potholes are necessary?

(1) IRI is an indication of the ride.

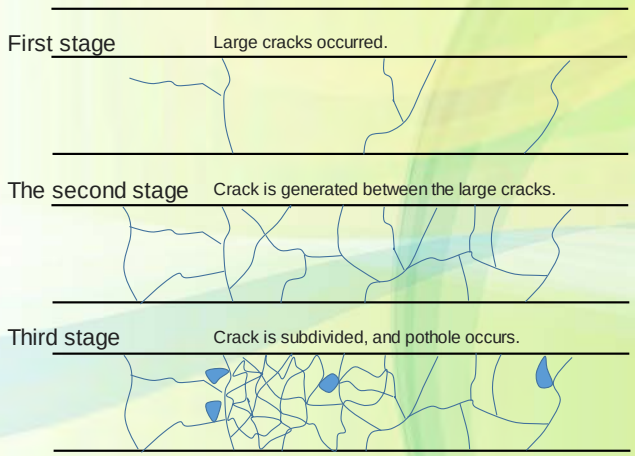
(2) Quality of the pavement structure is evaluated by cracks.

(3) Durability of pavement is determined by the crack.

(4) Potholes are an extreme condition of the pavement.

Проект по улучшению содержания дорог

Progress of the crack



Use of Form 1

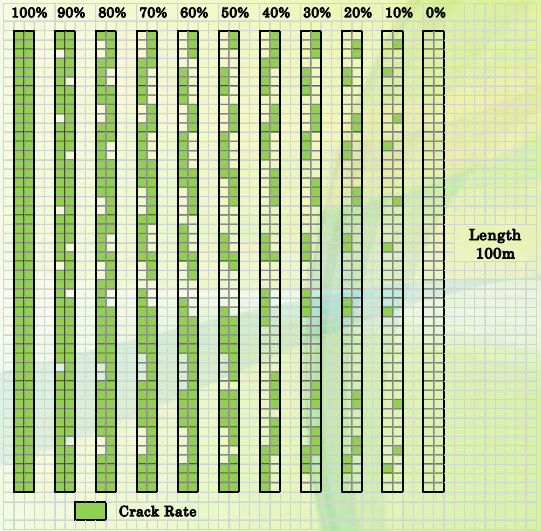
Example of Form 1

No	Раздел (КС) НАЧАЛО		~	КОНЕЦ		Ориентиро	Шероков МИШ (mm/m)		Пропорция трещины (%)	Категория выбоины (A,B,C)	Тип покрытия (AS,Gr,Eth)	Год строительства	Ремонт в прошлом Год месяц	Наименование	Примечание
301	15 КС	0	~	15 КС	100		3.22		60		AS				
302	15 КС	100	~	15 КС	200		4.53		80		AS				
303	15 КС	200	~	15 КС	300		9.11		80	C	AS				
304	15 КС	300	~	15 КС	400		12.33		100	C	AS				
305	15 КС	400	~	15 КС	500		11.23		100	C	AS				
306	15 КС	500	~	15 КС	600		6.13		70		AS				
307	15 КС	600	~	15 КС	700		9.26		100		AS				
308	15 КС	700	~	15 КС	800		10.06		100	B	AS				
309	15 КС	800	~	15 КС	900		3.78		40	B	AS				
310	15 КС	900	~	16 КС	0		3.09		30		AS				
311	16 КС	0	~	16 КС	100		3.40		20		AS				
312	16 КС	100	~	16 КС	200		3.86		10		AS				
313	16 КС	200	~	16 КС	300		3.89		0		AS				
314	16 КС	300	~	16 КС	400		4.80		50		AS				
315	16 КС	400	~	16 КС	500		7.11		30	A	AS				
316	16 КС	500	~	16 КС	600		6.31		100	A	AS				
317	16 КС	600	~	16 КС	700		3.83		30		AS				
318	16 КС	700	~	16 КС	800		3.68		20		AS				
319	16 КС	800	~	16 КС	900		3.59		50		AS				
320	16 КС	900	~	17 КС	0		3.84		60		AS				

Visual Inspection Result

Проект по улучшению содержания дорог

Crack Rate



Проект по улучшению содержания дорог

Crack Rate 10%

Проект по улучшению содержания дорог

Crack Rate 20%

Проект по улучшению содержания дорог

Crack Rate 30%

Проект по улучшению содержания дорог

Crack Rate 40%

Проект по улучшению содержания дорог

Crack Rate 50%

Проект по улучшению содержания дорог

Crack Rate 60%

Проект по улучшению содержания дорог

Crack Rate 70%

Проект по улучшению содержания дорог

Crack Rate 80%

Проект по улучшению содержания дорог

Crack Rate 90%

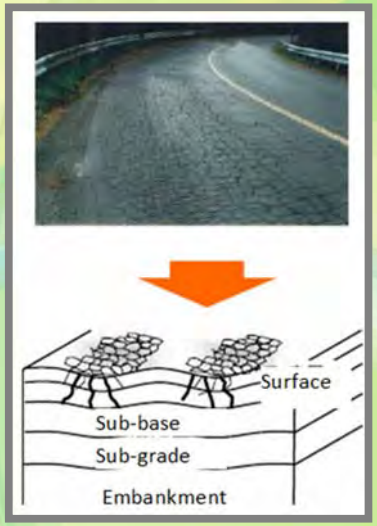
Проект по улучшению содержания дорог

Crack Rate 100%

Daily Inspection

Pothole is resulted from a damage or base course.

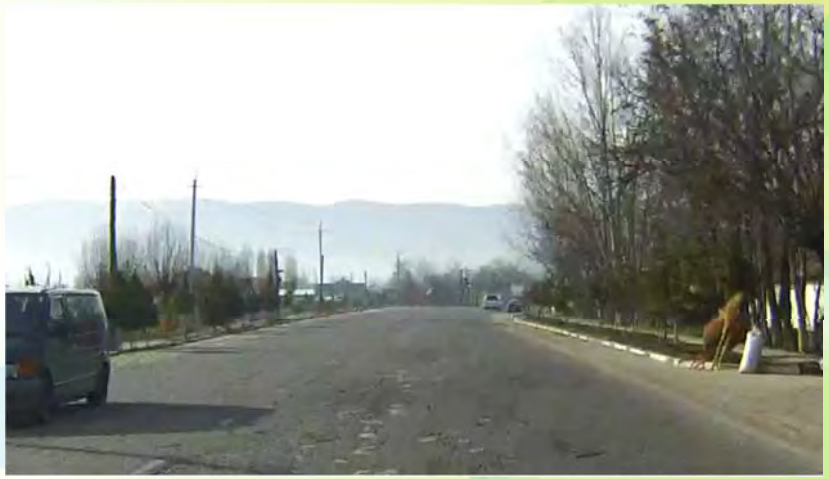
Blank	No Pothole	No pothole neither no repair patching
A	Few Potholes	1 to 5 potholes or patching per 100m
B	Several Potholes	More than 10 potholes or patching per 100m
C	Many Potholes	More than 20 potholes or patching per 100m



Pothole Rank A

Pothole Rank B

Pothole Rank C



Notes

(1) We evaluate patching and potholes as equivalent.

(2) If you leave pot holes, damage on pavement accelerates.

(3) You need to repair potholes urgently.

Example

Example 1 (0m point)

No	Раздел (КС)								
	НАЧАЛО				~	КОНЕЦ			
304	15	КС	+	300	~	15	КС	+	400

Crack Rate;100% Pothole Rank;A

Example 1 (25m point)

Crack Rate;100% Pothole Rank;B

Example 1 (50m point)

Crack Rate;100% Pothole Rank;A

Example 1 (75m point)

Crack Rate;100% Pothole Rank;C

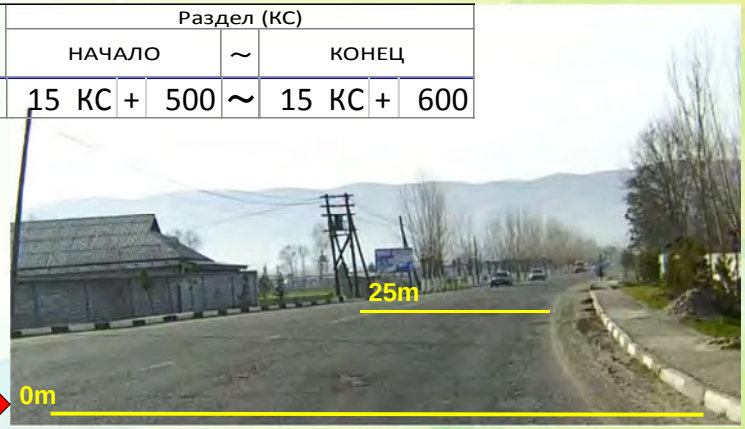
Example 1 Overall judgment

Шерохов МИШ (mm/m)		Пропорция трещины (%)	Категория выбоины (A,B,C)	Тип покрытия (AS,Gr,Eth)
4.53		80		AS
9.11		80	C	AS
12.33		100	C	AS
11.23		100	C	AS
6.13		70		AS
9.26		100		AS

Crack Rate;100% Pothole Rank;C

Example 2 (0m point)

No	Раздел (КС) НАЧАЛО			~	КОНЕЦ		
306	15 КС	+	500	~	15 КС	+	600



Crack Rate;100% Pothole Rank;C

Example 2 (25m point)

Crack Rate;80% Pothole Rank;A

Example 2 (50m point)

Crack Rate;80% Pothole Rank;A

Example 2 (75m point)

Crack Rate;40% Pothole Rank;Blank

Example 3 Overall judgment

Шерохов МИШ (mm/m)		Пропорция трещины (%)	Категория выбоины (A,B,C)	Тип покрытия (AS,Gr,Eth)
11.23		100	C	AS
6.13		70	C	AS
9.26		100		AS
10.06		100	B	AS
3.78		40	B	AS
3.09		30		AS

Crack Rate;70% Pothole Rank;C

Проект по улучшению содержания дорог

Example 3 (0m point)

No	Раздел (КС)								
	НАЧАЛО				~	КОНЕЦ			
310	15	КС	+	900	~	16	КС	+	0

Crack Rate;40% Pothole Rank;Blank

Проект по улучшению содержания дорог

Example 3 (25m point)

Crack Rate;20% Pothole Rank;Blank

Проект по улучшению содержания дорог

Example 3 (50m point)

Crack Rate;20% Pothole Rank;Blank

Проект по улучшению содержания дорог

Example 3 (75m point)

Crack Rate;20% Pothole Rank;Blank

Example 3 Overall judgment

Шерохов МИШ (mm/m)		Пропорция трещины (%)	Категория выбоины (A,B,C)	Тип покрытия (AS,Gr,Eth)
3.78		40	B	AS
3.09		30		AS
3.40		20		AS
3.86		10		AS
3.89		0		AS
4.80		50		AS

Crack Rate;30% Pothole Rank;Blank

Example 4 (0m point)

No	Раздел (КС) НАЧАЛО	~	КОНЕЦ
314	16 КС + 300	~	16 КС + 400

Crack Rate;80% Pothole Rank;Blank

Example 4 (25m point)

Crack Rate;60% Pothole Rank;A

Example 4 (50m point)

Crack Rate;60% Pothole Rank;Blank

Example 4 (75m point)

Crack Rate;70%　Pothole Rank;A

Example 4　Overall judgment

Шерохов МИШ (mm/m)		Пропорция трещины (%)	Категория выбоины (A,B,C)	Тип покрытия (AS,Gr,Eth)
3.86		10		AS
3.89		0		AS
4.80		70	B	AS
7.11		30	A	AS
6.31		100	A	AS
3.83		30		AS

Crack Rate;70%　Pothole Rank;B

Notes

(1) It is the overall evaluation of 100m.

(2) Visual observation from the car is different, please grasp the feeling of thumb.

(3) Some errors are inevitable.

(4) Please also take advantage of the cyclic memory of every day.

You fill out a field of Form1 the results of the inspection.

How to use the FORM1?

Use of Form 1

Example of Form 1

No	Раздел (КС) НАЧАЛО	~	КОНЕЦ	Ориентиро	Шерохов МИШ (mm/m)		Пропорция трещины (%)	Категория выбоины (A,B,C)	Тип покрытия (AS,Gr,Eth)	Год строительства	Ремонт в прошлом Год месяц	Наименование	Примечание
301	15 КС + 0	~	15 КС + 100		3.22		60		AS				
302	15 КС + 100	~	15 КС + 200		4.53		80		AS				
303	15 КС + 200	~	15 КС + 300		9.11		80	C	AS				
304	15 КС + 300	~	15 КС + 400		12.33		100	C	AS				
305	15 КС + 400	~	15 КС + 500		11.23		100	C	AS				
306	15 КС + 500	~	15 КС + 600		6.13		70		AS				
307	15 КС + 600	~	15 КС + 700		9.26		100		AS				
308	15 КС + 700	~	15 КС + 800		10.06		100	B	AS				
309	15 КС + 800	~	15 КС + 900		3.78		40	B	AS				
310	15 КС + 900	~	16 КС + 0		3.09		30		AS				
311	16 КС + 0	~	16 КС + 100		3.40		20		AS				
312	16 КС + 100	~	16 КС + 200		3.86		10		AS				
313	16 КС + 200	~	16 КС + 300		3.89		0		AS				
314	16 КС + 300	~	16 КС + 400		4.80		50		AS				
315	16 КС + 400	~	16 КС + 500		7.11		30	A	AS				
316	16 КС + 500	~	16 КС + 600		6.31		100	A	AS				
317	16 КС + 600	~	16 КС + 700		3.83		30		AS				
318	16 КС + 700	~	16 КС + 800		3.68		20		AS				
319	16 КС + 800	~	16 КС + 900		3.59		50		AS				
320	16 КС + 900	~	17 КС + 0		3.84		60		AS				

Repair candidate position

PD-5

Project for Improvement of Road Maintenance

Pavement Inspection Guideline 2016

October 2016

Prepared by the JICA Experts Team

Outline of the Guideline

Background of the Project and Development of Pavement Inspection Guideline

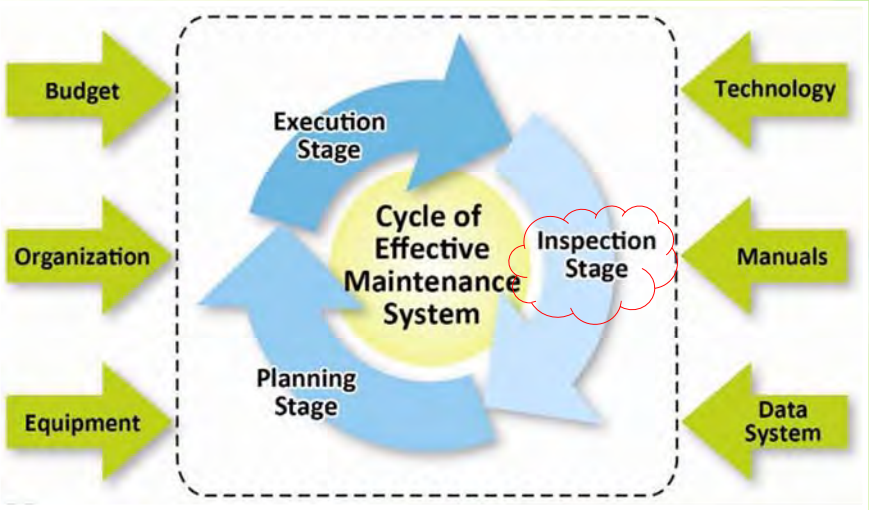
The Pavement Inspection Guideline 2016 was devellopped through "the Project for the Capacity Building of Road Maintenance" from 2013 to 2016. The project was targeted Gissar and Kurugan Tyube SETM regions. While the project had two objectives; 1. improvement of pavement inspection capacity, 2 improvement of pavement repair capacity, the guideline is the output of the 1st objective.

The guideline was finalized through the On-the-Job training of the area and adjusted to make it practical as possible considering to the availability and basic skill of the users. Through the project, 19 engineers have completed the training and 8 of them were certified as the Master Trainers.

Outline of the Guideline

1. Pavement Inspection Guideline

Project Concept



How road inspection can be improved

Technology	Introduction of 2 indices	(1) IRI (International Roughness Index) (2) RRI (Road Repair Index)
Manuals	Pavement Inspection Guideline	Including DRIMS manual and virtual kilo post map
Data System	KML files (google earth) Forms (excel) Virtual Kilo Post Map File saving roles	Form 1 for pavement condition assessment Form 2 for cost estimation by SEHM Form 3 for summary of SETM
Equipment	DRIMS	for measurement of IRI
Organization	Master Trainers	
Budget	Cost estimation method using inspection result	Standard unit price

Contents of the Final Version

Structure of Pavement Inspection Guideline

- Pavement Inspection Method
- Evaluation Method
- Pavement Maintenance Planning Method

Appendix 1: Inspection Result Recording Forms
Appendix 2: Pavement Distress Photo Album
Appendix 3: Samples of use of pavement inspection result
Appendix 4: Road Management Map
Appendix 5: Sample of pavement maintenance plan
Appendix 6: Cost Breakdown

Attachment-1: DRIMS* Operation Guideline
Attachment-2: Virtual Kilo Post Map

Two Indices (IRI)

IRI : International Roughness Index

Ride comfort is Good → IRI =Low

Ride comfort is Bad → IRI =High

Two Indices (RRI)

RRI : Road Repair Index

- **RRI = <u>IRI value</u> x <u>Visual Inspection Result</u>**

↑ ↑

It comes from IRI Measurement result. It depends on visual inspection result (1.0-1.56).

- RRI is the index considering visual inspection result by the inspector on the site.

Priority for Road for Maintenance

BAD Road condition GOOD

Traffic volume HIGH LOW

Traffic Volume	Example	corresponding VSN10-78 score	Repair Requirement Index				
			More than 12	12-10	10 to 7	7 to 5	Less than 5
			Very Urgent	Urgent	Routine	Routine	Monitoring
			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	

Relation between Pavement Inspection and Pavement Repair

Pavement Inspection Stage

1. IRI Measurement by using automatic road roughness measurement tool (DRIMS)
2. Data recording in specific sheet (Form 1)
3. Visual inspection
4. Data recording in specific sheet (Form 1)
5. Maintenance plan and Budgeting (Form 2 and 3)

Pavement Repair Stage

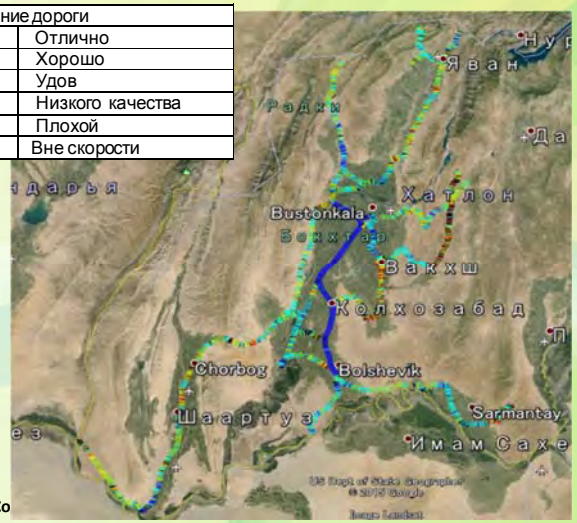
6. Material procurement and repair work

Inspection Result Integration into Form 1

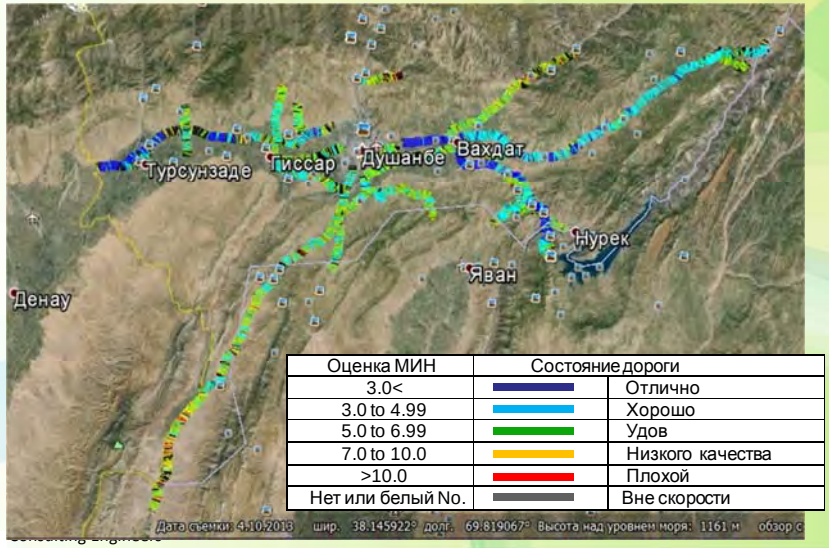
Methodology	IRI Measurement	Visual Inspection
Purpose	To measure IRI	To inspect road deterioration
Inspection Result	IRI value	Crack rate, Pothole rank
Data Integration	All inspection results are summarized in the specific form, called "**Form 1**".	

Example 1
IRI Measurement Result

Оценка МИН	Состояние дороги	
3.0<		Отлично
3.0 to 4.99		Хорошо
5.0 to 6.99		Удов
7.0 to 10.0		Низкого качества
>10.0		Плохой
Нет или белый No.		Вне скорости

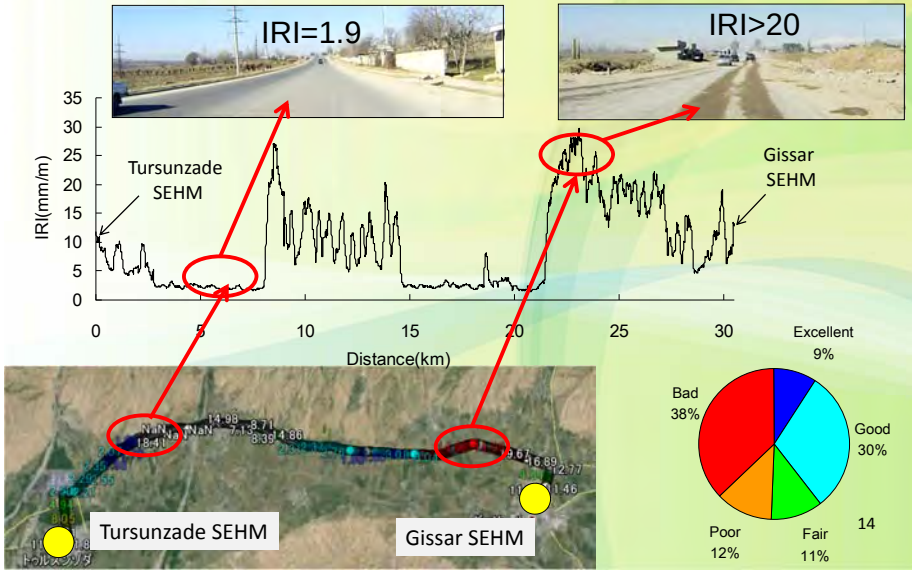


Example 1
IRI Measurement Result

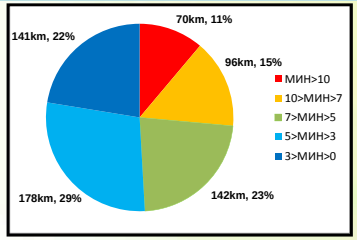


Оценка МИН	Состояние дороги	
3.0<		Отлично
3.0 to 4.99		Хорошо
5.0 to 6.99		Удов
7.0 to 10.0		Низкого качества
>10.0		Плохой
Нет или белый No.		Вне скорости

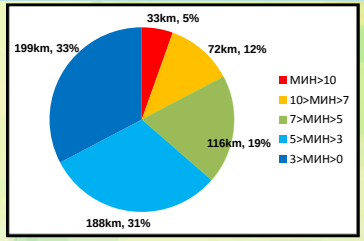
Example 2
Road Condition Evaluation by IRI



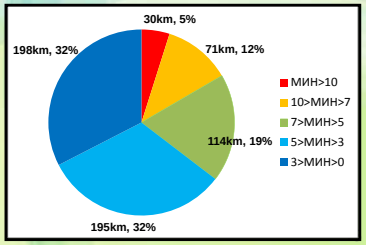
Example3: Improvement of Road since 2014 (Gissar SETM)



2014



2015



2016

Example 4
Detailed Information from Form 1

Рудаки-01 / Rudaki-01 — Форма 1

No	Раздел (КС) From	~	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)	Коэф.трещин α Crack Correction α	Коэф.выбоин β Pothole Correction β	ИРР =МИШ^α*β RRI =IRI^α*β	Год строительства Construction Year	Ремонт в прошлом Repair History: Год месяц Year Month	Наименование Work Item	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				

Example 5
Cost Estimation (Standard Price)

No	Repair method	Specification	Unit	Unit Price	Remark
1	Hot mix AC overlay	60/90, force account	Somoni/m2 (t=50mm) Somoni/ton	48 381	AP produced including transport 100km
2	Cold mix AC overlay	70/130, force account	Somoni/m2 (t=50mm) Somoni/ton	37 293	AP produced including transport 100km
3	Cold mix AC patching (AP produced)	70/130, force account	Somoni/m2 (t=50mm) Somoni/ton	36 288	AP produced including transport 100km
4	Cold mix AC patching (Manual produced)	70/130, force account	Somoni/m2 (t=50mm) Somoni/ton	28 228	Manual produced at SEHM (including transport 100km)

Example 5
Cost Estimation (Gissar SETM)

	Estimated Cost (Somoni)	km	Som/km	19-Aug-16
Rudaki / Рудаки		175	0	
Gissar / Хисор	582,120	70	8,316	
Shaharinav / Шахринав	134,400	25	5,376	
Tursandoza / Турсунзода	0	27	0	
Vahdat / Вахдат	1,825,880	110	16,599	
Varzov / Варзоб	793,900	63	12,602	
Norak / Норак	880,600	67	13,143	
Fayzobod / Файзобод	33,600	52	646	
Rogun / Рогун	545,600	34	16,047	
	4,796,100	623	7,698	Somoni
Участок ИПР>12	888,167		1,426	$

Example 6
Verification of pavement condition

Road Name	**Ulchaboev-Vahdat (Vah-05)**	
Repair work	Overlay	
Length	230m x 6m x 4cm	
Measuring time	2014 August	2015 April
IRI MAP		
Average IRI of PP#1 section	Not measurable (too bad)	3~5

DRIMS: Dynamic Response Monitoring System

2. IRI Measurement
DRIMS: Dynamic Response Monitoring System

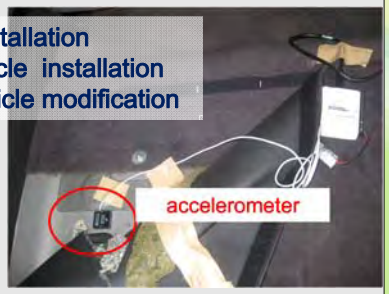
DRIMS: Dynamic Response Monitoring System

Ordinary vehicle

- Compact
- Inexpensive
- Battery-operated

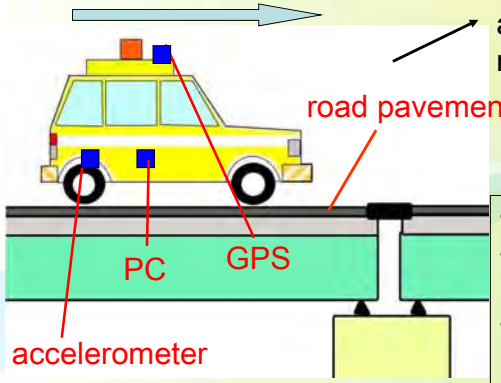
Accelerometer

- Easy installation
  - in-vehicle installation
  - no vehicle modification

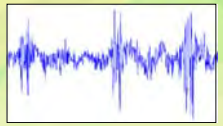


DRIMS: Dynamic Response Monitoring System

DRIMS is simple and inexpensive road monitoring system.



vertical acceleration response



IRI
(International Roughness Index)

- Proposed by World Bank in 1986.
- Quantitative measure of the ride comfort in the vehicle
- Adopted in road projects for quality evaluation
- Possible inputs for asset management & budget planning

CTI Engineering International Co., Ltd.
Consulting Engineers

DRIMS: Dynamic Response Monitoring System

Amplitude ratio function

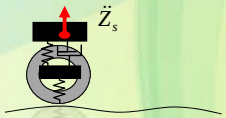
Linear regression

Acc. response → $TF(\omega)$ → **Acc RMS of quarter car** → Definition:

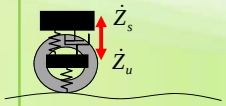
$$IRI = \left\{ \int_0^{L/V} |\dot{z}_s - \dot{z}_u| \, dt \right\} \Big/ L$$

L : evaluation road length
V : driving speed (80km/h)

Calibration
- Vehicle
- Drive speed



Standard Quarter Car



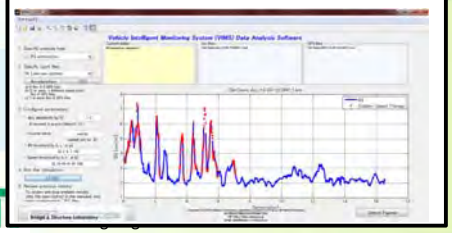
Standard Quarter Car

CTI Engineering International Co., Ltd.
Consulting Engineers

DRIMS: Dynamic Response Monitoring System

1. Measurement

2. Analysis



3. Output

DRIMS: Dynamic Response Monitoring System

DRIMS Performance Summary

	DRIMS
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
Calculation time	<10 min for 100km

DRIMS has been introduced to Japan, Kyrgyz, Viet Nam, Kenya and South Sudan.

DRIMS: Dynamic Response Monitoring System

DRIMS Setup and Operation Check

DRIMS: Dynamic Response Monitoring System

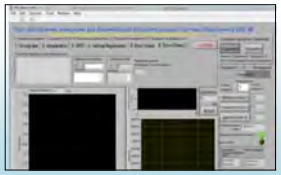
Set of Software

No.	Name	Icon	Description
1	VIMS Measurement		◆ For measuring GPS data and acceleration data
2	DRIMS Analysis		◆ For analyzing acceleration data and calculating IRI
3	Google Earth		◆ For visual checking of IRI on Google Earth ◆ Available when in connection to internet

DRIMS: Dynamic Response Monitoring System

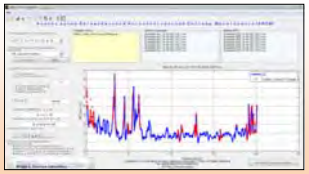
Measurement

1. Hump Calibration Data
2. Speed Calibration Data
3. Road Roughness Data



Analysis

1. Hump Calibration
2. Speed Calibration
3. IRI Estimation



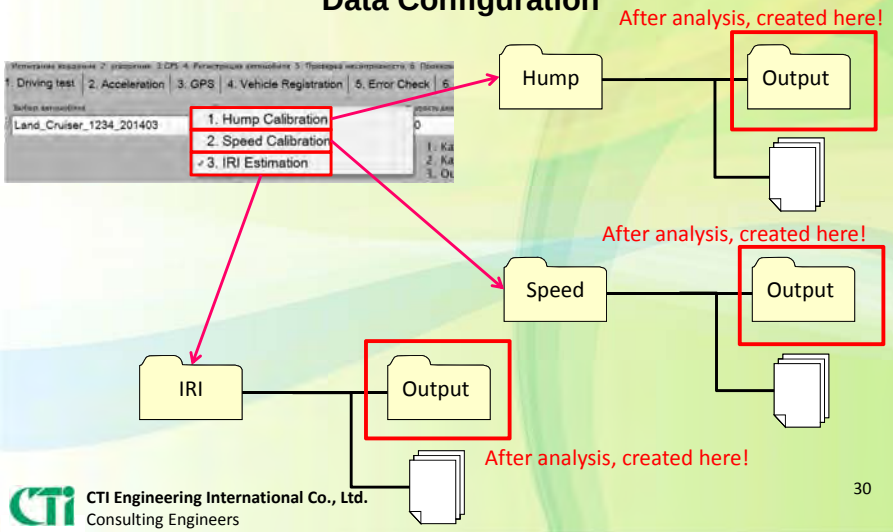
Procedure for IRI Estimation

Sedan: IRI value is big
4WD : IRI value is small
→ 1 Hump Calibration → Spring and damping property

Slow speed : IRI value is big
High speed : IRI value is small
→ 2 Speed Calibration → Speed property

3 IRI Estimation
Acceleration Data → Spring and damping property + Speed property → IRI

Data Configuration



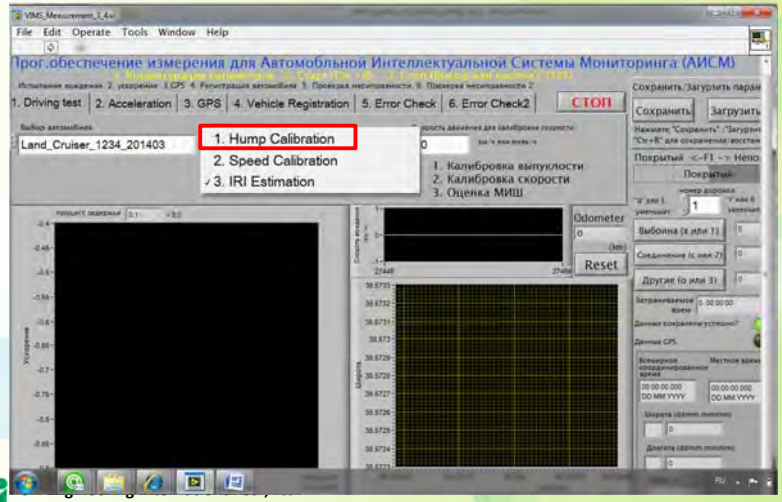
Hump Calibration

Hump Calibration is following 2 steps.

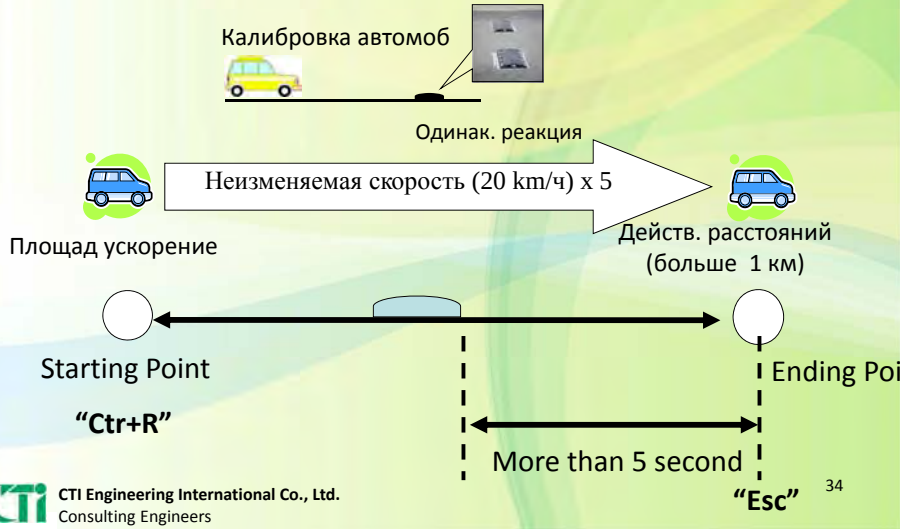
1. Measurement by using 
2. Analysis of measured data by using 

DRIMS: Dynamic Response Monitoring System

Measurement for Hump Calibration



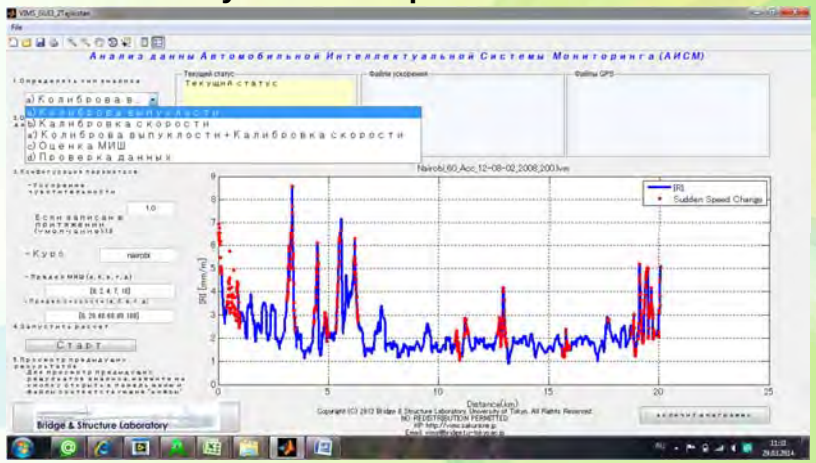
DRIMS: Dynamic Response Monitoring System



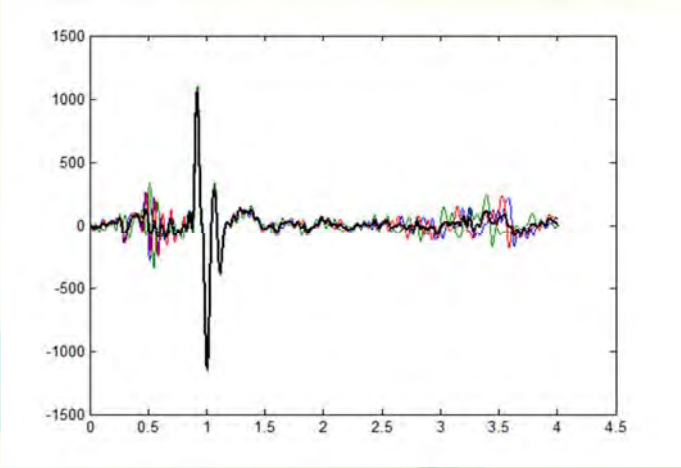
DRIMS: Dynamic Response Monitoring System

DRIMS: Dynamic Response Monitoring System

Analysis for Hump Calibration



Spring Characteristic of Vehicle



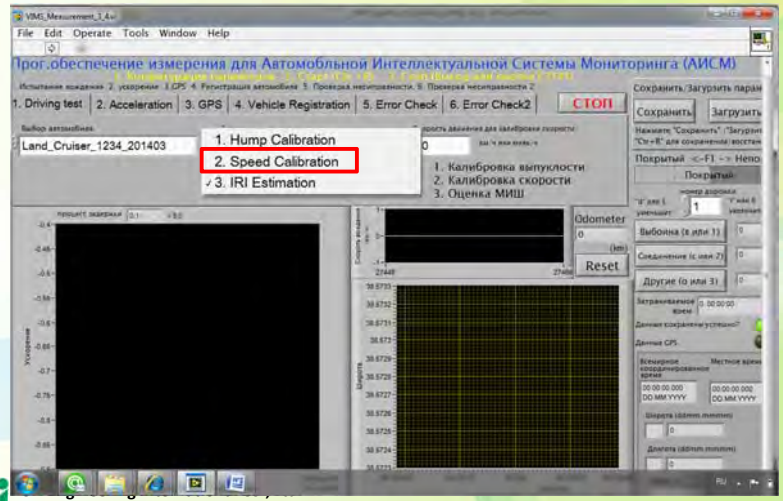
Speed Calibration

Speed Calibration is following 2 steps.

1. **Measurement by using**

2. **Analysis of measured data by using**

Speed Calibration



DRIMS: Dynamic Response Monitoring System

Измерение на скорость.

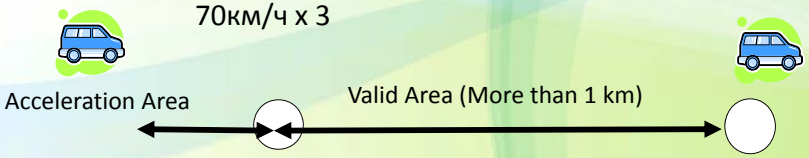
30км/ч x 3

40км/ч x 3

50км/ч x 3

60км/ч x 3

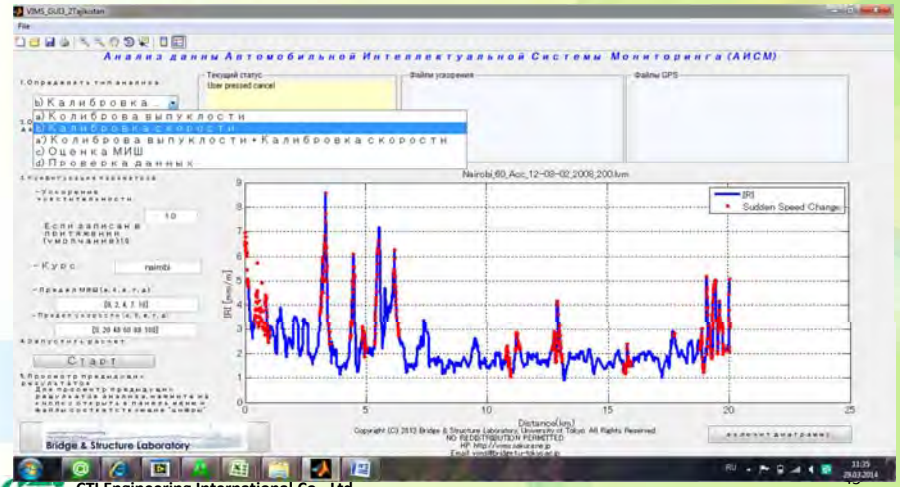
70км/ч x 3



DRIMS: Dynamic Response Monitoring System

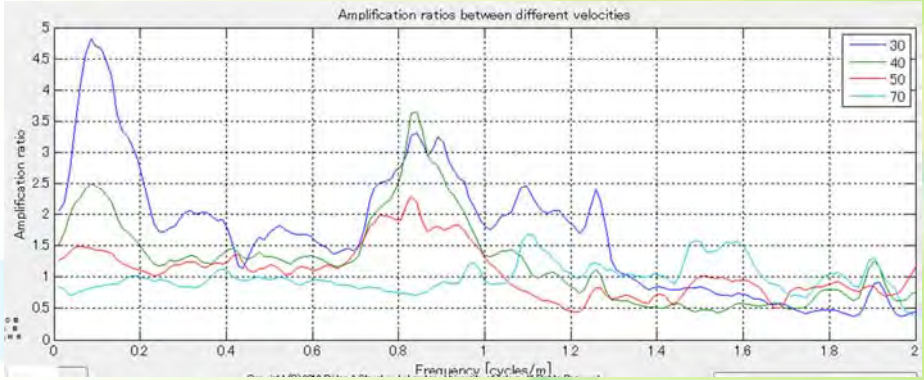
DRIMS: Dynamic Response Monitoring System

Analysis for Speed Calibration



DRIMS: Dynamic Response Monitoring System

Speed Characteristic of Vehicle



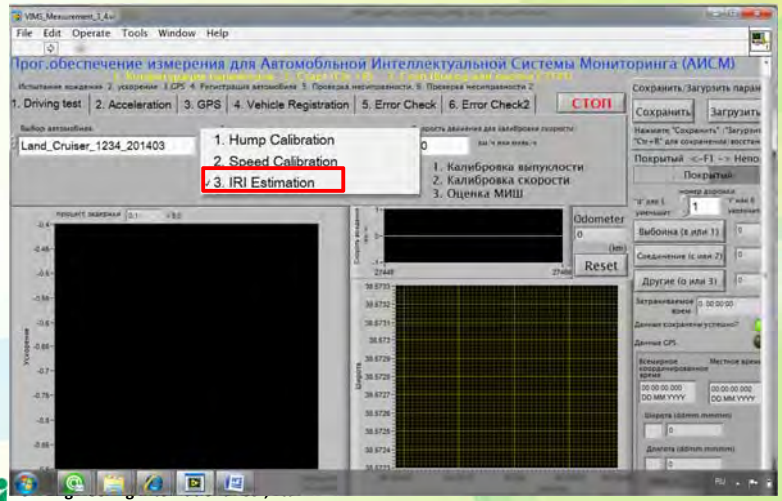
IRI Estimation

Speed Calibration is following 2 steps.

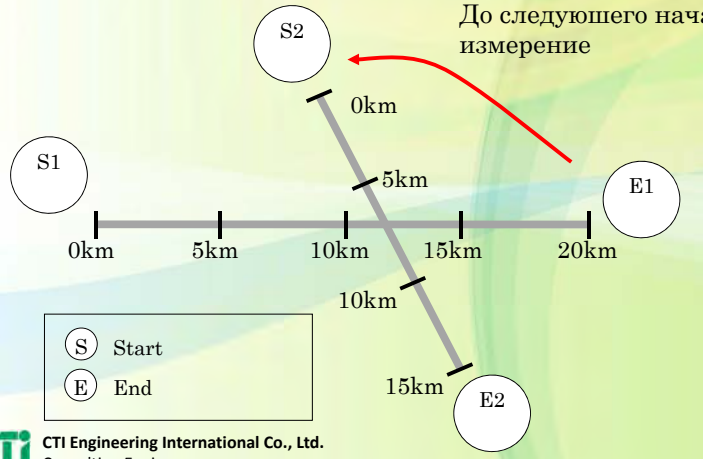
1. **Measurement by using** 

2. **Analysis of measured data by using** 

IRI Estimation



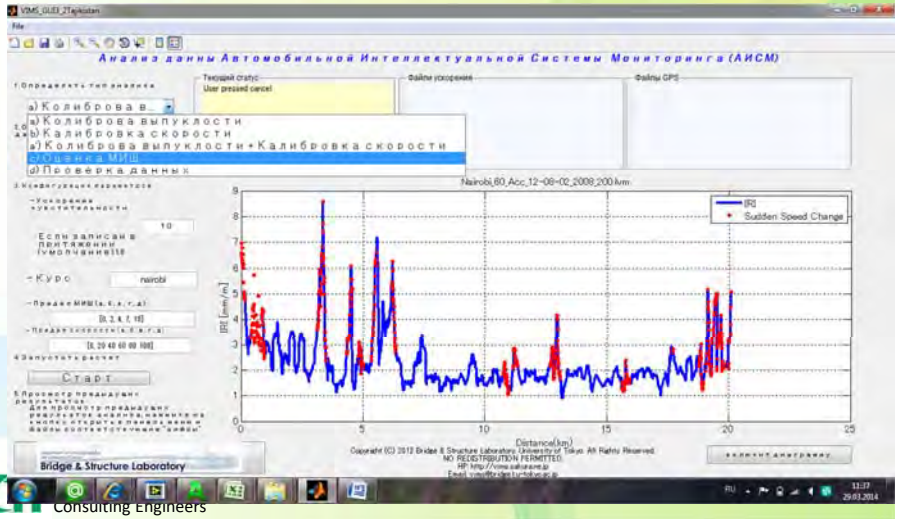
IRI Measurement



DRIMS: Dynamic Response Monitoring System

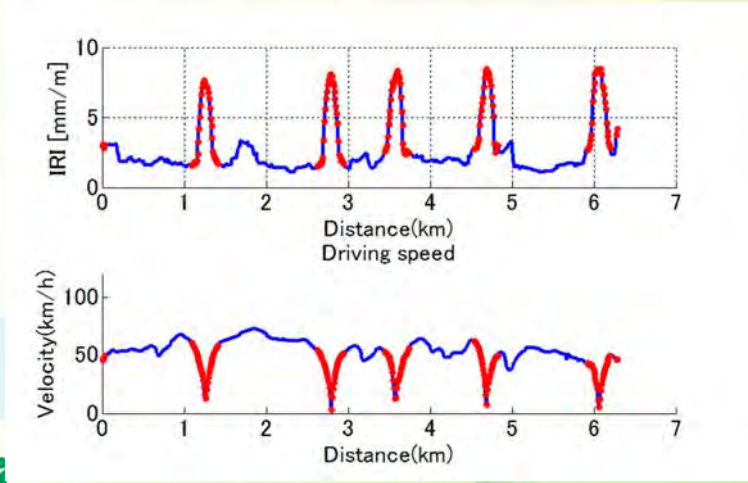
DRIMS: Dynamic Response Monitoring System

Analysis for IRI Estimation



DRIMS: Dynamic Response Monitoring System

Finally, IRI is obtained.

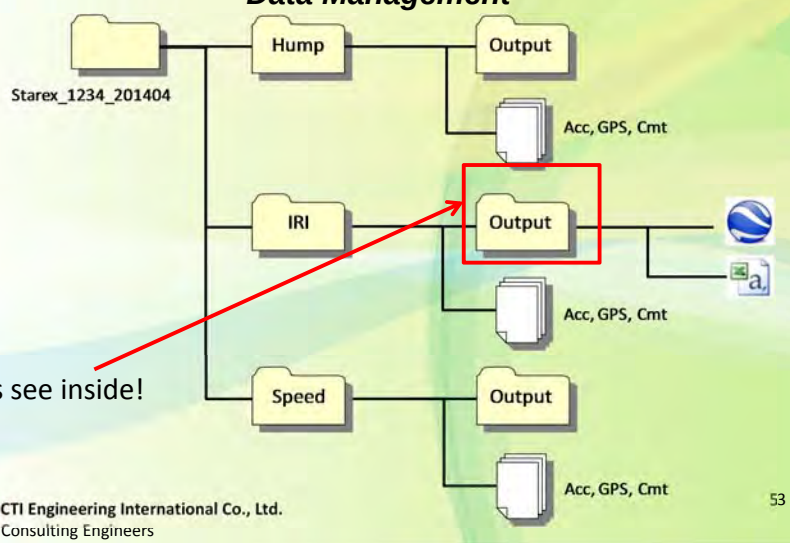


DRIMS: Dynamic Response Monitoring System

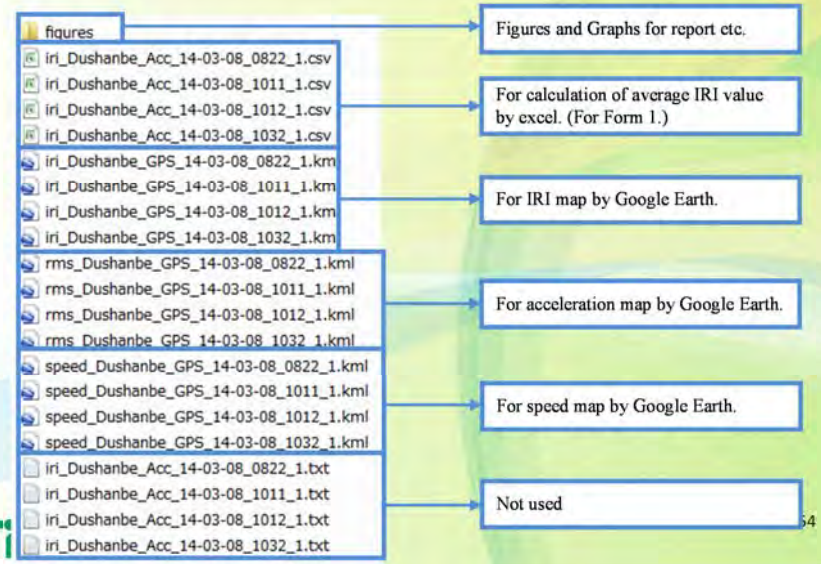
Data Management

DRIMS: Dynamic Response Monitoring System

Data Management



DRIMS: Dynamic Response Monitoring System



DRIMS: Dynamic Response Monitoring System

iri_Dushanbe_Acc_14-03-08_0822_1.csv
iri_Dushanbe_Acc_14-03-08_1011_1.csv
iri_Dushanbe_Acc_14-03-08_1012_1.csv
iri_Dushanbe_Acc_14-03-08_1032_1.csv

This data is used for Form 1.

VISUAL INSPECTION

3. Visual Inspection

VISUAL INSPECTION

Why, Visual inspection is necessary?

(1) IRI is an index of the ride confort.

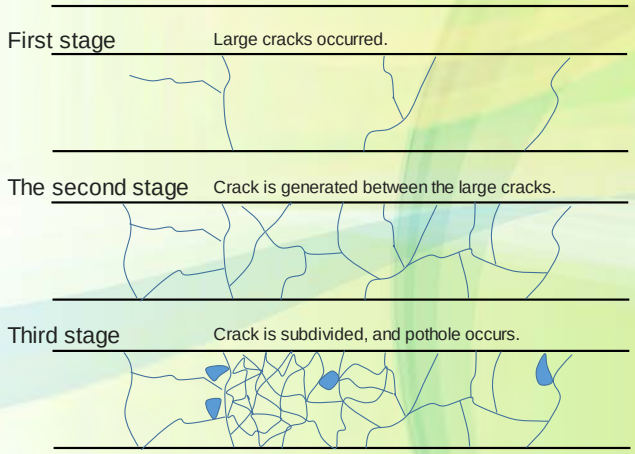
(2) Quality of the pavement structure is evaluated by cracks.

(3) Durability of pavement is determined by the crack.

(4) Potholes are an extreme condition of the pavement.

VISUAL INSPECTION

Progress of the crack



VISUAL INSPECTION

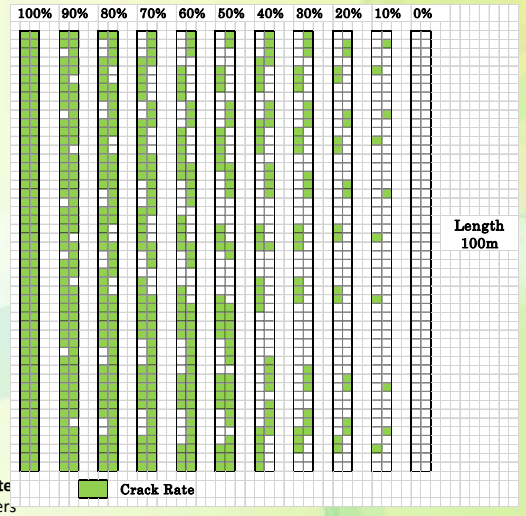
Visual Inspection Methodology

100m

Recording Crack rate, Pothole rank or landmark in handwriting at 100m interval

VISUAL INSPECTION

Image of Crack Rate



VISUAL INSPECTION

Definition of Crack Ratio

Crack Rate	Typical Condition
0%	***No Crack (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

VISUAL INSPECTION

Definition of Pothole Rank

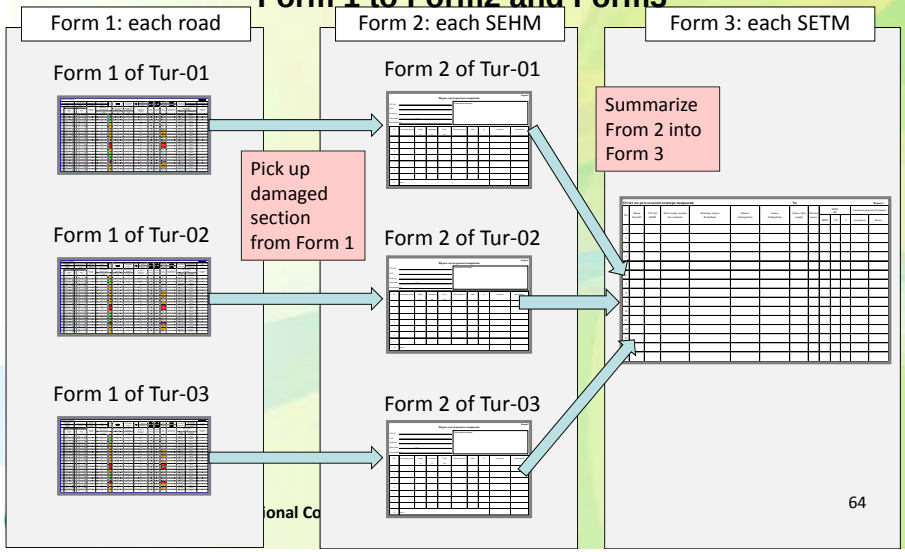
Pothole Rank	Condition	Criteria
A	No Pothole	No pothole neither no repair patching
B	Few Potholes	1 to 5 potholes or patching per 100m
C	Several Potholes	5 to 20 potholes or patching per 100m
D	Many Potholes	More than 20 potholes or patching per 100m

DATA FORMS

4. Data Forms and Evaluation

DATA FORMS

Form 1 to Form2 and Form3

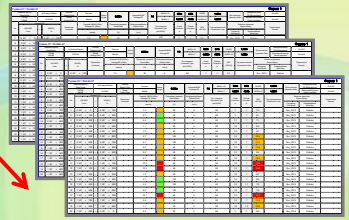


DATA FORMS

Form 1 Preparation for Target Roads

SETM	SEHM	Number of Road	Length
Gissar	Rudaki	9	175.9
	Gissar	6	70.4
	Shahrinav	4	25
	Tursunzoda	3	27.1
	Vahdat	6	109.9
	Varzob	5	63.3
	Norak	6	67.6
	Fayzobod	2	51.7
	Rogun	2	35.8
	Total	43	626.7
Kurgan Tyube	Bohtar	4	53.1
	Vacksh	2	67.3
	Sarband	4	51.9
	Huroson	2	72.8
	Jomi	2	42.5
	Rumi	4	69.9
	Kumsangir	3	68.6
	Piyang	1	46.9
	Jilikul	5	82.7
	Kabodiyon	1	36.1
	Shahritus	1	38.9
	N.Ckusrav	1	31.2
	Yovon	3	68.2
	Total	33	730.1
Ground Total		76	1356.8

Form 1 is prepared for each road.
"One road – One Form 1"

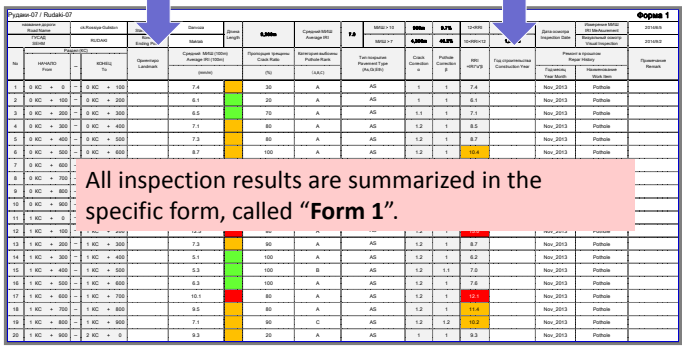


For example, under Rudaki SEHM, there are 9 sheets of Form 1.

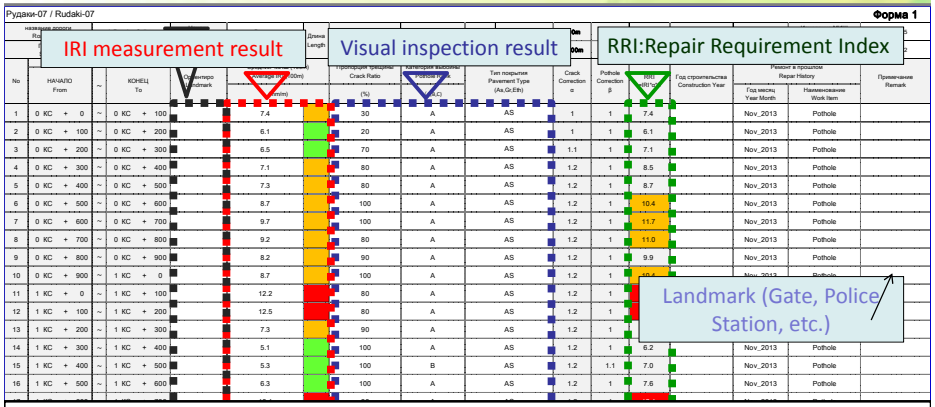
DATA FORMS

Inspection Result Integration into Form 1

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**".	



DATA FORMS



- Form 1 provides us the pavement condition at 100m interval.
- RRI (Requirement Repair Index) shows degree of damage on the road surface.
- The section indicated by high RRI means that this section needs to to be urgently repaired.
- RRI = IRI x α x β
  (α=1.0 to 1.2 according to crack rate, β =1.0 to 1.2 according to pothole rank)

DATA FORMS

Example of RRI Calculation

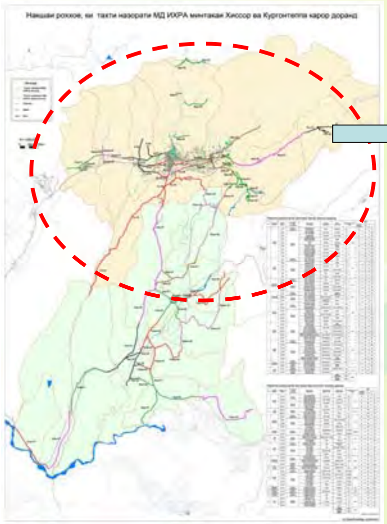
Рудаки-07 / Rudaki-07

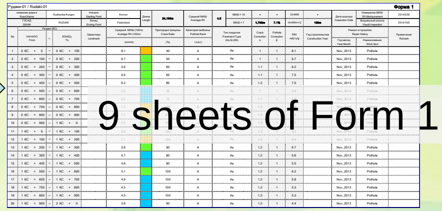
No	НАЧАЛО From	КОНЕЦ To	Средний МИШ (100m) Average IRI (100m) (mm/m)	Пропорция трещины Crack Ratio (%)	Категория выбоины Pothole Rank (A,B,C)	Тип покрытия Pavement Type (As,Gr,Eth)	Crack Correction α	Pothole Correction β	RRI =IRI*α*β
1	0 КС + 0	0 КС + 100	7.4	30	A	AS	1	1	7.4
2	0 КС + 100	0 КС + 200	6.1	20	A	AS	1	1	6.1
3	0 КС + 200	0 КС + 300	6.5	70	A	AS	1.1	1	7.1
4	0 КС + 300	0 КС + 400	7.1	80	A	AS	1.2	1	8.5
5	0 КС + 400	0 КС + 500	7.3	80	A	AS	1.2	1	8.7
6	0 КС + 500	0 КС + 600	8.7	100	A	AS	1.2	1	10.4
7	0 КС + 600	0 КС + 700	9.7	100	A	AS	1.2	1	11.7
8	0 КС + 700	0 КС + 800	9.2	80	A	AS	1.2	1	11.0
9	0 КС + 800	0 КС + 900	8.2	90	A	AS	1.2	1	9.9
10	0 КС + 900	0 КС + 0	8.7	100	A	AS	1.2	1	10.4
11	1 КС + 0	0 КС + 100	12.2	80	A	AS	1.2	1	14.6
12	1 КС + 100	0 КС + 200	12.5	80	A	AS	1.2	1	15.0

IRI=9.2, Crack Ratio=80%→α =1.2, Pothole Rank =A→ β=1.0
RRI = IRI x α x β = 9.2 x 1.2 x 1.0 = **11.0**

DATA FORMS

Data Filling (Example of Rudaki SEHM)





9 sheets of Form 1

- Form 1_Rud-01.xlsx
- Form 1_Rud-02.xlsx
- Form 1_Rud-03.xlsx
- Form 1_Rud-04.xlsx
- Form 1_Rud-05.xlsx
- Form 1_Rud-06.xlsx
- Form 1_Rud-07.xlsx
- Form 1_Rud-08.xlsx
- Form 1_Rud-09.xlsx

- 01-Rudaki
- 02-Gisar
- 03-Shahrinav
- 04-Tursunzoda
- 05-Vahdat
- 06-Varzob
- 07-Norak
- 08-Fayzobod
- 09-Rogun

2014

DATA FORMS

Form 1

Form 1: road condition

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	~	Раздел (КС) 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	Ремонт в прошлом Repar History: Наименование Work Item	Примечание Remark
1	0 КС + 0	~	0 КС + 100												
2	0 КС + 100	~	0 КС + 200												
3	0 КС + 200	~	0 КС + 300												
4	0 КС + 300	~	0 КС + 400												
5	0 КС + 400	~	0 КС + 500												
6	0 КС + 500	~	0 КС + 600												
7	0 КС + 600	~	0 КС + 700												
8	0 КС + 700	~	0 КС + 800												
9	0 КС + 800	~	0 КС + 900												
10	0 КС + 900	~	1 КС + 0												
11	1 КС + 0	~	1 КС + 100												
12	1 КС + 100	~	1 КС + 200												
13	1 КС + 200	~	1 КС + 300												
14	1 КС + 300	~	1 КС + 400												
15	1 КС + 400	~	1 КС + 500												
16	1 КС + 500	~	1 КС + 600												
17	1 КС + 600	~	1 КС + 700												
18	1 КС + 700	~	1 КС + 800												
19	1 КС + 800	~	1 КС + 900												
20	1 КС + 900	~	2 КС + 0												

DATA FORMS

Form 2 : Cost estimation

Form 2

Pavement Repair Cost Estimation Form

SEHM

SETM

Road Name

Total length km

Traffic Volume

Comment from Maintenance Engineer

No	Road condition	Length	Average width	Quantity	Repair Method	Unit	Unit Rate	Cost	Remark
		m	m	m2					
1									
2									
3									
4									
5									
6									
7									
8	Total								

DATA FORMS

Form 3 Summary

Pavement Inspection Resutl Report As of Form 3

No.	МДНРА Road ID	ракамм рох 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	МИШ IRI: Средний Average	МИШ IRI: >10	МИШ IRI: >7	Maintenance Cost (Somoni): per road	Maintenance Cost (Somoni): Total
1													
2													
3													
4													
5													
6													
7													
8													
9													
10													
11													
12													
13													
14													
15													

Pavement Defect Photo Album
Virtual Kilo Post Map

Pavement Defect Photo Album
Virtual Kilo Post Map

END

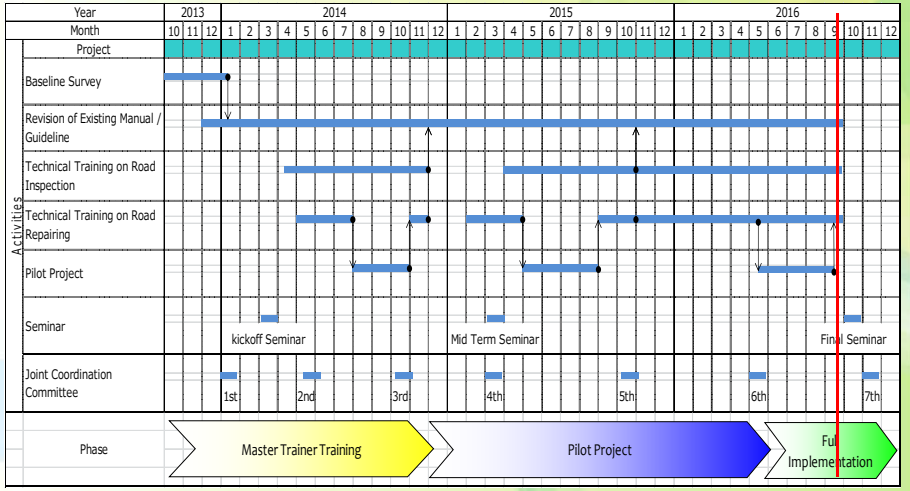
Project for Improvement of Road Maintenance

Final Workshop on Road Inspection

September 2016

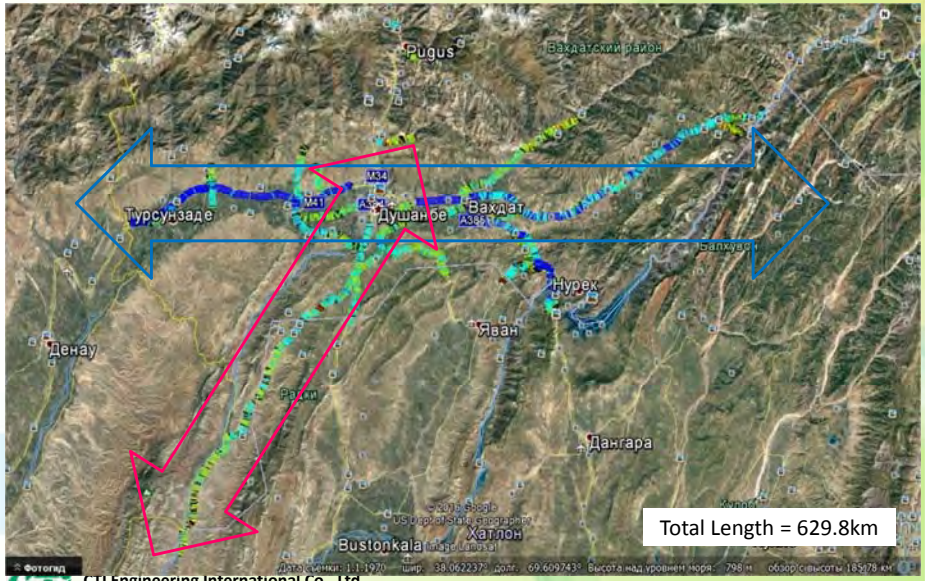
Prepared by the JICA Experts Team

Project Schedule

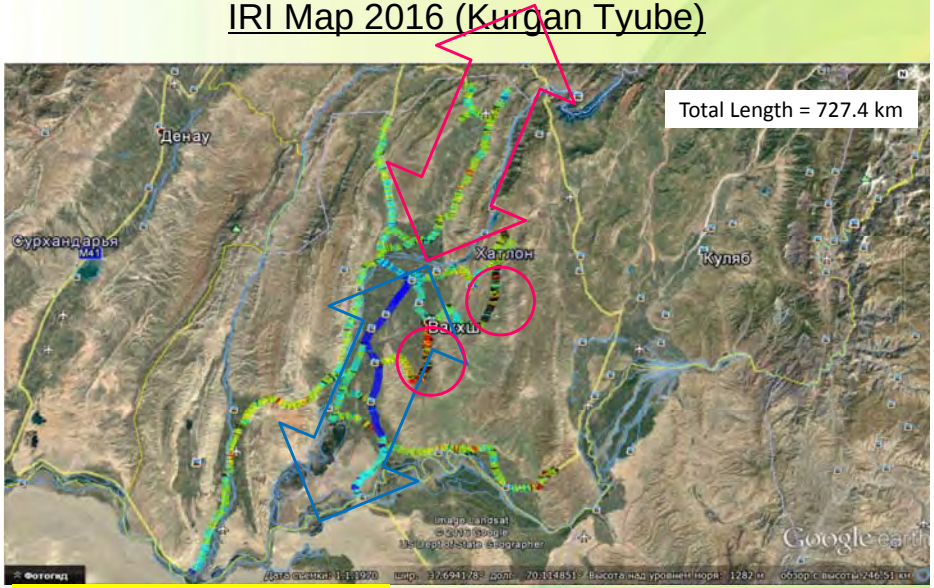


1. IRI Measurement Result & Visual Inspection Result

IRI Map 2016 (Gissor)



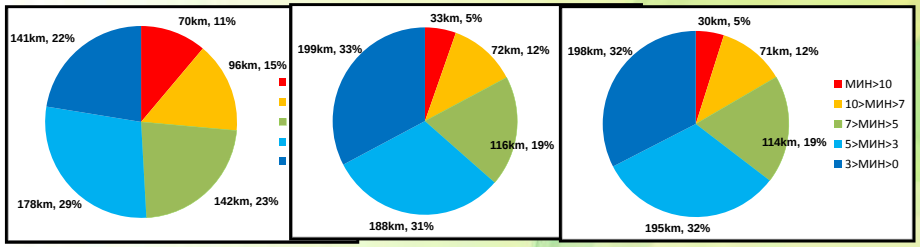
IRI Map 2016 (Kurgan Tyube)



N.Shcraf was not available in 2016

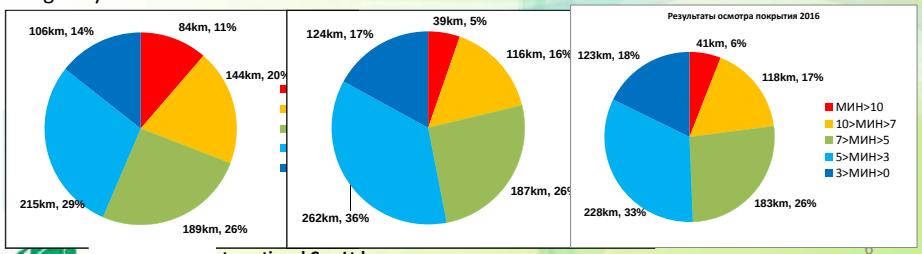
Transition of IRI since 2014 to 2016

Gissor



2014 2015 2016

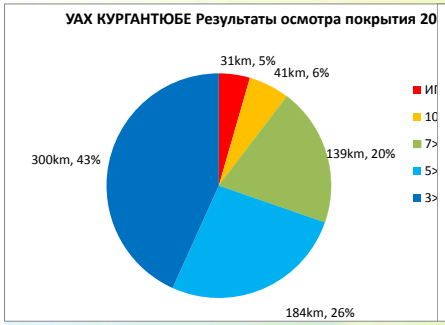
Kurgan Tyube



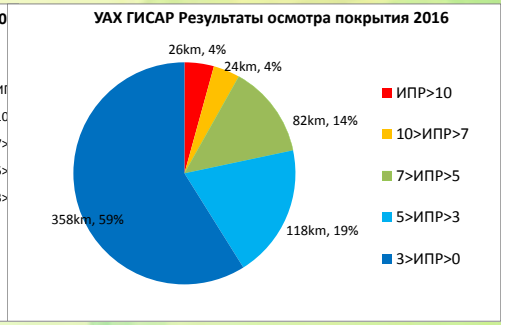
2014 2015 2016

RRI SETM in 2016

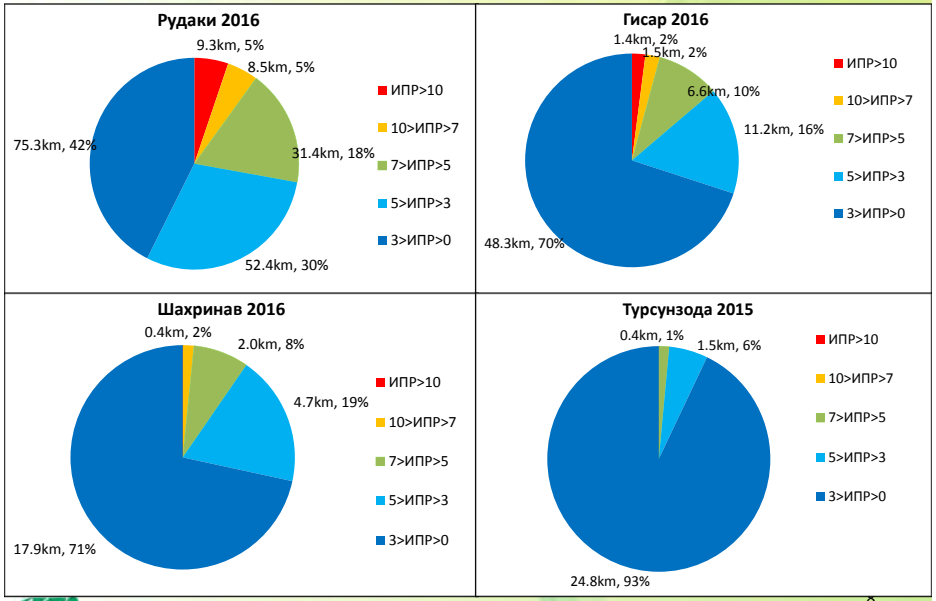
Kurgan Tyube



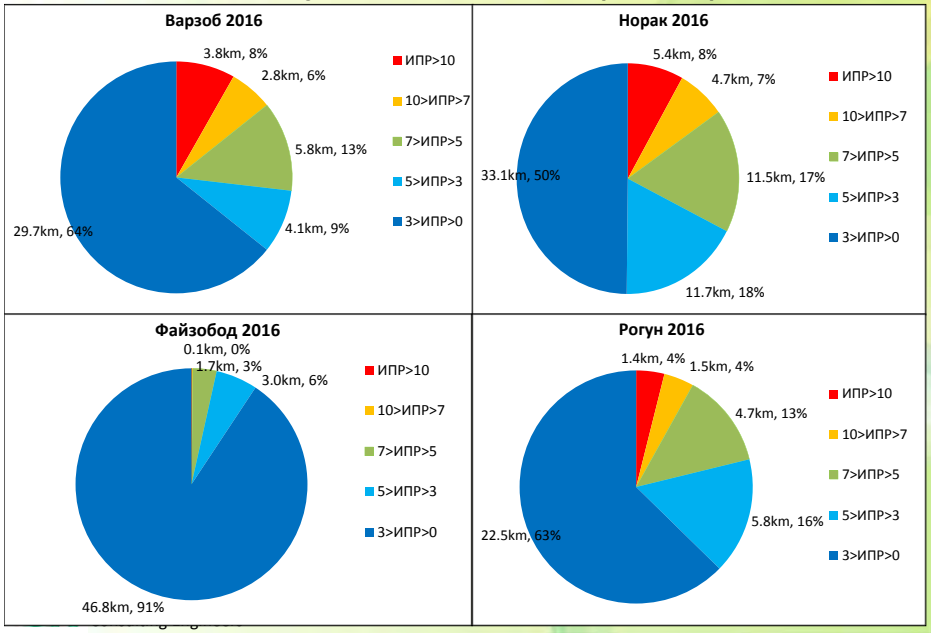
Gissor



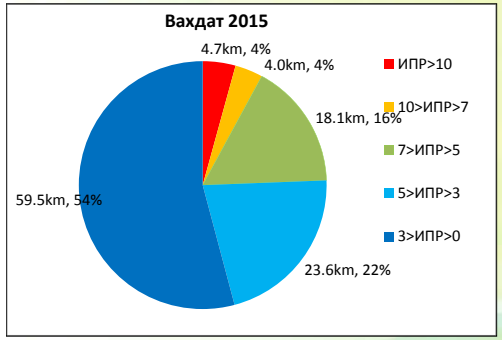
RRI by SEHMs in 2016 (Gissor)



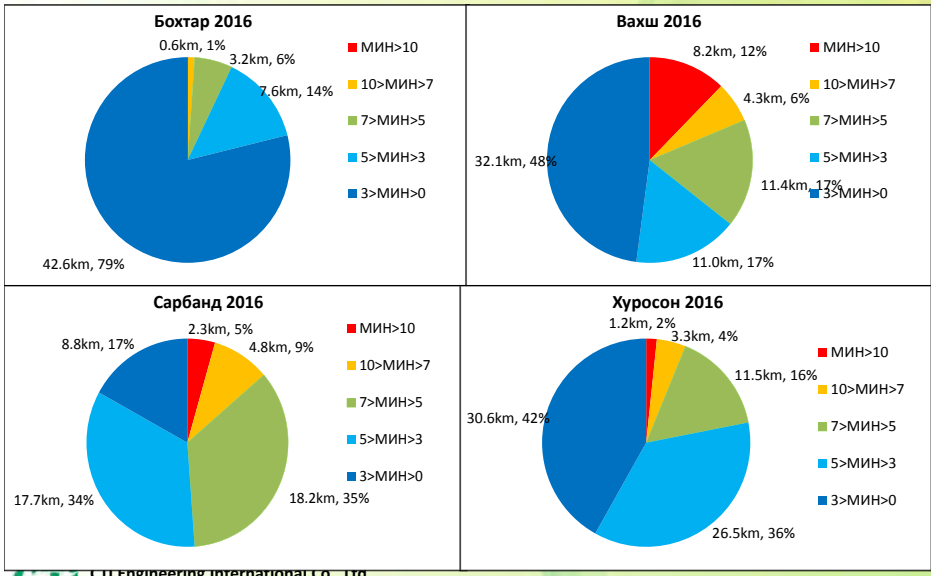
RRI by SEHMs in 2016 (Gissor)



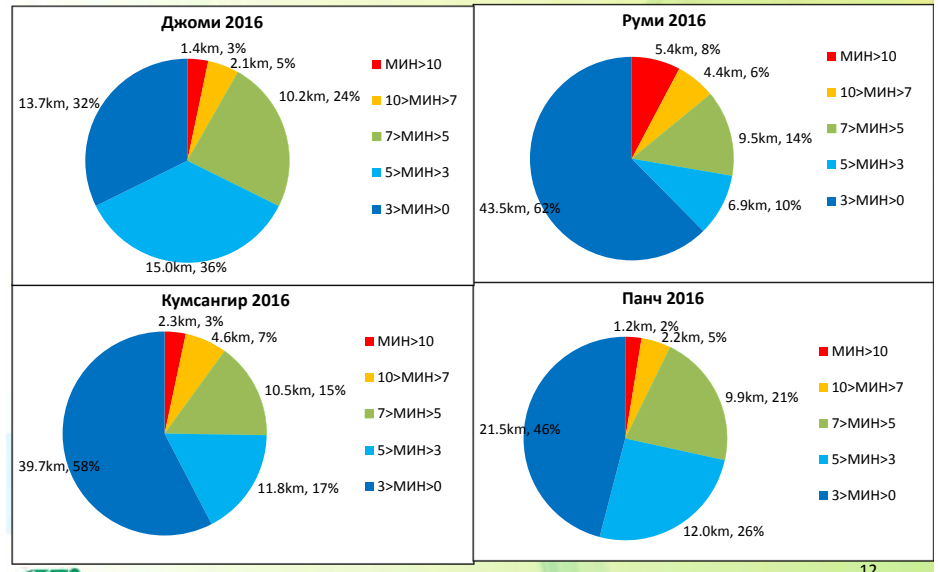
RRI by SEHMs in 2016 (Gissor)



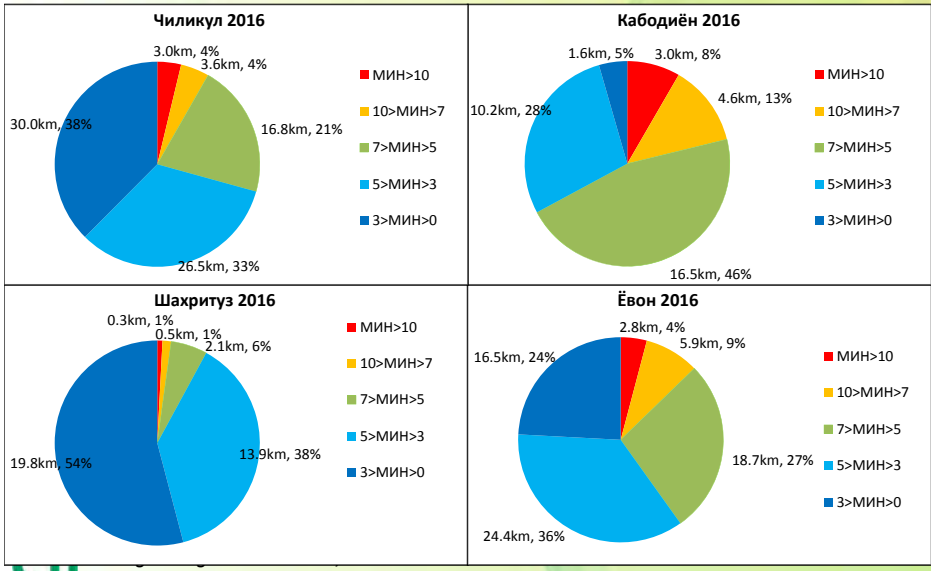
RRI by SEHMs in 2016 (Kurgan Tyube)



RRI by SEHMs in 2016 (Kurgan Tyube)



RRI by SEHMs in 2016 (Kurgan Tyube)



2. Evaluation of Pavement Inspection Result by JICA Expert Team

For IRI Measured length (1/3) (Gissor)

JICA experts checked the total length measured by DRIMS.

МДНРА Road ID	рохи ахмият доштаи Int or national	Номгуи роххо Road Name	Дарозии рох. Length (km)		Check (If difference between (1) and (2) is less than 200m, then "OK".
			(1) DRIMS	(2) GPS	
Ру-01	Байнал International	Душ-Кургонтеппа Dush.-Kurgan	24.0	23.9	OK
Ру-02	Чумхури National	Душ.-Чимтеппа Dush.-Chimteppa	11.7	11.8	OK
Ру-03		Рудаки-Ёвон Rudaki- Yovon	23.0	23.0	OK
Ру-04		Эсанбой-Шуртагай Esanboy-Shurtgay	82.9	82.9	OK
Ру-05		Лохур Lohur	2.0	2.0	OK
Ру-06		Душ-Айни- Хисор Dush-Aini- Hisor	7.8	7.7	OK
Ру-07		х.Россия-Гулистон hog.Rossia-Guliston	9.2	9.2	OK
Ру-08		Чам.сахом Улчабой G.Sahomi Ulchaboy	9.5	9.4	OK
Ру-09		Чимтеппа-Хисор Chimteppa-Hisor	6.0	6.1	OK
Х-01	Байнал International	Душ.-Турсунзода Dush.-Tursunzoda	24.0	23.9	OK
Х-02	Чумхури National	Чимтеппа-Хисор Chimteppa-Hisor	11.7	11.8	OK
Х-03		Даромади Хисор Entrance-Hisor	23.0	23.0	OK
Х-04		Душ-Айни- Хисор Dush-Aini- Hisor	82.9	82.9	OK
Х-05		Даром-и Алмоси Entrance of Almosi	2.0	2.0	OK
Х-06		Даром-и Шохамбр. Entrance ofShoham.	7.8	7.7	OK

For IRI Measured length (2/3) (Gissor)

Шах-01	Байнал International	Душ.-Турсунзода Dush.-Tursunzoda	24.0	23.8	OK
Шах-02	Чумхури National	Даром.Чептура Entrance Cheptura	13.0	12.9	OK
Шах-03		Дар.истир.Каратог ent.rest ho. Karatog	2.7	2.7	OK
Шах-04		Дар.дехаи Каратог Ent.vilage Karatog	8.4	8.4	OK
Тур-01	Байнал International	Душ.-Турсунзода Dush.-Tursunzoda	12.6	12.6	OK
Тур-02	Чумхури National	Дар. юТурсунзода Ent.Tursunzoda	8.7	8.7	OK
Тур-03		Дар.ш.Турсунзода Ent.Tursunzod-city	11.6	11.7	OK
Вах-01	Байнал International	Вах-Рашт-Чиргатол Vah-Rasht-Jirgatol	6.0	6.0	OK
Вах-02		Душ-Кулоб-Кулма Dush-Kulob-Kulma	3.2	3.2	OK
Вах-03	Чумхури National	Вахдат-Ромит Vahdat-Romit	4.0	4.1	OK
Вах-04		нБО Норак-Бустон NBO norak-Buston	20.8	20.9	OK
Вах-05		Улчабоев-Вахдат Ulchaboev-Vahdat	2.9	2.9	OK
Вах-06		Зардолу-Найзирак Zardolu-Naizirak	2.8	2.9	OK
Вар-01	Чумхури National	Хоча-оби-гарм Ckoja-obi-Garm	13.8	13.9	OK
Вар-02		рохи чашм.Сангхо Rohi chash.Sangcko	30.8	30.8	OK
Вар-03		Пугус-Тагоб-Сафедо Pugus-Tagob-Safedorak	36.8	36.5	NO
Вар-04		Варзоб Гес-Харангон-сан. Дусти Varzob Ges-Ckarangon-sanat Dusti	9.1	9.2	OK
Вар-05		Майху-Анзоб-Такф maykura-anzob-takfon	13.6	13.6	OK

For IRI Measured length (3/3) (Gissor)

Нор-01	Байнал International	Душ-Кулоб-Кулма Dush-Kulob-Kulma	21.8	21.1	NO
Нор-02	чумхури National	рохи Шар-Шар Shar-Shar road	8.3	8.3	OK
Нор-03		Дар.шахри Норак Entrans Norak sity	5.5	5.5	OK
Нор-04		Дар.дех.Хучалон Entr.to villag Ckuchalon	4.4	4.4	OK
Нор-05		Чормагзак-Ёвон Chormagzak-Yovon	8.9	9.0	OK
Нор-06		Зардолу-чормагзак-Найзирак Zardolu chormagzak-Nayzirak	18.2	18.1	OK
Фай-01	Байнал International	Вах-Рашт-Чиргатол Vah-Rasht-Jirgatol	48.0	48.0	OK
Фай-02	чумхури National	Дар.шах.Файзобод Entr. Fayzobad town	3.5	3.6	OK
Рог-01	Байнал International	Вах-Рашт-Чиргатол Vah-Rasht-Jirgatol	25.1	25.2	OK
Рог-02	чумхури National	Дар.шах.Рогун Entr.Rogun town	10.7	10.7	OK

Accuracy of measured length : 93%

For IRI Measured length (1/3) (Kurgan Tyube)

JICA experts checked the total length measured by DRIMS.

No.	раками рох SEHM	МДНРА Road ID	рохи ахмият доштаи Int or national	Номгуи роххо Road Name	Дарозии рох. Length (km) (1) DRIMS	(2) GPS	Check (If difference between (1) and (2) is less than 200m, then "OK".
1	Бохтар Bohtar	Бох-01	Байнал International	Душ.-Кургантеппа Dush-Kurgan-Tube	24.6	24.5	OK
		Бох-02		Кургантеппа-Дангара KurganTub-Dangara	5.5	5.5	OK
		Бох-03	Чумхури National	гирдгашти Кургонтеп Around Kurgantube	10.3	10.6	OK
		Бох-04		Кургонтепа-Вахш KurganTub-Vacksh	13.4	13.5	OK
2	Вахш Vacksh	Вахш-01	Чумхури National	Вахш-Дангара Vacksh-Dangara	49.1	48.9	OK
		Вахш-02		Исоев-Гулистон-Вахш Isaev-guliston-Vacks	18.2	18.1	OK
3	Сарбанд Sarband	Сар-01	Байнал International	Кургантеппа-Дангара KurganTub-Dangara	36.4	36.4	OK
		Сар-02	Чумхури National	рохи охани Кургон Kurgan rail station	1.0	1.0	OK
		Сар-03		дар.шах.Сарбанд Entr.Sarband town	2.0	2.0	OK
		Сар-04		ГЕС-и Сангтуда Ges Sangtuda	11.9	12.5	OK
4	Хуросон Huroson	хур-01	Байнал International	Душ.-Кургантеппа Dush-Kurgan-Tube	50	50	OK
		хур-02		Кизилкала-Чорбуча Kizilkala-Chorbucha	22.8	23.1	OK
5	Чоми Jomi	Чом-01	Чумхури National	Рудаки-Ёвон-Чоми-Уяли Rudaki-Yovon-Jomi-Uyali	31.1	31.1	OK
		Чом-02		Чоми-Кизилкала Jomi-Kizilkala	11.6	11.5	OK

Measured length Check (Kurgan Tyube)

6	Руми Rumi	Руми-01	Байнал International	Душ-Кург-Афг-границ Dush-Kurg-Afg.borde	34.2	34.3	OK
		Руми-02	Чумхури National	Узун-Чиликул Uzun-Jilikul	6.8	6.8	OK
		Руми-03		Руми-Чиликул Rumi-Jilikul	4.4	4.3	OK
		Руми-04		Исоев-Вахш Isoev-Vacksh	23.8	23.8	OK
7	Кумсангир Kumsangir	Кум-01	Байнал International	Душ-Кург-Афг-границ Dush-Kurg-Afg.borde	34.7	34.6	OK
		Кум-02		Гулистон-фархор-Панч-Дусти Guliston-Farkor-Piyang-Dusti	25.2	25.3	OK
		Кум-03	Чумхури National	Комсомол-Пахтакор Komsomol-Packtakor	8.7	8.6	OK
8	Панч Piyang	Панч-01	Байнал International	Гулистон-фархор-Панч-Дусти Guliston-Farkor-Piyang-Dusti	46.9	46.9	OK
9	Чиликул Jilikul	Чил-01	Байнал International	Кизилкала-Чорбуча Kizilkala-Chorbucha	37.3	38.1	NO
		Чил-02	Чумхури National	Узун-Чиликул Uzun-Jilikul	21.1	21.1	OK
		Чил-03		Чиликул-Гароути Jilikul-Garouti	9.3	9.2	OK
		Чил-04		Дусти-Чиликул Dusti-Jilikul	5.7	5.8	OK
		Чил-05		Руми-Чиликул Rumi-Jilikul	5.3	5.6	OK

Measured length Check (Kurgan Tyube)

10	Кабодиён Kabodiyon	Каб-01	Байнал International	Кизилкала-Чорбуча Kizilkala-Chorbucha	36.1	35.6	OK
11	Шахритус Shahritus	Шах-01	Байнал International	Кизилкала-Чорбуча Kizilkala-Chorbucha	38.9	38.6	OK
12	Н.Хусрав N.Ckusrav	Хуср-01	Байнал International	Кизилкала-Чорбуча Kizilkala-Chorbucha	31.6	-	-
13	Ёвон Yovon	Ёвон-01	Чумхури National	Чормагзак-Ёвон Chormagzak-Yovon	11.9	11.8	OK
		Ёвон-02		Рудаки-Ёвон-Чоми Rudaki-Yovon-Jomi	51.4	51.4	OK
		Ёвон-03		Точик-тон-КорКимиё Tojikiston-Kipr.Kimiyo	5.0	5.1	OK

Accuracy of measured length : 97%

For Visual Inspection (1/3)

JICA experts checked Form 1 from the Drive Record data.

According to Form1, **IRI=6.0, Crack Rate=60%, Pothole Rank=B** at this section.

8~10?? **80~100%??** **C??**

For Visual Inspection (2/3) (Gissor)

No.	раками рох SEHM	IRI			Visual Inspection				
		IRI	Sample Nos*	Evaluation	Crack	Pothole	Average	Sample Nos	Evaluation
1	Рудаки	96%	3	Pass	91%	90%	90%	3	Pass
2	Хисор	97%	3	Pass	95%	95%	95%	3	Pass
3	Шахринав	95%	3	Pass	90%	95%	93%	3	Pass
4	Турсунзода	90%	3	Pass	93%	97%	95%	3	Pass
5	Вахдат	93%	3	Pass	98%	97%	98%	3	Pass
6	Варзоб	93%	3	Pass	100%	100%	100%	3	Pass
7	Норак	92%	3	Pass	100%	90%	95%	3	Pass
8	Файзобод	95%	3	Pass	90%	95%	93%	3	Pass
9	Рогун	95%	3	Pass	95%	85%	90%	3	Pass
		94%	27		95%	94%	94%	27	

For Visual Inspection (2/3) (Kurgan Tyube)

No.	раками рох SEHM	IRI			Visual Inspection				
		IRI	Sample Nos*	Evaluation	Crack	Pothole	Average	Sample Nos	Evaluation
1	Bohtar Бохтар	96%	3	Pass	93%	99%	96%	3	Pass
2	Вахш Vacksh	93%	3	Pass	98%	98%	98%	3	Pass
3	Сарбанд Sarband	94%	3	Pass	88%	94%	91%	3	Pass
4	Хуросон Huroson	95%	3	Pass	90%	95%	93%	3	Pass
5	Чоми Jomi	93%	3	Pass	90%	90%	90%	3	Pass
6	Руми Rumi	96%	3	Pass	96%	93%	94%	3	Pass
7	Кумсангир Kumsangir	95%	3	Pass	92%	90%	91%	3	Pass
8	Панч Piyang	100%	3	Pass	100%	100%	100%	3	Pass
9	Чиликул Jilikul	90%	3	Pass	92%	92%	92%	3	Pass
10	Кабодиён Kabodiyon	90%	3	Pass	90%	90%	90%	3	Pass
11	Шахритус Shahritus	90%	3	Pass	90%	95%	93%	3	Pass
12	Н.Хусрав N.Ckusrav	90%	3	Pass	-	-	-	3	-
13	Ёвон Yovon	90%	3	Pass	92%	92%	92%	3	Pass
		95%	27		92%	94%	94%	27	

For Visual Inspection (3/3) (Gissor)

2014	2015	2016
Accuracy of Form 1 IRI : 84% Crack Rate: 86% Pothole: 82%	Accuracy of Form 1 IRI : 90% Crack Rate: 81% Pothole: 87%	Accuracy of Form 1 IRI : 94% Crack Rate: 95% Pothole: 94%

Work Item	**2014 (Training)**	**2015 (1st Stand-alone)**	**2016 (2nd Stand-alone)**
IRI Measurement	May to July (3 months)	April to June (3 months)	April to June (3 months)
Visual Inspection	August to October (3 months)	July to August (2 months)	July to August (2 months)
Form 1, 2 and 3	December (1 month)	September (1 month)	
Total	About 7 month	About 6 month	About 5 month

For Visual Inspection (3/3) (Kurgan Tyube)

2014	2015	2016
Accuracy of Form 1 IRI : 84% Crack Rate: 86% Pothole: 82%	Accuracy of Form 1 IRI : 90% Crack Rate: 81% Pothole: 87%	Accuracy of Form 1 IRI : 93% Crack Rate: 92% Pothole: 94%

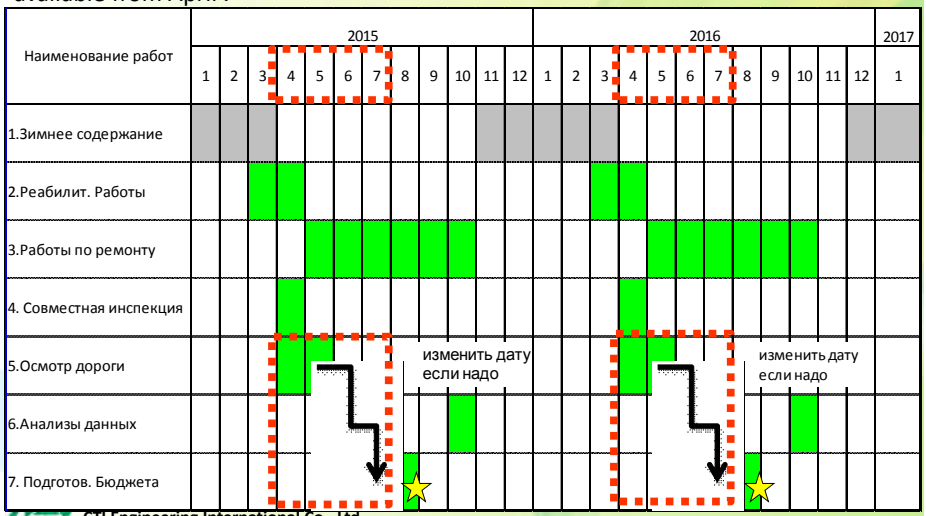
Work Item	2014 (Training)	2015 (1st Stand-alone)	2016 (2nd Stand-alone)
IRI Measurement	May to July (3 months)	April to June (3 months)	April to June (3 months)
Visual Inspection	August to October (3 months)	July to August (2 months)	July to August (2 months)
Form 1, 2 and 3	December (1 month)	September (1 month)	
Total	About 7 month	About 6 month	About 5 month

3. Recommendation for Improvement

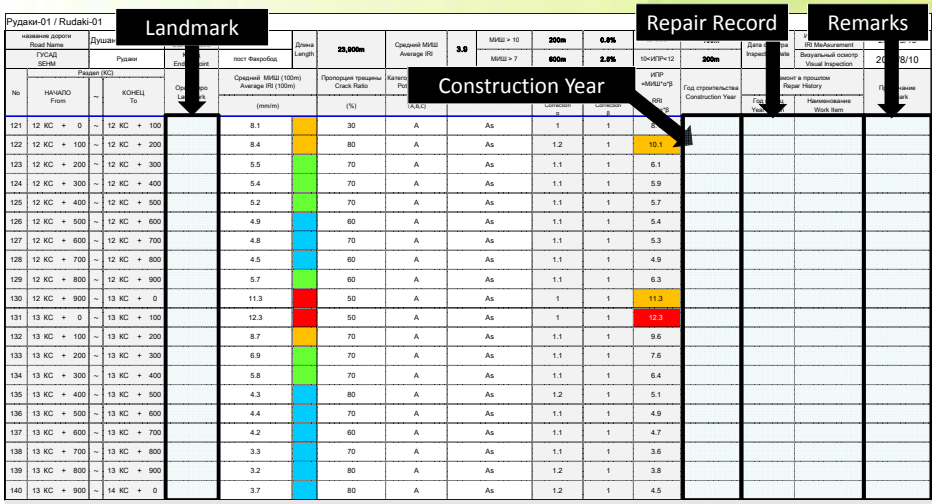
Importance of Periodic Road Inspection

★ Deadline for Budget Request

In order to meet the deadline for budget request to MOT, **4 months** at longest is available from April .



Add more information into Form 1



Although you can not stop on the way during IRI measurement, you can stop wherever you want during visual inspection, and input some information in handwriting into Form 1.

3. The way forward

When you have trouble of DRIMS

For trouble shooting of DRIMS, contact to;

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

Importance of Kilopost

In order to facilitate road inspection, it is important to easily identify exact locations. Kilopost should be maintained in good condition always.



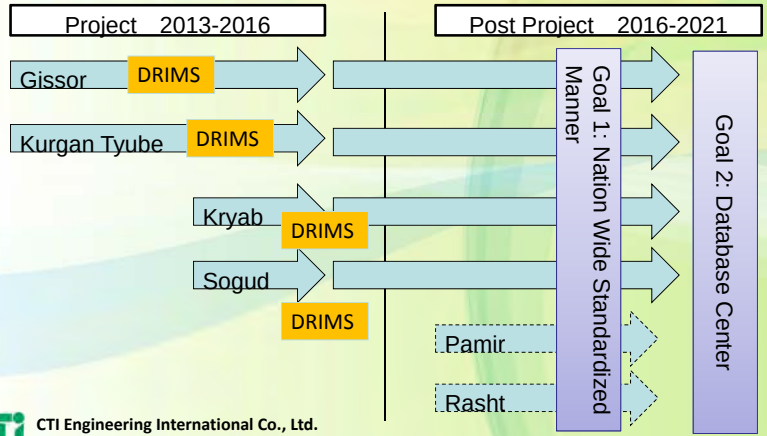
Kilo Post


Building


Gate

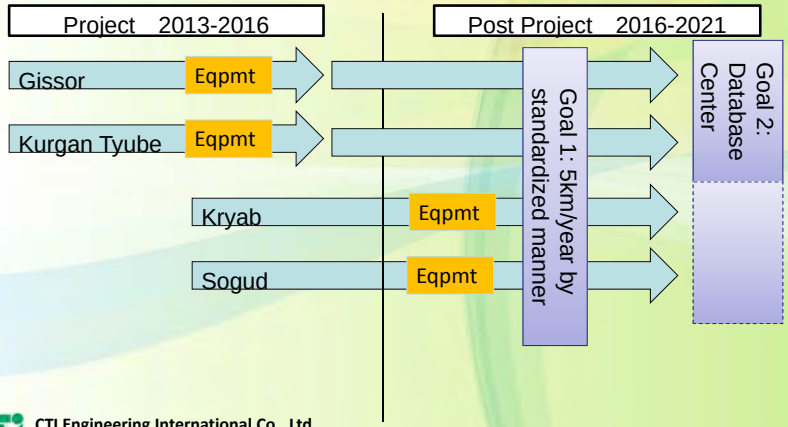
Post Project Strategy (Inspection)

1. Goal 1 : Standardized Inspection to nation wide road network
2. Goal 2 : Data oriented inspection (IRI) and centralize the data for policy making



Post Project Strategy (Repair)

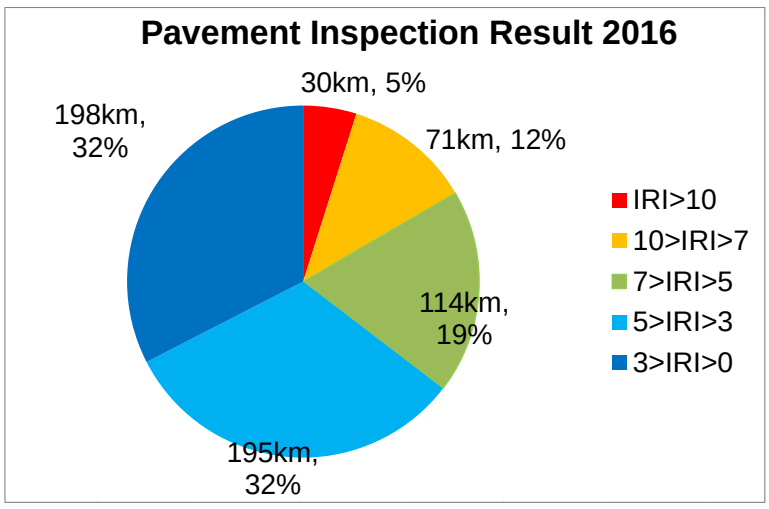
1. To be able to apply hot mix asphalt to pavement repair in 4 regions
2. To have more systemized (databased) records



Thank you for your attention!

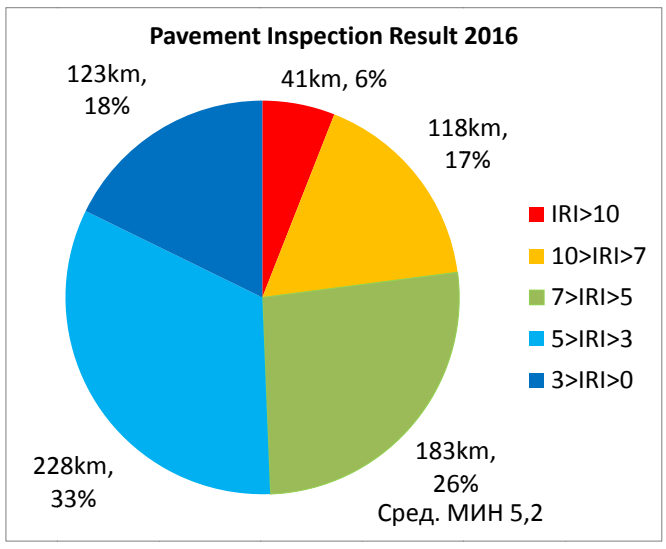
PD-6

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



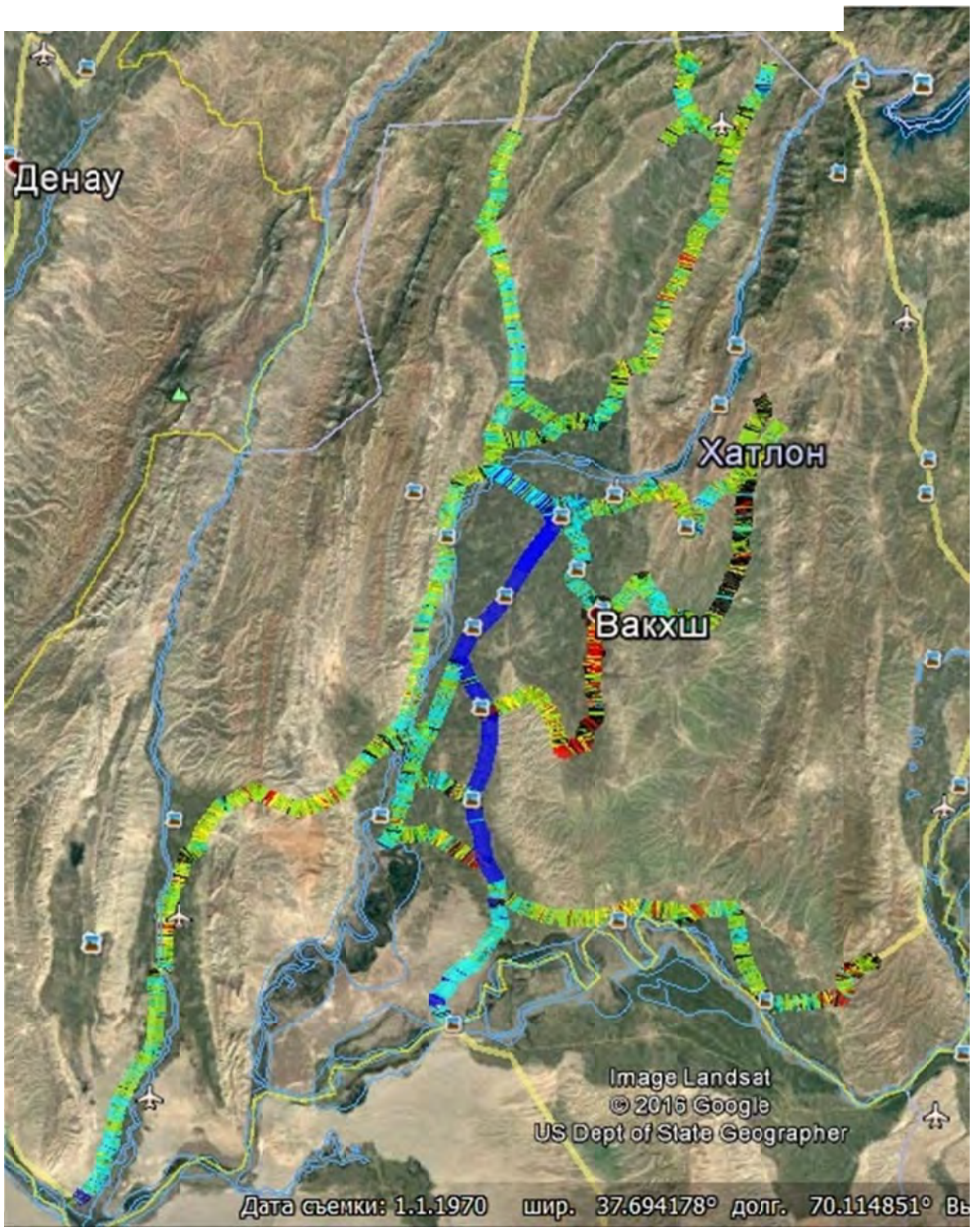
IRI>10	29,700m	30km	5%
10>IRI>7	71,200m	71km	12%
7>IRI>5	114,100m	114km	19%
5>IRI>3	194,800m	195km	32%
3>IRI>0	197,800m	198km	33%
Total	607,600m	608km	100%

Average IRI=4.9



IRI>10	41,400m	41km	6%
10>IRI>7	118,000m	118km	17%
7>IRI>5	183,400m	183km	26%
5>IRI>3	228,300m	228km	33%
3>IRI>0	123,300m	123km	18%
Total	694,400m	694km	100%

Average IRI=5.2



PD-7

Training program for pavement and pavement repair

a. Management of Asphalt Mixing Plant

1. Crushing Plant	How aggregates are produced.
2. Asphalt Mixing Design	procedure –From the sampling of materials to the Job mix design.
3. Asphalt Mixing Plant	Components and Procedure.
4. Manpower planning for Asphalt Mixing Plant	What is the duty?
5. Quality Control	What kind of tests and document are required.
6. Material Control	Balance and Order
7. Advice from my experience.	What is important for producing.

b. Maintenance of machine

1. Daily Inspection and Maintenance	Greasing ,Check before starting.
2. Periodic Maintenance	Replacement of filters, Oil change, Operation manual.

c. Pavement construction and repair

1. Construction planning	Typical contents in plan.
2. Pavement method	Material order, Machinery and procedure.
3. Maintenance and Repair of pavement	Type of maintenance and Repair.
4. Quality control at site	What is required to keep good quality.

d. Safety

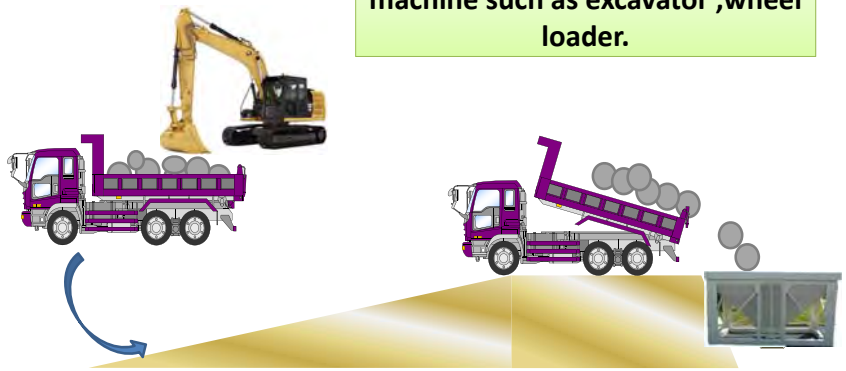
e. Evaluation of training

CRUSHING PLANT

Produce base material and aggregate for Bituminous mixture and/or Cement concrete

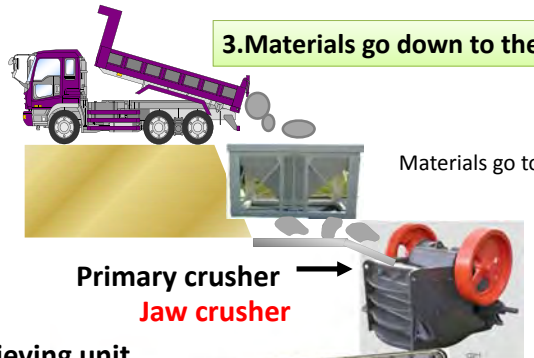
FLOW1,2

1.Load the materials by loading machine such as excavator ,wheel loader.



2.Feed the material to the hopper

FLOW3,4



3.Materials go down to the Jaw crusher.

Materials go to the sieving unit

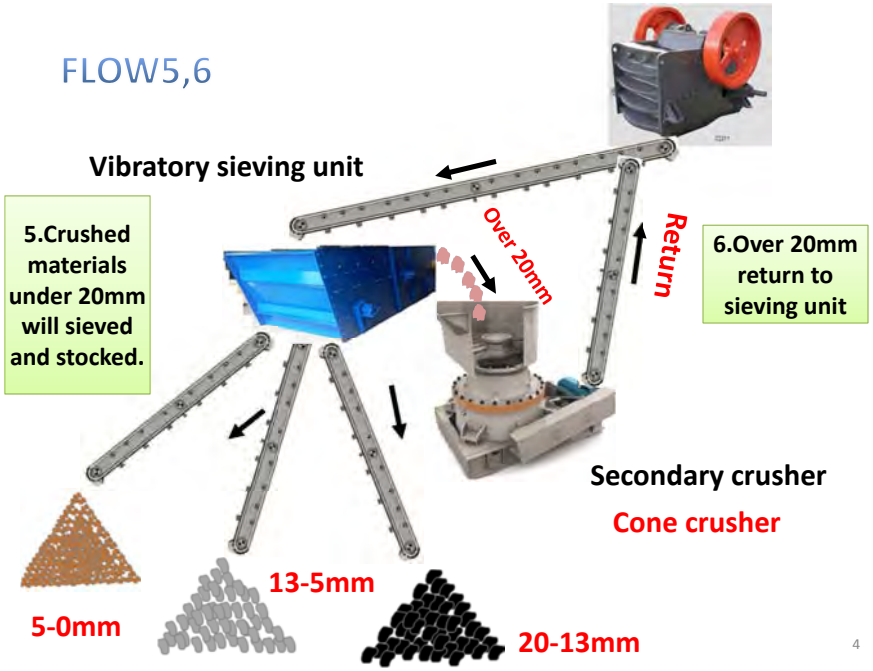
Primary crusher

Jaw crusher

Vibratory sieving unit

4.Crushed materials go to sieving unit.

FLOW5,6



Vibratory sieving unit

5.Crushed materials under 20mm will sieved and stocked.

Over 20mm

Return

6.Over 20mm return to sieving unit

Secondary crusher

Cone crusher

13-5mm

5-0mm

20-13mm

TYPE OF CRUSHER

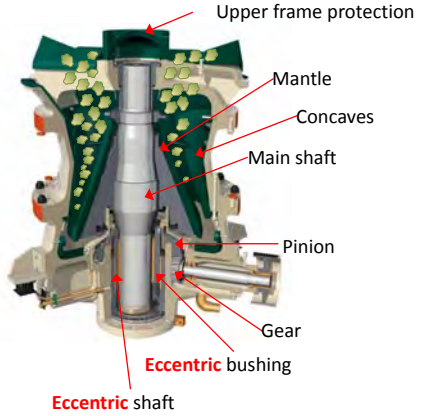
JAW CRUSHER

JAW CRUSHER consist of two jaws. One fixed and the other reciprocating. The opening between them is largest at the top and decreases towards the bottom. The pitman moves on an eccentric shaft and swing lever swings on center pin. The rock is thrown between two jaws and crushed by mechanical pressure.

Jaw crushers are classified on the basis of the position of the pivoting of the swing jaw

- **The swing jaw is fixed at the upper position**
- **The swing jaw is fixed at the lower position**
- **The swing jaw is fixed at an intermediate position**

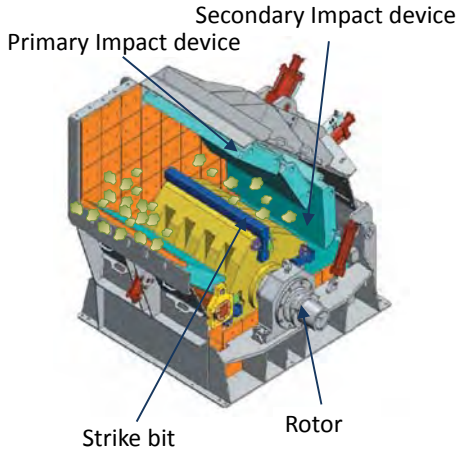
CONE CRUSHER



A cone crusher breaks rock by squeezing the rock between an **eccentrically gyrating spindle**, which is covered by a wear resistant mantle, and the enclosing concave hopper. As rock enters the top of the cone crusher, it becomes **wedged and squeezed** between the **mantle** and the **concave**. Large pieces of rock are broken once, and then fall to a lower position (because they are now smaller) where they are broken again. This process continues until the pieces are small enough to fall through the narrow opening at the bottom of the crusher.

Hopper attached on a corn crusher to receive the material to be crushed.

IMPACT CRUSHER



When the **IMPACT CRUSHER** works, the motor drives the **rotor** of the impact crusher rotate with a high speed. When the materials get into the area which the hammers effect, under the impact function of the hammer at a high speed, materials are thrown to the **impact device** above the rotor continuously. And then the materials are rebounded from the impact liner to the area where the hammers effects for re-crushing, then discharged from the discharge port. Users can adjust the space between Impact Rack and Rotor Support to get the expected size.

SCREEN(SIEVING UNUIT)

Horizontal Screens

- Vertical and horizontal amplitudes.

- Horizontal vibration conveys aggregate along screens, vertical vibration ensures fast and accurate sieving.

(ASPHALT)BITUMINOUS MIXING DESIGN

Uses OF ASPHALT HOT MIXTURE

- Highways
- Airfield
- Port facilities
- Parking lot
- Recreational facilities
- Hydraulic structure
- Recycled material

FLOW CHART OF MIXING DESIGN

STEP 1

1. Mixing design in laboratory.

STEP 2

2. Determination of Job mix design

3

1. Mixing design in laboratory.

a. Select the Materials

b. Characteristic Test of Materials

O.K

NO

c. Sieve test of aggregate and sand

d. Determination of combined grading

e. Determination of asphalt content

a. Select the Materials

Components of Asphalt Hot Mixtures

2 or 3 size of aggregates	20-10, 10-05, 05-00
Sand	Coarse sand /Fine sand.
Filler	Cement or lime powder
Asphalt(Bitumen)	Specified penetration
Additive(if required)	

b. Characteristic Test of Materials

Required test in Specification-1

- Aggregate
  - Water absorption test
  - Specific gravity
  - Los Angeles abrasion test
  - Test for soundness of aggregates by use of sodium sulfate
  - Flakiness Index
- Sand
  - Water absorption test
  - Specific gravity
- Filler
  - Specific gravity

Required test in Specification-2

- Asphalt(Bitumen)
  - Penetration (25℃)
  - Softening point℃
  - Ductility (15℃)
  - Solubility in Trichloroethylene(% by weight)
  - Flashing point℃
  - Thin Film Oven Test (% mass change)
  - Penetration of Residue (%)
  - Viscosity (60 ℃)
  - Specific gravity(Density) (15℃)g/cm3
  - Kinematic Viscosity（120℃,150 ℃,180℃)

ASPHALT（BITUMINOUS）MIXING DESIGN

Materials have to meet all requirements of SPECIFICATIONS!!

Materials which do not meet the requirements will be REJECTED

⇩

Find another material and carryout all tests again.

c. Sieve test of aggregate, sand and filler

This test can be done after the characteristic test, because selected materials(aggregates) may be rejected if they do not meet the requirements of specifications.

d. Determination of combined grading

Specification covers the grading range(upper and lower limit) for each types of mixtures.

⇩

Determine the mixing proportion of each aggregate, sand and filler to get the near center grading of the grading range. Combined grading can be calculated as below.

Calculate as below.

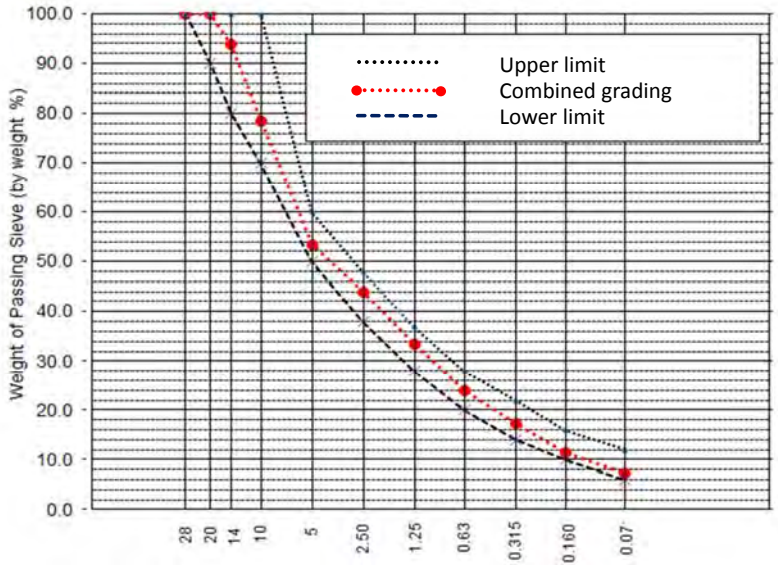
Sieve Analysis

Material		28	20	15	10	5	2.5	1.25	0.63	0.315	0.16	0.071
(20-10)		100.0	100	76.3	23.2	4.8	2.1	1.8	1.2	0.8	0.5	0.4
(10-5)		100.0	100	100	93.9	18.3	5.8	3.3	2.8	2.1	1.2	0.5
(5-0)		100.0	100	100	100	93.4	78.3	58.7	38.9	28.4	18.7	12.3
sand		100.0	100	100	100	100	94.3	68.3	47.2	26.9	12.6	0.5
Filler		100.0	100	100	100	100	100	100	99	94.1	81	72.9

Calculation of combined grading

Material	Proportion		28	20	15	10	5	2.5	1.25	0.63	0.315	0.16	0.071
(20-10)	26		26.0	26.0	19.8	6.0	1.2	0.5	0.5	0.3	0.2	0.1	0.1
(10-5)	24		24.0	24.0	24.0	22.5	4.4	1.4	0.8	0.7	0.5	0.3	0.1
(5-0)	34		34.0	34.0	34.0	34.0	31.8	26.6	20.0	13.2	9.7	6.4	4.2
sand	12		12.0	12.0	12.0	12.0	12.0	11.3	8.2	5.7	3.2	1.5	0.1
Filler	4		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	3.8	3.2	2.9
	100												
Combined grading			100.0	100.0	93.8	78.5	53.4	43.8	33.5	23.9	17.4	11.5	7.4
Range of grading			100 ~ 100	90 ~ 100	80 ~ 100	70 ~ 100	50 ~ 60	38 ~ 48	28 ~ 37	20 ~ 28	14 ~ 22	10 ~ 16	6 ~ 12
Target passing			100.0	100.0	90.0	85.0	55.0	43.0	32.5	24.0	18.0	13.0	9.0

Grading curve



e. Determination of asphalt content

- 15* pieces of Marshall test specimens are made to determine proper asphalt content.

*5 deferent asphalt content with same proportion of aggregate/sand/filler x 3peace for each=15

These specimens are tested to obtain the followings.

1. Density (Bulk density.)
2. Marshall stability
3. V.M.A: Voids in the Mineral Aggregate
4. V.F.A: Voids Filled with Asphalt
5. Air Void
6. Flow value

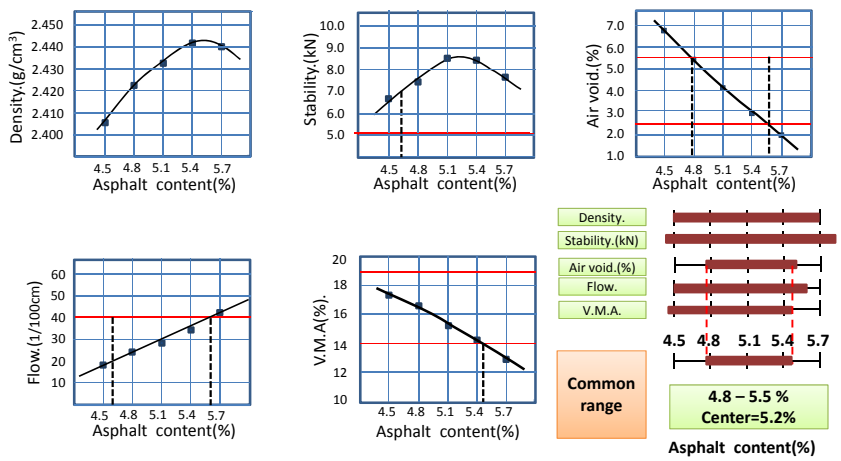
To be Continued

From the result above, optimum asphalt content(%) is derived based on the following method.(Example)

The summery of the Marshal test result (example)

Asphalt content(%)	Density	Air void(%)	V.M.A	Stability	Flow
4.5	2.406	5.3	17.5	6.7	18.0
4.8	2.422	4.2	16.4	7.3	24.0
5.1	2.432	3.3	15.2	8.5	29.0
5.4	2.442	2.5	14.1	8.4	34.0
5.7	2.440	1.8	12.7	7.6	42.0
Requirment		2.5-5.0	14-19	more than 5	Less than40

From the table above, optimum asphalt content(%) is derived.
(Example: Dense type, continues graded, Type-B, class-Ⅱ)



Mixing design in laboratory is completed.

2. Determination of Job mix design.

a. Determine the speed of the each cold bin feeder.

↓

b. Take samples from hot bin

↓

c. Sieve test of the materials from hot bin.

↓

d. Determine the proportion of the aggregate in hot bin.

↓

e. Product the mixture and take sample.

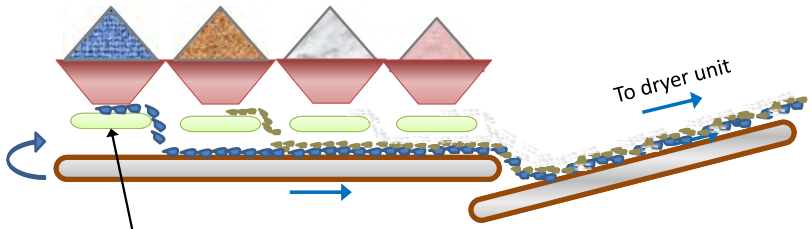
↓

f. Check the Stability, air void and others.

↓

g. Trial construction. ⇨ **Construction**

a. Determine the speed of the each cold bin feeder.



FEEDER : Speed can be controlled by frequency converters.
By changing the frequency, feeder speed changes **Steplessly**.

Example of frequency converter.

Adjust the frequency by this knob.

Continue.

Find out the proper frequency of each feeder.

Maximum Production volume per hour of your Plant → 600kg/batch x 3600sec/60sec = 36.0t/hour

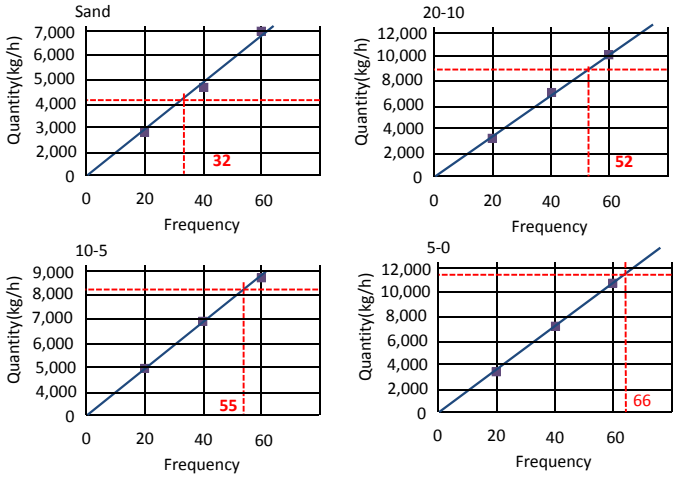
Example of grading is as follow.

Material	Mix proportion(%)
20-10	26
10-5	24
5-0	34
sand	12
Filler	4
Asphalt	5.2
Total	105.2

Required volume in weight.

- 36t x 0.26x100/105.2= 8.9 t
- 36t x 0.24x100/105.2= 8.21 t
- 36t x 0.34x100/105.2= 11.63 t
- 36t x 0.12x100/105.2= 4.11 t
- Is not from hot bin
- Is not from hot bin

Find out the proper frequency of each feeder.



b. Take samples from hot bin

Adjust the frequency by knob according to the result .

Example of frequency converter.

Adjust the frequency by this knob.

Start feeding of aggregate and sand.

Heat the materials.

Stock the materials in hot bin.

Take samples from all hot bin.

c. Sieve test of the materials from hot bin.

Calculation of combined grading

BIN No.	Sieve size	28	20	15	10	5	2.5	1.25	0.63	0.315	0.16	0.071
BIN.1	5-0	100	100	100	100	94.9	73.5	53.8	38.1	26.3	18.7	11.8
BIN.2	10-5	100	100	100	96.1	12.7	5.4	2.2	0.3	0.1		
BIN.3	20-10	100	98.5	78.3	9.8	4.2	2.1	1.2	0.8			
BIN.4	-	-	-	-	-	-	-	-	-	-	-	-
Filler		100	100	100	100	100	100	100	99	94.1	81	72.9
Material	Proportion	28	20	15	10	5	2.5	1.25	0.63	0.315	0.16	0.071
BIN.1	50.0	50.0	50.0	50.0	50.0	47.5	36.8	26.9	19.1	13.2	9.4	5.9
BIN.2	25.0	25.0	25.0	25.0	24.0	3.2	1.4	0.6	0.1	0.0	0.0	0.0
BIN.3	21.0	21.0	20.7	16.4	2.1	0.9	0.4	0.3	0.2	0.0	0.0	0.0
BIN.4	-	-	-	-	-	-	-	-	-	-	-	-
Filler	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	3.8	3.2	2.9
	100.0											
Combined grading		100.0	99.7	95.4	80.1	55.5	42.5	31.7	23.3	16.9	12.6	8.8
Range of grading		100	90 ~ 100	80 ~ 100	70 ~ 100	50 ~ 60	38 ~ 48	28 ~ 37	20 ~ 28	14 ~ 22	10 ~ 16	6 ~ 12
Target passing		100	95	90	85	55	43	32.5	24	18	13	9

d. Determine the proportion of the aggregate in hot bin.

Proportion of each bin has decided in the table above .

Weight of materials of each bin ,filler and bitumen.

Material	Proportion(%)	Conv.proportion	Weight(KG)
BIN.1	50.0	47.53	285
BIN.2	25.0	23.76	142
BIN.3	21.0	19.96	120
BIN.4			
Filler	4.0	3.80	23
Asphalt	5.2	4.95	30
Total	105.2	100.0	600

Input the weight in the system.

e. Product the mixture and take sample.

Product 3 batch

1.Design asphalt - 0.1%
2.Design asphalt
3.Design asphalt + 0.1%

Check the appearance, Luster and mixing condition.

Take samples for stability test.

f. Check the Stability, air void and others.

Choose one of 3. → Trial construction

g. Trial construction.

Purpose

1.Determine the No. of compaction.
2.Find out compaction ratio.
3.Check the surface condition.
4.Find out the defect.

Start construction

ASPHALT MIXING PLANT

Asphalt (Bituminous)hot mixtures are composed with

- Coarse aggregate
- Fine aggregate
- Bitumen
- Filler
- Additives if required

Asphalt mixing plant can mix these materials in designated proportion with proper temperature according to the mix design.

ASPHALT MIXING PLANT ARE MADE UP with MANY EQUIPMENTS AND OTHERS BELOW.

1.STOCK YARD: Stock pile for each size of aggregates

Stock yard should have roof if possible to keep all aggregates in dry condition.

Stock yard should have concrete floor to minimize the loss of aggregate and to minimize the contamination with foreign materials.

2.COLD BIN: STOCK BIN FOR EACH SIZE OF AGGREGATE

COLD BIN should have roof if possible or be covered by any water proof sheets especially in the rainy season.

This property is composed with:

1. 4 or 5 storage bins for each size of aggregates and sand.

2. Belt feeder below each bin with motors. Each bin has its individual feeder belt. Material flow is controlled by a combination of belt speed and gate opening.
Independent feed control is done by frequency converters.

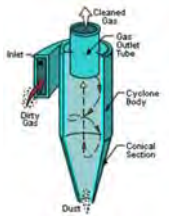
3. One continuous belt conveyer for all bins with motor.

3.DRUM DRYER: Dry up and heat the aggregates by burner.

Oil burner is equipped to Drum dryer.

About 7-12 litter of Fuel is required to dry up and heat 1 ton of aggregate.(in Japan)

4. DUST COLLECTION SYSTEM: Collect the dust to minimize the dust for environment protection.



Primary:Cyclone separators

Reclaimed dust can be used as filler.

Secondary : Bag filter

Bag filtering system purify the exhaust gases from its plants for environmental protection by collecting/catching the dust in this unit.

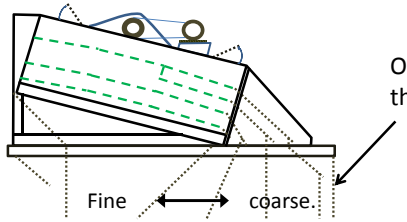
5.HOT ELEVATER: Vertical hot elevator transfers heated aggregate from the dryer to the sieving unit.

This system is composed with gears, Single or double row chain with buckets which feed the hot aggregate into the sieving device.

Bucket in the hot elevator

6. SIEVING UNIT: Sort out the aggregate which conveyed by hot elevator to required grading

SIEVING UNIT are equipped with vibration motors to create vertical and horizontal amplitudes. While horizontal vibration conveys aggregate along screens, vertical vibration ensures fast and accurate sieving.



Over size materials go out from the unit through the pipe.

7. HOT BIN : Stock the hot aggregate come from SIEVING UNIT.

This unit is composed with:

1. 4 or 5 stock bins for classified aggregate.

2. Gate with pneumatic cylinder to open /close the gate to the weighing unit for each bins.

3. Sensor to alarm when the level of material come up to the limit capacity of each bin.

8.AggregateWeighingUnit: Accumulative weighing by electronic loadcells.

9.Pneumatically controlled discharge gate of aggregate to batch mixer .

10.Asphalt(Bitumen) Weighing Unit: Weighing by electronic loadcells.
With hot oil or electrical heating system.
Discharge the bitumen into the mixing unit by special pump.

11.BATCH MIXER : Device that uniformly mix the aggregate, asphalt(bitumen) and filler which was weighed and discharged from weighing units.

Mixing unit with 2 motors.

Inside of mixer with twin shaft

12. FILLER SUPPLY SYSTEM: System to supply the filler into the mixing unit.

Filler Supply System is composed with :

1.Filler silo

2.Screw conveyer

3.Filler elevator.

4.Filler weighing unit with pneumatic controlled gate.

13.ASPHALT(BITUMEN)TANK: Storage tank of hot asphalt(bitumen).

Horizontal tanks

1.Outer surface of the tank is Covered with thermal insulation.

2.Tank is Equipped with heating system.

Vertical tanks

3. Gear pump, thermostat, thermometer, thermal insulated pipe up to the asphalt weighing unit and other devices are connected.

14.ASPHALT (BITUMEN) MELTING KETTLE:

Asphalt melting kettle with oil burner, pump, hoist crane and Plumbing.

15.POWER GENERATOR:

Power generator:
200 to 350 KVA Is required for asphalt mixing plant.

16-1. Other main equipment.

Fuel tank and Plumbing

Air compressor with casing for pneumatic control device and for other purpose.

16-2. Other main equipment

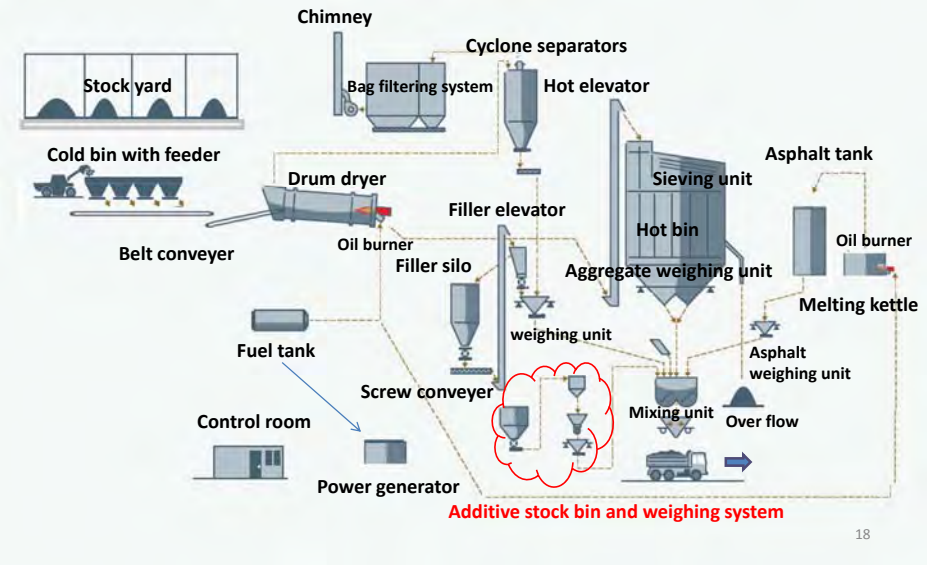
Control system

chimney

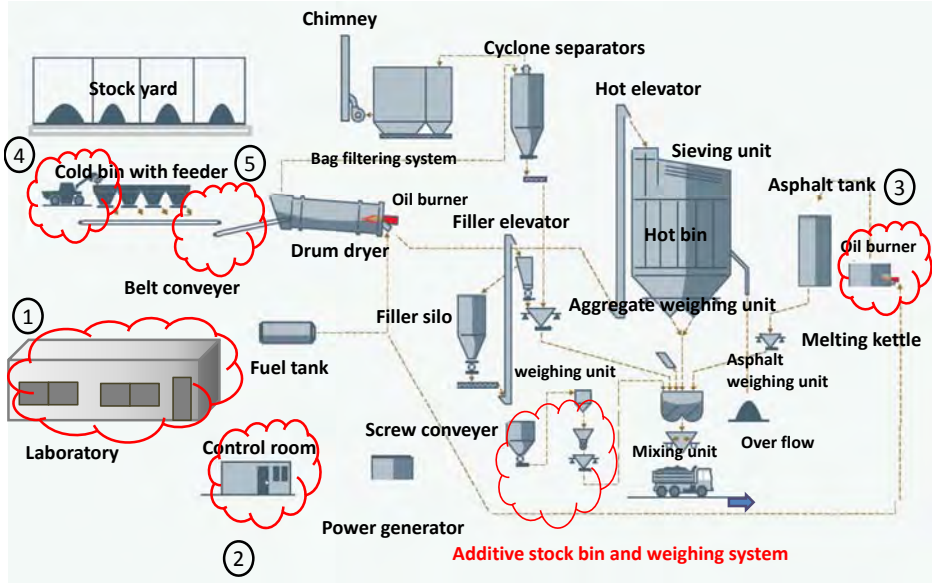
17. Laboratory

Assure the quality of the Mixture

DIAGRAM OF ASPHALT MIXING PLANT



4. Manpower planning for Asphalt Mixing Plant



Management Plant Manager 1 Assistant 1

- Total Management of Asphalt Mixing Plant
- Management of Staffs
- Coordination with all the related offices
- Production scheduling → Supply schedule to SEHM
- Material order → Shortage of Materials cause the delay of construction.
- Document control
- All others inclusive safety → Sum up all the report and analyze.

1.Laboratory Lab. Engineer 1 Lab. technician 1 Helper 3-4

- Quality control of Asphalt Mixture
- Quality check of Materials.
- Aggregate, asphalt and other → Does all Material meet with the requirement s of Specs?
- Test of Hot mixture
- Sampling of mixture and test → Temperature check, Sampling, marshal test and other required test.
- Assist the Quality control at site. → Density, thickness and other

2.Control room

Plant operator 1 Assistant 1

Plant operation

Production of Asphalt mixture.

Check the balance and consumption of materials and report.

Aggregates and sand.

Asphalt.

Asphalt in tank.

Filler.

Fuel.

3.Melting kettle

Helper 4-5

Shift the drum asphalt.

Cut the cover.

Heat the drum to melt down.

4.Wheel loader operator

Operator 1 Assistant 1

Check the machine before start and report the record.

Charge the materials into the cold bin.

5.Conveyer belt and cleaning

Worker 1-2

Check the material on conveyer, cleaning around the mixing plant and work as helper of the Plant operator.

Loader operator may charge foreign materials at quarry or stockyard. If it is big size of rock or cobblestone, it cause serious damage to the mixing plant.

→ It is necessary to make a trap to catch the foreign materials.

6. Mechanic and Electrician.

Periodical check and maintenance of machine and plant.

Repairing of machine and plant when necessary.

* 7. Workers to supply filler.

Worker 4-5

*If filler silo is not include in Asphalt mixing plant unit.

5. Quality Control at asphalt mixing plant

Components of Asphalt Hot Mixtures

- Aggregates
- Sand
- Filler
- Asphalt(Bitumen)
- Additive(if required)

→ Mix design

→ Keep samples in clear container at A.P ★

↓

Visually compare with delivered materials

Aggregate

- Water absorption test
- Specific gravity
- Los Angeles abrasion test
- Test for soundness of aggregates by use of sodium sulfate
- Flakiness Index
- Grading

Sand

- Water absorption test
- Specific gravity
- Grading

Filler

- Specific gravity
- Grading

Asphalt(Bitumen)

- Penetration (25℃)
- Softening point℃
- Ductility (15℃)
- Solubility in Trichloroethylene(% by weight)
- Flashing point℃
- Thin Film Oven Test (% mass change)
- Penetration of Residue (%)
- Viscosity (60 ℃)
- Specific gravity(Density) (15℃)g/cm3
- Kinematic Viscosity（120℃,150 ℃,180℃)

Mix design has done

AP → Assure the quality

a. Periodical check of materials

↳ Whether materials are same quality with the materials which was used in design.

b. Daily quality control

↳ Every production days

to be continued

What should be done in every production days?

1.Check the temperature of mixture

↳ Every dump track before leave

2.Take samples from mixture

↳ Make specimen for Marshall test

↳ Marshall test

Grading

Asphalt content

→ Asphalt extraction

3. Assist/cooperate construction site

Check the mixture at site

- Temperature
- Grading, Luster, Foreign material etc.
- Appearance

Core sampling

- Density → Inform the result to site
- Thickness

↓ If not meet requirement

Site have to improve there procedure of compaction

6. Material Control

Stock of the materials

Materials to be used

- Coarse aggregate
- Fine aggregate
- Bitumen
- Filler
- Additives if required

+

Fuel

All of these materials must not be stockout

Stock control

You must grasp:

a. Stock

b. Consumption

c. Planning use

↓

Calculate the stock in at least next **?** days.

→ Order/Purchase.

?: Depend on number of the day from ordering to arrival

Matters to be attention to

a. Stock

1.Aggregates	Some of them can not be used Contaminated at the bottom
2.Asphalt in tank	2 or 3 tons of dead stock
3.Asphalt in melter	1 or 2 tons of dead stock

4.Calculation and actual survey result is differ

5.Keep the stock with **sufficient** margin

b. Consumption

1.Loss

Some of aggregate go out as dust

Some of aggregate go out as over size

* Some of aggregate go into the ground

Loss of aggregate for cleaning of mixer

Some of filler will have moisture

c. Planning use

Additional order because of loss at site

7.Advice from my experience

a. At asphalt mixing plant

- Increase the capacity of AP

Adjust the mixing time

Trial mixing is required to do this.

60 second → 54 second → 48 second

↓ ↓ ↓

36t/hour → 41.5t/hour → 45t/hour

- Stock the mixture on the dump track

Use the dump track as HOT SILO.

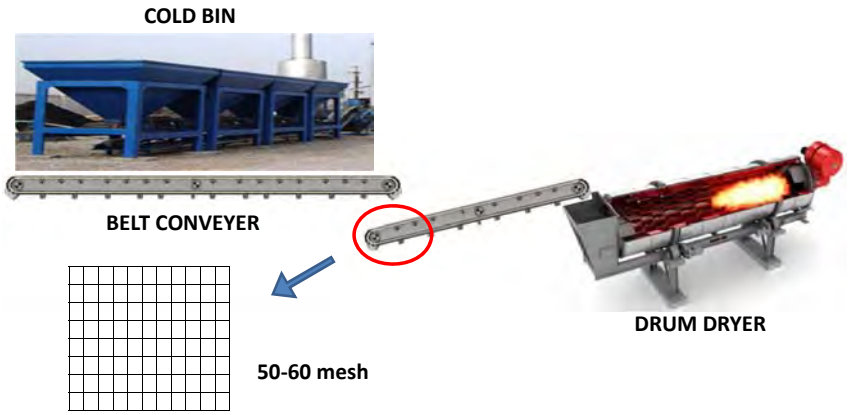
At hot season only

You can start mixing(production) early in the morning

↳ Increase daily production of AP

↳ Increase the productivity at site

- Make a trap to catch the foreign materials



This can decrease the so many trouble

b. At site

- Adjust the speed of Paver

Operator check the number of standby dump track!

Slow down the Paver speed if 1 stand by dump track!

1 or 2 dump truck stand by is better

Slow down the speed if 1

- Do not close hopper for every dump track

It makes segregation on the surface

- Dump track should stop at 50-60cm in front of paver

↳ Paver will approach and push the dump track .

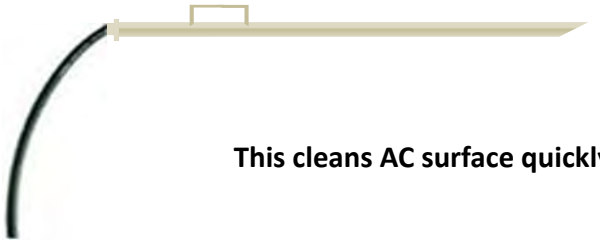
- Make slope bridge for hand guide roller

2 piece with hook

You do not need Crane track

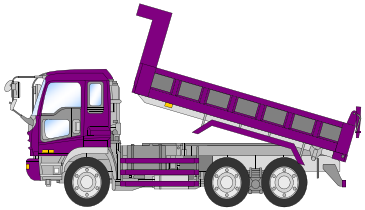
- Make Proper tool to clean the AC surface

For compressor



This cleans AC surface quickly

Maintenance of Machine



Inspection and maintenance

- Commencement inspection (inspection before starting work)
- Periodic inspection and maintenance
- Occasional inspection and maintenance

No periodic inspection and maintenance

⇩

Machine failure

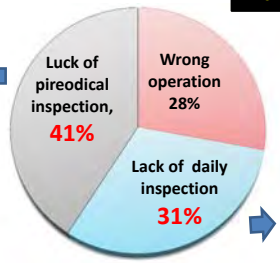
⇩

- Injure/Kill persons by accident. ★
- Decrease the productivity at site.
- Increase the cost of constriction.
- Increase the cost of maintenance.

Cause of machine troubles.

This is the Data from KOMATSU

- Neglect the element Replacement
- Neglect the adjustment
- Neglect the oil replacement and etc.



- Water drain from fuel
- Cleaning of element
- Shortage of cooling water
- Shortage of oil and etc.

More than **70%** of the machine troubles are caused from **shortage/failure/lack** of daily inspection and periodical maintenance.

In order to prevent the trouble of the machine and to maintain the performance same as new machine, a reliable **inspections and maintenance** are quite essential.

Daily inspection and maintenance based on the **instruction manual of the manufacturers** is important.

Each machine has its own instruction manual of the manufacturers.

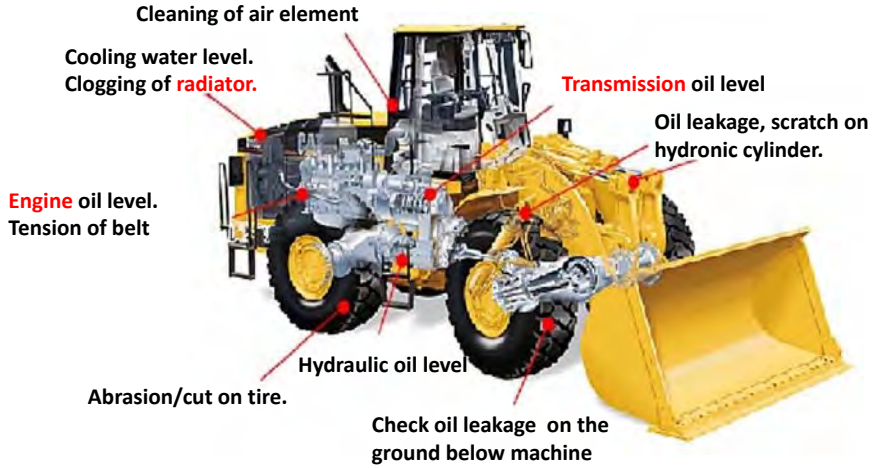
Example of Inspection before starting work

Following figure is **just one example** of this machine of this makers.

Required checking point is different by the type of machine and manufacturers instruction.

Follow the Maintenance Manual of each machine.

Example



*This is not include function check for safety.

Periodical maintenance

Replacement of filters	Replacement of oil
Engine oil filter	Engine oil
Hydraulic oil filter	Hydraulic oil
Fuel filter	Pump mission oil
Air filter	Traveling mission oil
	Turning mission oil

Interval of this replacement is noted in each Maintenance Manual.

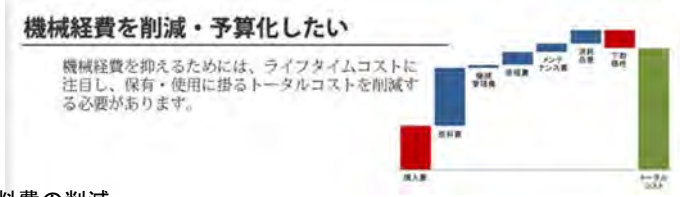
Preventive inspection and maintenance

"Preventive maintenance" ensures your production plan

In a general machine maintenance is performed only "after" a machine comes to a sudden stop or fails and cannot restart production until inspection and repair of the machine is completed. On the other hand, "preventive maintenance" prevents sudden machine stoppage by means of periodic inspection

機械は、使用により部品の磨耗や劣化が進んで行き、これらが故障の原因につながります。定期点検・メンテナンスを怠ると、機械本来の性能が維持できず生産性が低下するばかりでなく、故障の未然防止が図れず無駄な修理費の負担につながります。

検査項目	クラッチ／他	作業装置 作業機 ワイヤーロープ チェーン／他	ステアリングブレーキ 作業機 油圧装置 電気回路／他
点検検査の担当者と必要資格	1. 事業者	1. 事業者	1. 検査業者 2. 事業者（厚生労働大臣が定めた有資格者）
事業者の責務	事業者は職場環境の快適化や労働条件の改善により、職場における労働者の安全と健康の確保を図る責務がある。 （労働安全衛生法3条1項）		
記録の保管期間	-	3年間	3年間
チェックシートのご用意	あり コマツオリジナル健康診断	あり コマツオリジナル健康診断	あり 労働省監修特定自主検査記録表（1年または2年） （有償）



燃料費の削減

機械コストの内、大きなウエイトを占める燃料コストは機械の使い方によって大きく異なります。
コマツでは、省エネ運転講習やKOMTRAX省エネ運転レポートによりお客様の機械の使われ方を分
ン、機械の効率的な運転方法のアドバイスを行っています。

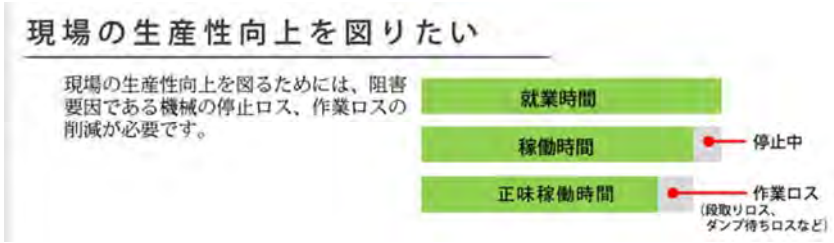
詳しくは >> コマテック　省燃費運転講習
詳しくは >> KOMTRAX省燃費運転支援

故障リスクの低減

突発的な故障で主要部品の交換が必要となると、機械経費が増大します。機械の故障は修理費を
大させるだけでなく、休車による二次的損害や、現場の生産性にも大きな影響を与えます。
特に代替機の調達が困難な現場では、定期点検・メンテナンスの予防保全により故障リスクを低
常にベストコンディションで機械をお使いいただくことが機械経費の削減に有効です。

定期メンテナンス・点検

オイル・フィルタなどの交換といったメンテナンス代行のほか、機械点検も同時に行います。
各部エレメント交換（エンジンオイルエレメント、燃料エレメント、作動油エレメント、エアーエレメント）
各部オイル交換（エンジンオイル、作動油、ポンプミッションオイル、走行ミッションオイル、旋回ミッションオイル）
冷却水交換
バッテリー交換
エアコンフィルター交換
エアコンガスチャージ
燃料タンク清掃
Vベルト交換

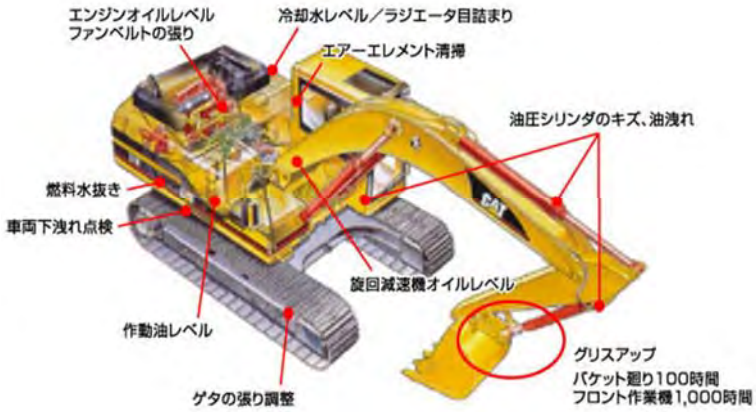


現場の生産性向上を図りたい

停止ロスの削減
Decrease the productivity on site.
Increase the cost at site
Increase the cost of maintenance.

ear

奥部品



Economic Life of Raod/Bridge Construction Equipment

S.N.	Name of Machine	Years	Km./hrs.
I.	Bittumenous Construction Equipment		
1.	Hot Mix Plant (Below 20 TPH)	12	9000 hrs.
2.	Hot Mix Plants (Above 20 TPH)	12	9000 hrs.
3.	Drum Mix Plants	12	9000 hrs.
4.	Paver Finisher	15	9000 hrs.
5.	Bitument Boilesrs	10	---
6.	Bitumen Pressure Distributor/ Bitument Transportaion Tanker	12	9000 hrs.
7	Bitumen Storage Tank	10	----
8.	Asphalt Mixer	12	8000 hrs.
9.	Front End Loader (Wheeler)	15	9000 hrs.
10.	Tippers	12	2,40,000 km.
11.	Chip Spreadoer	10	---
II.	Heaver Earth Moving Equipment		
1.	Dozer Wheeled	15	9000 hrs.
2.	Dozer Creqler	15	9000 hrs.
3.	Motorised scraper/ Towed screper	15	9000 hrs.
4.	Motor Grader	15	9000 hrs.
5.	Excavator upto 1 cum	12	10000 hrs.
6.	Mobile Crane	15	8000 hrs.
7.	Cumper (All size)	12	1000 hrs.
8.	Tractor (Wheeled)	12	1000 hrs.
9.	Grab Dredging Cranes	12	9000 hrs.
III	COMPACTION EQUITPMENT		
1.	Road Roller 8-10T	15	12000 hrs.
2.	Sheep foot Roller	15	---

エンジンオイルの交換
作動油の交換
作動油パイロットフィルターの交換
トランスミッシオンオイルの交換
走行装置のオイル交換
エアクリーナエレメントの交換
燃料フィルターの交換

The periodic inspection and maintenance, there is Commencement inspection (inspection before starting work), inspection and maintenance intervals, the occasional inspection and maintenance, the monthly-annual periodic inspection record table, implementation is required without omission

1.	Truck	12	2,40,000 km.
13.	Stone Crushing & Screening Unit	10	10000 hrs.

c. Pavement construction and repair

c-1. Planning of construction

What kinds of the information you need to start and complete the project?

Example in japan

Documents of construction plan must contain the followings.

1. Outline of the project

- Name of the project
- Route name
- project location
- Period of the project
- Contract Amount
- Client name
- Contractor name
- Bill of quantities
- Location map
- plan view
- Typical section and others

2. Construction schedule

- Bar chart or Network scheduling

3. Site organization

- Organization
- Person in charge
- Duty of each person

4. Specified machineries

- Name of machine
- Maker
- Capacity
- Usage

Construction machine may cause the noise and vibration. Where it should be limited, client specify the type of machine to minimize the noise and vibration.

5. Main machineries list

- Same with 4.

6. Main materials list

- Name of materials
- Maker
- Standard/Quality
- Quantity
- Usage
- * Does it meet to spec?

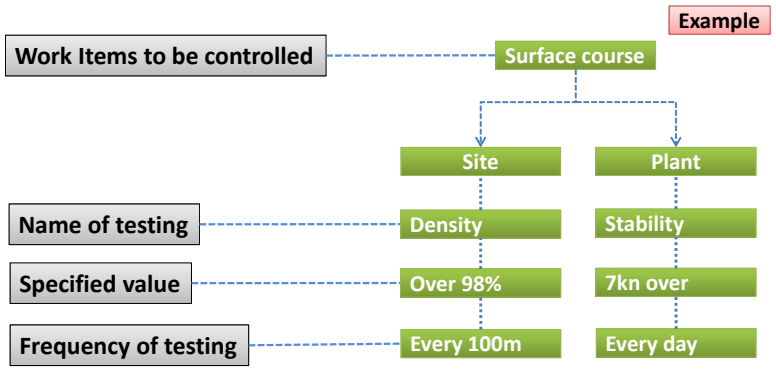
7. Construction procedure

- Construction order of the work item
- Description of the each work items
  - How to
  - Points of concern
  - Machine to be used
- * Does it meet to spec?

8. Construction management plan-1

Quality control plan

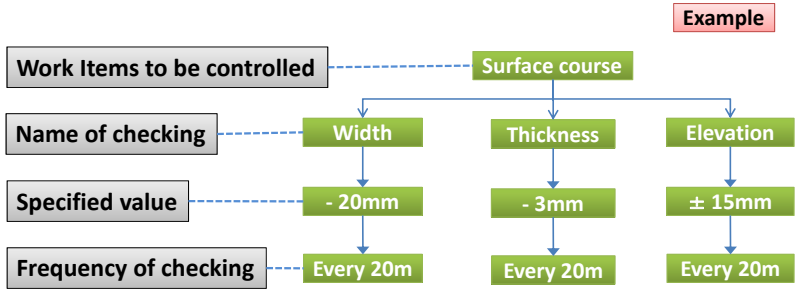
Check the required quality to confirm construction/production procedures are stable or not.



8. Construction management plan-2

Shape and elevation control plan

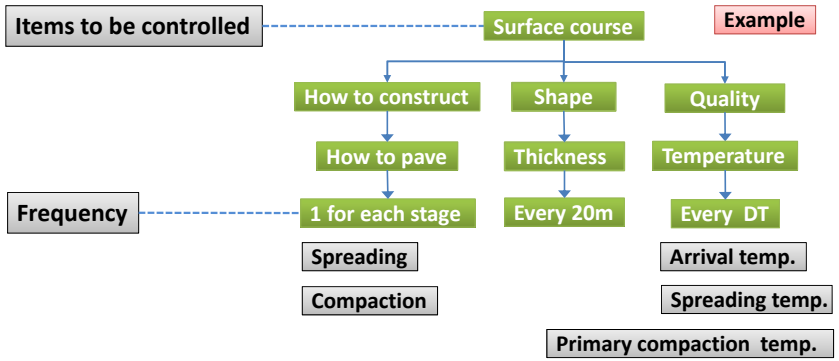
Check all dimension and others to confirm that construction procedures are stable or not.



8. Construction management plan-3

Picture control plan

Take pictures to prove that the dimension, quality and procedure of construction are meet to specifications.



9. Safety control

- Safety organization
- Prevention plan of Disasters.
- Safety training plan.
- Safety patrol plan.

10. Correspondence in emergency

- Contact diagram in accident.
- Disaster prevention plans in Unusual weather.

11. Traffic control plan

- Temporal Traffic control plan.
- Temporal traffic sign.
- Traffic Safety facility plan.

12. Environmental measures

- Air Pollution measures.
- Water pollution measures.
- Noise and vibration measures.

2. Pavement method

Types of Pavements

Flexible Pavements ➡ **Asphalt concrete** ★

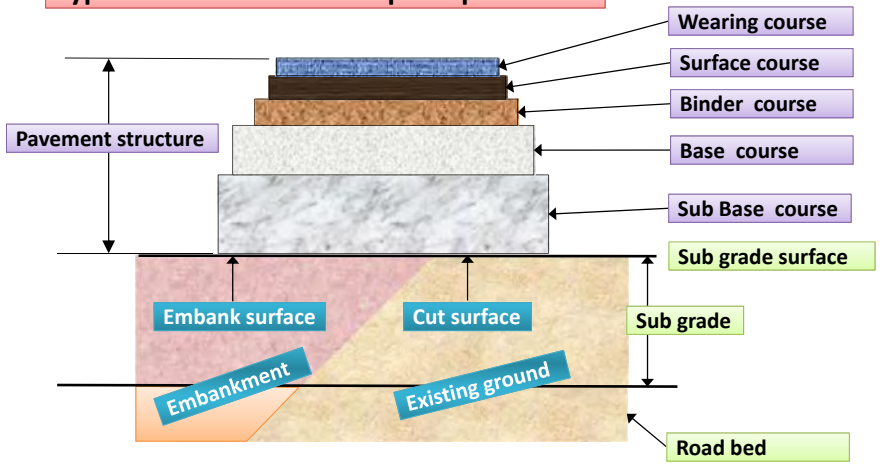
1. Deformation in the sub grade is transferred to the upper layers
2. Low construction cost but high repairing cost
3. Have low life span (High Maintenance Cost)
4. Expansion joints are not needed
5. Road can be used for traffic within 24 hours after pave
6. Damaged by Oils and Certain Chemicals

Rigid Pavements ➡ **Cement concrete**

1. Deformation in the subgrade is not transferred to subsequent layers
2. Low repairing cost but construction cost is high
3. Life span is more as compare to flexible (Low Maintenance Cost) X
4. expansion joints are needed
5. Road cannot be used until 14 days of curing after pave
6. No Damage by Oils and Greases

Asphalt concrete pavement

Typical Structure of the asphalt pavement



Machine to be used.


Asphalt Paver


Water truck


Hand guide roller


Steel roller


Plate compactor


Pneumatic roller

Procedure of Asphalt pavement

1.Preparations of the base surface
2.Prime coat/Tack coat
3.Curing
4.Paving Lane marking And Form setting
5.Machine setting
6.Start paving
7.Compaction
8.Open for traffic

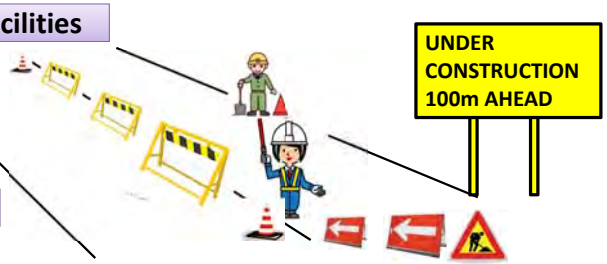
- Material order — Damp truck
- Date — How many
- Starting time
- How many tons or final delivery time
- Machine transport
- Delivery of Material

Procedure

Tool box meeting everyday in the morning

- Today's schedule — How many tons, How many meter and etc.
- Work sequence — Start point, order, End point and etc.
- Duties of each personal
- Safety — Pre- see and how to prevent accident.

Setting of safety facilities



Start daily works

1.Preparations of the base surface

- Enough compaction with watering.
- Enough grading.
- Density test.
- Check the thickness, width and elevation.
- Clearing of foreign matter and debris on the base.

2.Prime coat/Tack coat

- Check the application ratio.
- Sand spreading (Prime coat)

3.Curing

- Water in the emulsified asphalt should be evaporated.
- Penetration in the base course

4.Paving Lane marking And Form setting

- Determine the paving sequence in advance
- All workers have to know the order to pave

The day before pave is better

Include all corners and widening area

5.Machine setting

→ Inspection before transport

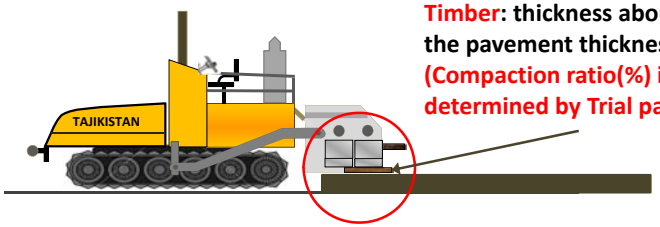
Start Heating of Screed at least 1hour before pave.

Daily inspection before Start the work

Set the paver on the line.

Especially water supply system of rollers

Set the screed.



Timber: thickness about 20% of the pavement thickness (Compaction ratio(%) is determined by Trial pavement)

6.Start paving 1

The followings should be carried out at regular intervals during paving operations:

a. Check the temperature of the mixture before unloading.

- Material which temperature is low should be rejected
- Inform it to asphalt plant immediately

b. Visual inspection of the mixture(appearance, quality)

- Does all aggregate covered by bitumen?
- Does appearance is same with previous one?
  - Grading, Luster, Foreign material etc.

2

c. Amount of mixture being placed and layer thickness

- Check the laying thickness by thickness gage.
- How many tons are paved to the placed area.
  - Smaller than design. → Thin → thickness problem
  - Bigger than design. → Thick → Cost problem

Adjust the laying thickness

3

d. Visual inspection regarding to uniform surface condition of the placed layer.

- Treat the rough surface manually by using sieve and other.
- No spot bleeding because of mixing problem?

e. Alignment of edges. (correct location and true alignment)

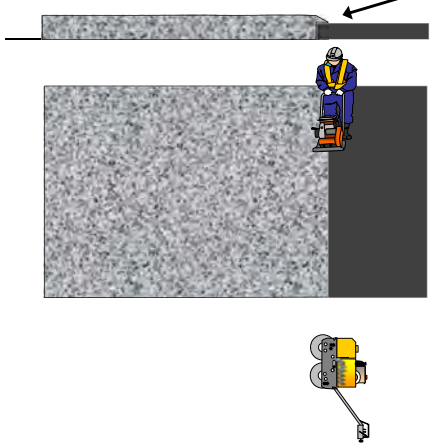
f. Quality/condition of longitudinal and transverse joint.

- difference in level
- Rough joint

g. Inform the final tonnage to Asphalt plant.

7.Compaction

a. At first treat the transverse joint.



Treat the joint

↓

*Compact the joint first by small compacter.

Plate compactor.

Hand guide roller.

↓

Check the joint surface condition and repair if necessary

If new surface is flat with existing, it will get low by compaction by roller.

↓

Start compaction

b. Start the primary compaction by Steel roller as soon as possible.

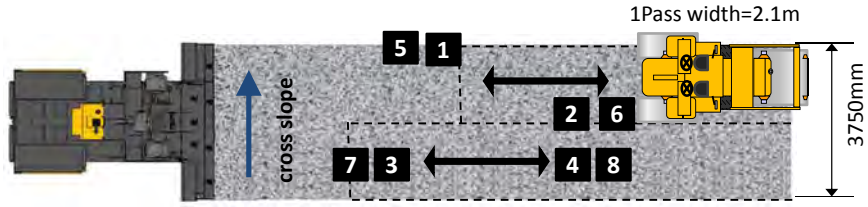
Speed : 2～3km/h(almost same speed with human slowly walk)

★ Minimum temperature 110℃

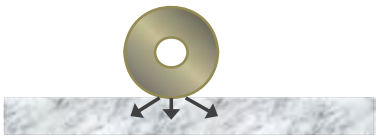
1.Longitudinal joint

2.Lower area of cross slope.

3.Go up the cross slope.



Number of compaction is determined by trial pavement.

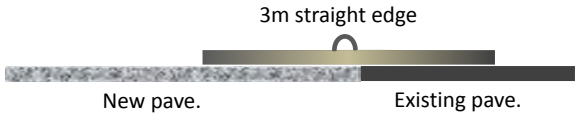


Primary compaction mainly effect to longitudinal direction.

Primary compaction push down the large particles.

← longitudinal direction

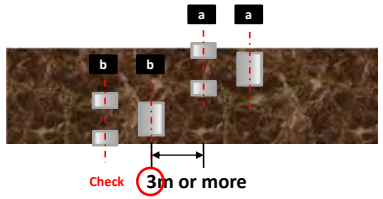
Check the joint condition by 3m straight edge



★ Just little higher than existing is better, because additional secondary compaction will come.

Correct the gap immediately by using sieve and other if there are Irregular gap.

Do not stop the roller at the same position with previous compaction.

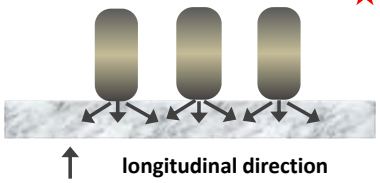


Stoppage at same position makes bigger unevenness after compaction finish!!

c. Secondary compaction by pneumatic roller

Speed : 6～10km/h(Faster than human walk)

★ Enter from the drive wheels.



↑ longitudinal direction

Secondary compaction mainly effect to transverse direction.

Secondary compaction push the fine particles into the void and gap in the mixture. And it makes dense surface.

d. Finishing compaction by pneumatic roller or steel roller.

- Correct the unevenness.
- Remove the roller marks*

*indentations on the surface caused by rolling operations

- Additional roller is required if paving area/unit hour is large.

8. Open for traffic

- Traffic release at higher temperatures cause a rutting.
  - ⮡ Open the traffic at About 50 ˚C.

Capacity of pavement by your AP

AP Capacity — 600kg /batch/min. X 60min. = 36t/hour

How many Square meter you can pave per hour?

5cm thick Density = 2.45t/m³

36t/hour ÷ 2.45t/m³ ÷ 0.05m

$$= \frac{36\text{t/hour}}{2.45\text{t/m}^3 \times 0.05\text{m}} = 294\text{m}^2\text{/hour}$$

By no loss

- 3% loss → 285m²/hour
- 5% loss → 280m²/hour △
- 10%loss → 267m²/hour X

Thank you.

3. Maintenance and Repair of pavement

1.Types of maintenance

a. Preventive Maintenance:

Purpose
- Extend the functional life of a pavement.
- Retard progressive failures.
- Reduce the routine maintenance and service activities.

Typical Activities
- Crack sealing.
- Rut filling.
- Thin overlay.

b. Corrective Maintenance:

Purpose
- After a deficiency occurs in the pavement .
  - Severe friction(wearing).
  - Rutting of moderate to severe.
  - Extensive cracking.

Typical Activities
- Milling and overlay.
- Structural repair.
- Patching.
- Pothole repair.

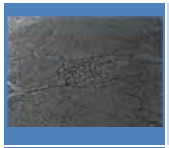
c. Emergency Maintenance: (temporal maintenance)

Purpose
- To avoid accident.
- Temporal treatment to keep traffic path.

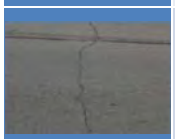
⬇

more permanent repairs will be done.

Type of Damages -1

TYPE OF DAMAGE		POSSIBLE CAUSE	MAINTENANCE SUGGESTIONS
	Alligator Cracking	1.Excessive loading 2.Weak surface, base, or subgrade 3.Thin surface or base 4.Poor drainage 5.Any combination of 1-4	・Full-depth replacement
	Block Cracking	1.Old and dried out mix 2.mix with low penetration asphalt & absorptive aggregates 3. Deterioration by low traffic volume	・Any surface treatment or thin overlay
	Edge Cracks	1.Lack of lateral support 2.Settlement of underlying material 3.Shrinkage of drying out soil 4.Weak base or subgrade layer 5.Poor drainage 6.Heavy traffic pass	・Improve drainage. ・Fill cracks with asphalt emulsion slurry or emulsified asphalt ・Crack seal/fill

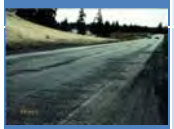
Type of Damages -2

TYPE OF DISTRESS		POSSIBLE CAUSE	MAINTENANCE SUGGESTIONS
	Longitudinal (Linear) Cracking-1	1.Shrinkage of the asphalt layer 2.Cracks in an underlying layer reflect up through the pavement 3.Repeated stress by wheel	・Seal crack or fill with asphalt emulsion slurry or light grade of asphalt mixed with fine sand. ・Crack seal/fill
	Longitudinal (Linear) Cracking-2	1. Poor longitudinal joint construction. 2. No tack coat on the joint.	
	Transverse Cracking	1.Shurinkage by cold temperature 2.Daily temperature cycling 3.Poor transverse joint construction 4.No tack coat on the joint	

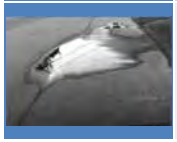
Type of Damages -3

TYPE OF DISTRESS		POSSIBLE CAUSE	MAINTENANCE SUGGESTIONS
	Reflection Cracking	1.Differential movement between the asphalt and concrete layers (Joint of PCC)	・Crack seal/fill
	Slippage Cracks	1.Lack of a good bondage between surface layer and the base below due to dust, oil, dirt, water and other non-adhesive material 2.Tack coat has not been used 3.Mixture has a high sand content 4.Vehicular turning or stopping movements on pavements with a low-strength surface mix	・Partial or full-depth patch

Type of Damages -4

TYPE OF DISTRESS		POSSIBLE CAUSE	MAINTENANCE SUGGESTIONS
	Corrugations & Shoving	1.Mixtures too high in asphalt 2.Low air voids 3.Fine aggregate content too high 4.Excessive moisture or contamination in the granular base 5.Smooth or rounded aggregate Incorrect asphalt grade	・Full-depth patch ・Removal/Cold mill and overlay
	Rutting	1.Consolidation or lateral movement of any of the pavement layers or the subgrade under traffic 2.Lack of compaction 3.Weak asphalt mixtures 4. Physical loss due to wearing by studded tire	・Removal/Cold mill /leveling and overlay or thin surface patch
	Raveling	1.Inadequate compaction during construction. 2.Mechanical dislodging by certain types of traffic (studded tires, snowplow blades	・Remove or cold mill and overlay

Type of Damages -5

TYPE OF DISTRESS		POSSIBLE CAUSE	MAINTENANCE SUGGESTIONS
	Pot Hole	1.Continued deterioration of another type of distress, such as thawing of a frozen subgrade, cracking, raveling, or a failed patch after pieces of the original pavement surface have been dislodged 2.Poor surface mixtures 3.Weak spots in the base or subgrade 4.Severity of the surrounding distress and traffic action accelerate potholes	・Partial, full-depth patching
	Settlement/ Grade Depressions	1.Settlement or failure in the lower pavement layers 2.Improper construction techniques	・Cold mill and overlay ・Thin surface patch

3.Types of repairing

a. Crack Seal/Fill

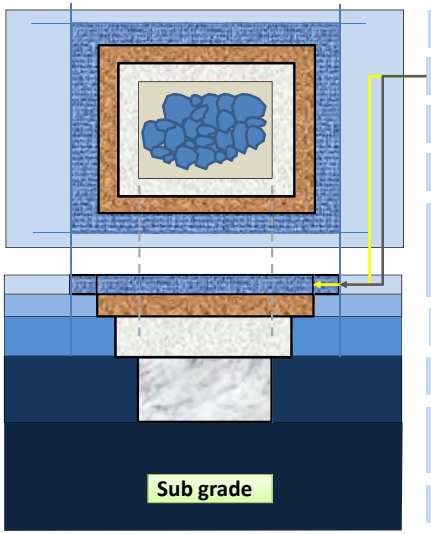
Cracks that are sealed are typically less than 3/4-inch wide.

Object	**Early stage** longitudinal cracks, transverse cracks, reflection cracks and block cracks.
Purpose	To prevent entering of water, sand, dirt, rocks or weeds
Material	Heated liquid asphalt / Rubberized asphalt / Sand or rock dust
Note	Crack sealing is best done in moderate temperatures (spring or fall)
	Cracks need to be routed out
	Cracks need to be cleaned
	Performed immediately after cracks occurs.

b.Full-depth replacement 1

Object	Alligator Cracking
Purpose	To improve pavement structure
Material	Subgrade material* / Sub base material* / Base course material*
	*Depend on the investigation result of the cause on damage.
	Cutback asphalt or emulsified asphalt / Asphalt hot mixture
Machine	Asphalt cutter / Excavator* / Dump truck* / Tamping compactor
	Plate compactor / Hand guide roller / Heavy roller*
	Asphalt distributer* or hand sprayer* / Asphalt paver*
	*Depend on the volume of works.
	Water tank truck*
Note	Each layer have to keep a gap at least **15**cm at all 4 sides.
	Clean/wash AC cut surface!!

b.Full-depth replacement 2



- Decide the damaged area
- Cut the AC pavement(2 line)
- Remove the AC
- Remove the base, sub base
- Fill the new acceptable sub base and base materials for each layer and compact until get the specified density for each layer
- Remove the AC surface course.
- Clean the base surface and AC cut surface
- Apply prime coat and tack coat on AC cut surface
- Construct AC layer after curing of coating

AC : Asphalt Concrete

c. Removal/Cold mill and overlay 1

- Object: Rutting, Raveling, Bleeding, Shoving, Settlement
- Purpose: To improve pavement surface condition
- Material: Cutback asphalt or emulsified asphalt, Asphalt hot mixture
- Machine: Milling machine*or excavator, Dump truck, Compressor, Asphalt distributer, Motor grader**, Asphalt paver, Pneumatic tired roller, Steel roller, Water tank truck, Hand guide roller, Plate compactor

*This machine is not include in Machine-donating from Japan

**In case of removal

- Limitation in use: Under layers should not have any distress/damage
- ***Milled surface should be bituminous or rigid one

***In case of milling

c.Removal/Cold mill and overlay 2

a. Cold milling

Purpose

1.Recycling of the road surface

Milled surface will receive new layer

→ Get Comfortable drive

2.Remove damages from the surface

- Raveling
- Bleeding
- Rutting
- Shoving:
- Swells
- Bumps
- Depressions

Milling thickness can be controlled

b. Overlay

Start the paving after enough cleaning and tack coat

Please follow to the pavement procedure of
『PAVEMENT METHOD』

▪In case of only 1 layer of Asphalt pavement

→ **Removal of asphalt layer and AC pavement**

3. Maintenance and Repair of pavement

1.Types of maintenance

a. Preventive Maintenance:

Purpose
- Extend the functional life of a pavement.
- Retard progressive failures.
- Reduce the routine maintenance and service activities.

Typical Activities
- Crack sealing.
- Rut filling.
- Thin overlay.

b. Corrective Maintenance:

Purpose
- After a deficiency occurs in the pavement .
  - Severe friction(wearing).
  - Rutting of moderate to severe.
  - Extensive cracking.

Typical Activities
- Milling and overlay.
- Structural repair.
- Patching.
- Pothole repair.

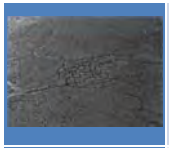
c. Emergency Maintenance: (temporal maintenance)

Purpose
- To avoid accident.
- Temporal treatment to keep traffic path.

⬇

more permanent repairs will be done.

Type of Damages -1

TYPE OF DAMAGE		POSSIBLE CAUSE	MAINTENANCE SUGGESTIONS
	Alligator Cracking	1.Excessive loading 2.Weak surface, base, or subgrade 3.Thin surface or base 4.Poor drainage 5.Any combination of 1-4	・Full-depth replacement
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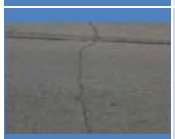	Transverse Cracking	1.Shurinkage by cold temperature 2.Daily temperature cycling 3.Poor transverse joint construction 4.No tack coat on the joint	

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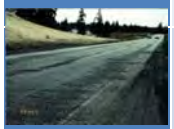	Raveling	1.Inadequate compaction during construction. 2.Mechanical dislodging by certain types of traffic (studded tires, snowplow blades	・Remove or cold mill and overlay

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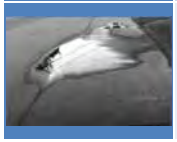	Settlement/ Grade Depressions	1.Settlement or failure in the lower pavement layers 2.Improper construction techniques	・Cold mill and overlay ・Thin surface patch

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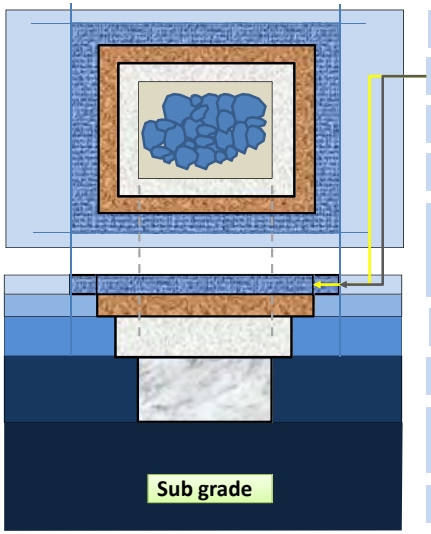
b.Full-depth replacement 2



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- Shoving:
- Swells
- Bumps
- Depressions

Milling thickness can be controlled

b. Overlay

Start the paving after enough cleaning and tack coat

Please follow to the pavement procedure of
『PAVEMENT METHOD』

▪In case of only 1 layer of Asphalt pavement

→ **Removal of asphalt layer and AC pavement**

4. Quality control at site

For asphalt pavement

How to keep the requirement of specification?

1.Check the temperature of asphalt mixture

↳ **Every tracks**

2.Check the appearance of asphalt mixture

↳ **Mixing is enough or not?**

↳ **All particles are covered with asphalt?**

Asphalt is not biased?

Particles are not segregated?

No spot breeding?(After spreading)

3. Reject the material if bad quality

↳ **Inform it to asphalt mixing plant**

↳ **Which dump track?**

Reason (Low temp, segregation)

AP will take action to improve ↵

4.To get the required density

↳ **Proper preparation to start paving**

↳ **Long time stand-by cause Temperature drop**

Check the temperature of primary compaction

Start primary compaction as soon as possible

Keep the number of compaction which determined by trial construction

5. Take core sample to check density

↳ **Check density everyday when pave**

↳ **Judge work procedure was good or not**

Safety

Anybody who get accident will cry, but also the person who make the accident will also cry.

Please think about their family

Never make accident!!!!!

1.For pedestrian and vehicle traffic

a. Set the barricades and others to prevent entering of them.

b. Set the signboards

c. Assign a traffic guide

2.For Workers

a. Tool box meeting in the morning

- Today's schedule
- Work sequence
- Duties of each personal

Safety

- **What kind of accident may happen**
- **How to prevent it**
- **What you have to do**

What kind of accident may happen

a. Worker working on the ground was injured/killed by roller

Do not enter in dead angle!

Operator must check around!

Assign a person who take care of safety!

b. Worker taking rest in the shade of roller was injured/killed by roller.

Do not take rest in the shade of machine!

Operator must check around the roller before get on!

c. Wheel loader hit the person near by at asphalt plant

Close the working area when working!

Operator must check his surroundings!

d. Belt conveyer roll up workers at asphalt plant and crushing plant

Do not start without notice!

Always check the emergency rope*!

Workers who work near there

- **Wear should not have rope**
- **Hem of jacket should put in the trousers**

*** Every belt conveyer has emergency rope to stop it**

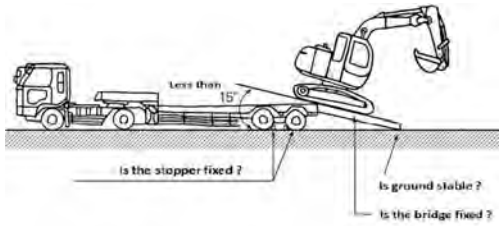
e. Machine go down without operator at slope area

Do not Park without stopper!

Stop engine when leave the seat!

Brake when leave the seat!

f. Fail at loading/unloading and travelling



Work at flat and stable area!

Fix the stopper under the wheel!

Check the bridge!

Steel roller is easy to slip down!

Tight the machine by proper tools !

g. Machine hit track/another machine

Assign a person who guide machine and tracks!

These are only a few examples on many kinds of accidents

Safety meeting before start your job!!

Thank you

PD-8

Проект по улучшению содержания дорог

Quality Control of Asphalt Mixture

September,2016

CTI Engineering International Co., Ltd.
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Проект по улучшению содержания дорог

Quality Control of Asphalt Mixture

1 . Purpose

- Confirm whether a produced mixture complies with the mix design
- Confirm whether frequent mixture variation does not occurs, when producing mixture
- Reduce variation in quality of the produced mixture
- It is a technical basis for certifying the pavement quality
- It provides a technical clue when investigating the cause of irregularity

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Проект по улучшению содержания дорог

Quality Control Training

Quality Control Training was conducted in Vahdat laboratory from June 2015 until July 2016 for lab technicians from Gissar and Kurgan-tyube regions into II sessions.

Session I.(2015)

1) Installation and Operation check of Quality Control Equipment
2) Sieve Analysis and Combined Gradation Test
3) Density Test and Marshall Stability Test
4) Core sample

Session II(2016)

1) Combined Gradation (Using Graph Line) and Mix Design Calculation
2) Aggregate density and Maximum Theoretical Density Calculation

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Проект по улучшению содержания дорог

Introduction and Installation Process of Quality Control Equipment(Session I/2015)

Introduction training process

Training on utilization equipment process

Installation equipment process

Installation equipment process

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2. Daily Quality Control in the Asphalt Plant

Table-1 Tests of Daily Quality Control

Test Name	Frequency	Test Item	Purpose	Test Method	Notes
Sieve Analysis of Aggregate	1time/Day	Grading	Combined Gradation	ASTM C 136	Every Hot Bin
Density Test(Marshall)	1time/Day	Bulk Density	Standard Density Void	ASTM D 2726	3Piese/time
Marshall Stability Test	1time/Day	Marshall Stability Flow	Marshall Stability	ASTM D 6927	3Piese/time 4.9kN or more
Density Test(Core)	Every 1,000m2	Bulk Density	Degree of Compaction	ASTM D 2726	95% or more

3. Sieve Analysis Test of Aggregate (Session I/2015)

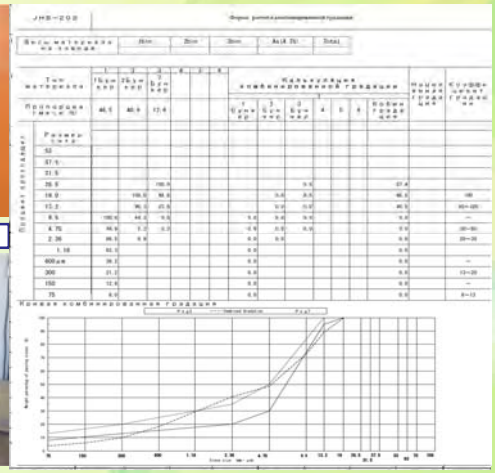
Sieve Analysis Test of Aggregate is covering following procedure

- Selection of Aggregate
- Sieving and weighing of aggregate
- Calculation of sieved aggregate
- Calculation of combined gradation
- Standard form for calculation of sieve analysis and combined gradation

Aggregate sieve analysis process (Session I/2015)

Taking sample from hot bin

Sieving and weighing process



Standard form for calculation

4. Marshall Stability Test (Session I/2015)

Daily Quality Control on production of asphalt plant is most important.

Marshall Stability Test has following steps:

Step 1. Taking sample from asphalt plant

Step 2. Heating up Marshall mold and collars in set and making Marshall Specimen(Required temp 145^0 C and 50/times both sides)

Step 3. Extruding Marshall specimen from Marshall mold

Step 4. Insert of specimen into water curing bath in 60^0 C during 30 minutes

Step 5. Conducting Marshall stability test

Step 6. Record of proof ring dial gauge and flow value in time

Step 7. Calculation of Stability kN and flow value 1/100cm in standard form after the completion of Marshall Stability Test

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Marshall Stability test procedure (Session I/2015)

Making specimen

50/ times compaction

Extruding specimen

Marshall Stability Test

Проект по улучшению содержания дорог

Marshall Stability test procedure (Session I/2015)

JHS-202 Форма испытания стабильности по Маршаллу (Стандартная форма)

1,030 g/cm³

Количество пробы	Содержание асфальта (%)	h 1	h 2	h 3	h 4	Среднее	Пустой вес (g)	Вес в воде (g)	Насыщенный поверхностный вес (g)	Объем (cm³)	Плотность (объем) (g/cm³)	8 (mm)	9 (kN)	10 (0.1mm)	11 (0.1mm)	12 (1/100cm)	Отметка
1		6,55	6,56	6,53	6,68	6,59	1143, 7	655, 0	1148, 6	493, 6	2, 317	52	6,7	45	44	44,5	4,9kN or More
2		6,57	6,66	6,53	6,66	6,60	1156, 3	661, 1	1160, 6	499, 5	2, 315	63	8,1	36	35	35,5	20-40
3		6,52	6,53	6,53	6,52	6,53	1167, 0	669, 1	1171, 1	502, 0	2, 325	58	7,8	38	38	37	
Среднее											2, 319						
4																	
5																	
6																	
Среднее																	
7																	
8																	
9																	
Среднее																	

Проект по улучшению содержания дорог

5 . Density Test（Marshall and Core）(Session I/2015)

Marshall density procedure (Laboratory)

- Making specimen for Marshall density test

Core density procedure (Site)

- Taking core sample from the paved field site using core machine
- Measuring of thickness from 4th side
- Weighing of Aerial weight, underwater weight and saturated surface dry weight
- Calculation specimen density using core specimen form
- The procedure for definition of density ratio takes one day

Проект по улучшению содержания дорог

Core density process (Session I/2015)

Taking core sample at the site

Weighing specimen

Measuring thickness

Calculation of density

Проект по улучшению содержания дорог

Core density process (Session I/2015)

Форма испытания плотности (пробный образец)

Название объекта _____

Название смеси _____ Испытающий человек

Точка бурения		Толщина							Плотность					Плотность	
		Измерения (cm)					По дизайну	Отличие	Вес (g)			Объем (cm^3) v=③-①	Объем плотности (g/cm^3) ①/V	基准密度	Коэффициент уплотнения (%)
Точка исследования	Место	1	2	3	4	Средний	(cm)	(cm)	Сухой весь ①	Весь в воде ②	Весь насыщености ③			g/cm³	
		5,3	5,4	5,2	5,3	5,3	5,0	0,3	920,6	523,0	925,1	402,1	2,289	2,319	98,7
		5,2	5,0	5,1	4,9	5,1	5,0	0,0	934,1	533,1	938,3	405,2	2,305	2,319	99,4
		4,9	4,8	5,0	4,7	4,9	5,0	-0,2	911,7	517,9	916,6	398,7	2,287	2,319	98,6
Средный						5,1		0,1					2,294	2,319	98,9

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Проект по улучшению содержания дорог

Session II (2016)

1)Calculation Combined Gradation and Mix Design process

Sieve analysis process

Calculation combined gradation process

Form for Calculation of Combined Gradation and Mix Design

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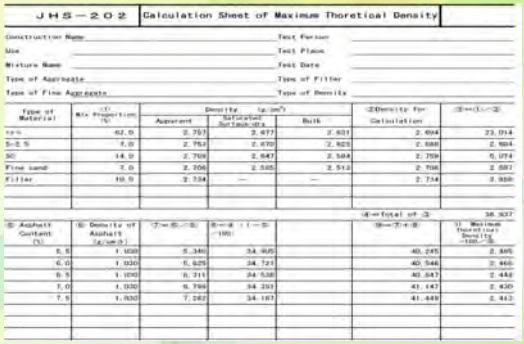
Проект по улучшению содержания дорог

Session II (2016)

2) Aggregate Density and Maximum Theoretical Density process

Process of washing aggregate

Calculation process of Maximum Theoretical Density



JHS—202 Calculation Sheet of Maximum Theoretical Density

Form for calculation Aggregate density and Maximum Theoretical Density

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Our conclusion on daily quality control

1) Conduct test for definite property and density of aggregate
2) Conduct Marshall Density test
3) Conduct Marshall Stability test
4) Conduct Core Sample test (Definition Compaction Ratio)
5) Calculation combined gradation and making mix design
6) Calculation Coarse aggregate density and Maximum Theoretical Density

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The result of Marshall Stability test 2015-2016 (Example)

Result of Marshall Stability test

No.	Result of Marshall test in Vahdat 2015-2016			Result of Marshall test in Jilikul 2015-2016		
	Marshall stability test	Flow value	Standard	Marshall stability test	Flow value	Standard
1	7,4kN(Rudaki-06 PP#2)	39	4.9kN/20-40	2,5kN(Chorbogh PP#2)	22	4.9kN/20-40
2	8.0kN(QC training)	34	4.9kN/20-40	3,2kN(Jilikul-01 PP#2)	28	4.9kN/20-40
3	9,1kN(QC training)	27	4.9kN/20-40	5,1kN(ZargarPP#2)	28	4.9kN/20-40
4	6,7kN(Rud-03 PP#2)	32	4.9kN/20-40	5,4kN(QC training)	28	4.9kN/20-40
5	8,0kN(QC training)	36	4.9kN/20-40	7,7kN(QC training)	52	4.9kN/20-40
6	8,0kN(QC training)	24	4.9kN/20-40	3,4kN(QC training)	21	4.9kN/20-40
7	4,4kN(QC training)	25	4.9kN/20-40	2,5kN(QC training)	20	4.9kN/20-40

Note: Quality Control trainings were conducted in Vahdat Asphalt Plant Laboratory and Lab technicians from Jilikul laborarty were invited to Vahdat Asphalt Plant laboratory.

Mixed with luquid bitumen

Does not properly made specimen (Does not match with norms of making Marshall specimen)

Recommendation for Technical Improvement in the Quality Control

1) The daily quality control must be custom for lab technician because if you will not conduct daily quality control you can not improve quality in production and quality at the site.

2) Stock of the daily quality control data ,because the skill of the quality controller improves and by the Line graph analysis it is possible to predict the quality change

3) The training for mastering a skill and knowledge of mix design, in addition , supply of the test equipment, because overall technical knowledge and skill to resolve technical problems that occur on the site will be necessary in future

Thank you for your attention!

Pilot Project #2 2016

Mini Workshop

Review **on P.P#2**

1.Plan and Actual

Plan	Length		Width	Area		Remark
Rudaki-02	223	m	8.0	1,784	m2	
	Access			216	m2	
Rudaki-03-1	150	m	7.0	1,050	m2	Canceled
Rudaki-03-2	210	m	7.0	1,470	m2	
Rudaki-03-3	860	m	7.0	6,020	m2	
Rudaki-03-4	150	m	7.0	1,050	m2	Added
Total	**1443**	**m**		**10,540**	**m2**	**（1505m）**

Actual	Length		Width	Area		Remark
Rudaki-03-4	150	m	7.0	1,050	m2	126t
Total	**150**	**m**		**1,050**	**m2**	

2. Location

Location map - 1

2. Location 48km from Bahdat Asphalt Plant

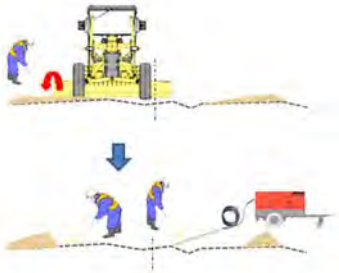
Location map - 2

3. Preparation work in Method Statements

1.Shoulder treatment

1-1)
Clean out the sand and garbage from the edge of road

1-2)
Manually(with compresser) clean the pavement surface



This activity has done as planed.
But, cleaning was not sufficient because of no compressor.

4. Pavement in Method Statements - 1

4 Bituminous pavement(Over lay)

4-1
Mark the center and edge line

Work was carried out properly!

4-2
Apply tack coat

*Handy type sprayer also acceptable.

*Check the apply rate (once a day)

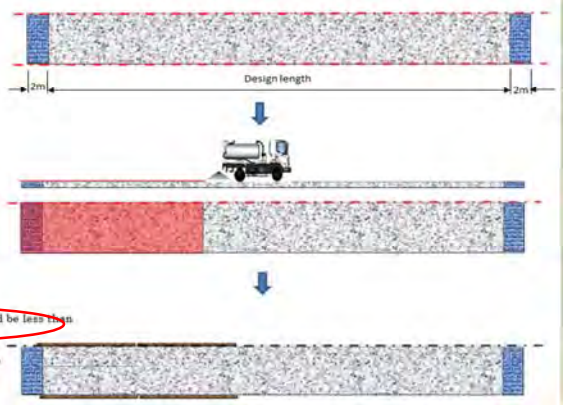
No check!

4-3
Set timber along the cener line and edge line

*the length of pavement for one time should be less than 200m for traffic control.

*Apply tack coat for joint again to enshure the stickness before pavement works

Good! You considered the intersection.



4. Pavement in Method Statements - 2

4-4-1
Set timber up with 6cm thickness

4-4-2
Set paver machine on the imber

*Heat scread up one houre before pavement operation start

No heating because no Gas and cylinder!

4-4-3
Start pavement

Check the hot mixture tempreture before unloading'

Filling up and compaction the small pots holls in front of paver machine before spread over lay

No check because no thermometer!

4. Pavement in Method Statements - 3

4-4-4
Take out the timber

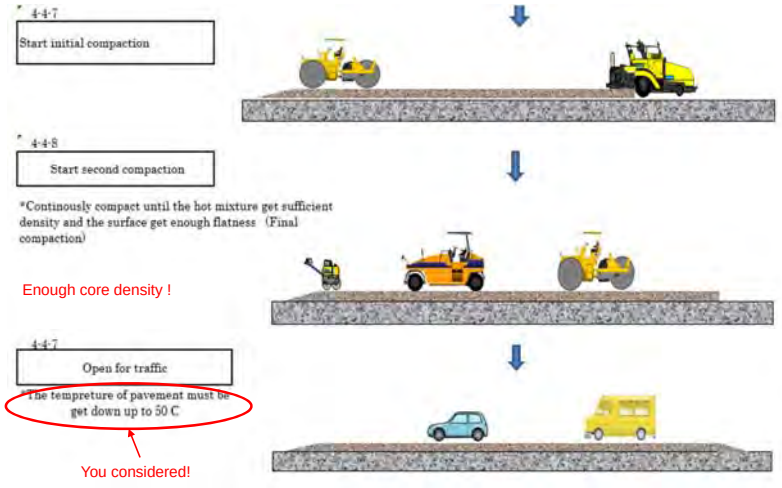
4-4-5
Make slope properly

Applied other method

4-4-6
Treat and complete the joint promptly and properly

Small compactors are not prepaired

4. Pavement in Method Statements - 4



5. Result - 1

Before repair

After repair

5. Result - 2

Quality of mixture and pavement

Standard density

	Density(g/cm3)	Stability(KN)	Core density(g/cm3)
Specimen-1	2.230	6.29	2.249
Specimen-2	2.236	7.58	
Specimen-3	2.222	6.16	
Average	2.230	6.68	2.249

Degree of compaction

2.249/2.230 *100 = 100.8%

6. Example of Defect -1

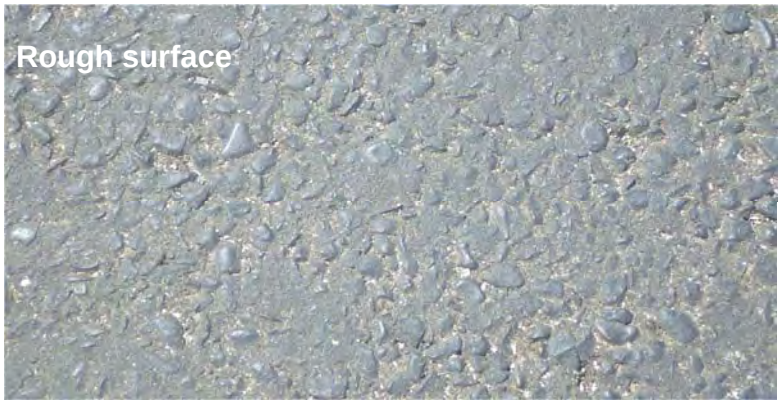
Tack Coat

Application of 0.1~0.3 lit/m2 (average 0.2lit/m2) was required in Guide line

Best condition

Actual application

6. Example of Defect -2



6. Example of Defect - 3

6. Example of Defect - 4

6. Example of Defect - 5

6. Example of Defect - 6

7. How we can improve/solve? - 1

1.Tools and consumables are not sufficient!

No asphalt cutter!

No timber!

No Gas for screed heating!

No sufficient hand tools!

No ---- etc.!

I understand that you can not solve these by your own effort!

But!

I hope you understand that we can get the better result if we can prepare/get even one of above !

7. How we can improve/solve? - 2

2.Tack coat application volume is small!

No weighing tool!

No checking material!

You can not solve this by your own effort!

But I want you to understand that 100% of existing surface should be covered by bitumen!

Worker should know the best/better visual condition after apply!

7. How we can improve/solve? - 3

3.Finished pavement surface is not good!

You can solve all of this by your own capacity!

!Education! and !instruction! to the operators and workers!

You have to know what is the reason of these defects.

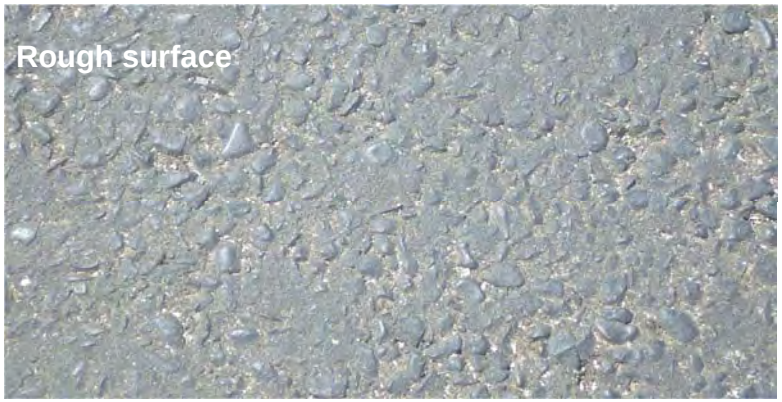
8. Let us find out the reason!!

Tack Coat

Application of 0.1～0.3 lit/m2 (average 0.2lit/m2) was required in Guide line

Best condition

Actual application



You can decrease those defect if you educate and instruct them what is required.

END