Road Asset Management Systems
+
Performance-Based Contracting

Session 3.2: Performance Standards

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Agenda

Day 1 Road Asset Management System (RAMS)	Day 2 Road Asset Management System (RAMS)	Day 3 Performance Based Contracting (PBC)
Session 1.1 **Introduction to RAMS**	**Session 2.1** **Data processing and management**	**Session 3.1** **Introduction to PBCs**
Coffee break	Coffee break	Coffee break
Session 1.2 **Functions of a RAMS**	**Session 2.2** **Data analysis and planning**	**Session 3.2** **Performance standards**
Lunch	Lunch	Lunch
Session 1.3 **Data to be collected**	**Session 2.3** **Road asset management**	**Session 3.3** **Inspections and Payments**
Coffee break	Coffee break	Coffee break
Session 1.4 **Method of data collection**	**Session 2.4** **Conclusions and way forward**	**Session 3.4** **Conclusions and way forward**

Performance Standards

- Performance Indicator
  - Defines what will be assessed/measured
  - Related to condition of specific road element
- Threshold
  - Value that the performance indicator cannot exceed
- Performance payment
  - Agreed payment made if the performance standard is complied with
  - Threshold is not exceeded

Performance Standards

- Drainage
  - Side drains, culverts
- Road surface
  - Potholes, cracks, edge break, ruts, ravelling, obstacles and sediment
- Shoulders
  - Potholes, drop-offs, banks, obstacles
- Right-of-Way
  - Vegetation control, visibility, obstacles
- Bridges and other structures
  - Bearings, erosion, concrete damage, steel painting
- Road furniture and markings
  - Markings, guardrails, signs, kilometre/marker posts
- Winter (generally with response times)
  - Snow removal, de-icing, salt/sand spreading
- Road usability (generally with response times)
  - Blockages (accident, landslide, flooding)
- Management and reporting
  - Performance report, condition and traffic data

Performance Standards

- SMART performance standards define what needs to be achieved
  - **S**pecific – define specific elements of the overall standard to be achieved
  - **M**easurable – contractor and employer can objectively verify compliance
  - **A**chievable – the defined threshold must be achievable at acceptable cost
  - **R**elevant – must be relevant to the standard to be achieved
  - **T**ime-bound – the standard must be achieved within a specific timeframe

SMART - Specific

- Performance Indicator is clearly defined
  - Not vague or open to interpretation
  - For specific road element and/or type of defect
  - Employer and Contractor are clear on what is meant

- Example
  - Road is in good condition
    - What elements of the road? What is good condition?
  - Cleanliness of road carriageway and shoulders when safety hazard - response time 12 hours
    - When is it considered a safety hazard? What is meant by cleanliness?
  - Culverts including inlet and outlet ditches for 3m on each end - < 20 % obstructed at any culvert
    - 20% of length? 20% of area? 20% of cross section?
  - No unsightly material on/in pavement, shoulder or drainage facilities
    - When is material unsightly?

SMART - Measurable

- Value of performance indicator can be objectively measured
  - Not subject to interpretation
  - Preferably easy to measure – no complicated equipment

- Measurement unit is suitable for the performance indicator
  - Use maximum number and dimensions of potholes rather than percentage

- Example
  - Traffic markings at least 70% visibility
    - Measured from what distance? Measured how?
  - Potholes on 1000 m^2 of carriageway, not more than 5 m^2 (0.5% of pavement)
    - 6 metre wide pavement – 30 m^2, >400 potholes of 30 cm diameter per kilometre
    - Lowest service level 50 m^2/ 1,000 m^2 – 4,000 potholes 30 cm, 4 potholes per metre

SMART - Achievable

- Performance standard can be achieved at acceptable cost
  - Target threshold should not be set too high
  - Be careful setting a threshold of zero for any defect – very costly to achieve
    - "No potholes" is very costly to achieve
    - "No potholes >30 cm" diameter is OK – potholes gradually grow in size

- Maximum threshold must not be too low
  - Important to use measurement units and values that clearly reflect what is desired

- Example
  - Allowable sediment in culvert pipe varying from "Forbidden" to "½ cross section"
    - How can we achieve no sediment whatsoever? What is the cost of doing so?
  - Maximum size of any pothole on the paved road surface 0.5 m^2
    - Equal to a pothole with a diameter of 80 cm

SMART - Relevant

- Performance standards must reflect a defect that is relevant to the condition of the road

- Example
  - Not cleaned side ditches < 50 m/km
    - Not the length of blockage is important, but the degree of blockage

SMART – Time-Bound

- Performance standards need to be achieved within set time period
  - For most performance standards – defect to be corrected before it exceeds the defined threshold
  - Some performance standards will have response times – defect to be corrected within the defined response time from the time of occurrence

- Example
  - Snow removal from carriageway after snowfall – response time 8 hours
  - Maximum interruption of traffic after accident – 24 hours
  - Road closure after flood waters have receded – maximum 6 hours

Example: Tajikistan

Roadway Surface, Shoulders and Roadside	
1.1 Road shall be open to traffic at all times with maximum interruption of:	24 Hours
2.1 Average Safe Operating Speed from beginning to end of the Road Section	60 km per hour (1 minute per km)
2.2 Potholes on road surface >10 cm in any dimension	No potholes > 0.5 m^2 or < 5 smaller potholes in any 1 km section
2.2a Maximum size of any pothole on the paved road surface	0.5 m^2
2.3 Potholes on shoulder > 15 cm in any dimension	< 15 potholes in any 1 km section
2.4 Vegetation on road formation including shoulders, medians and traffic islands	No vegetation >0.5 m tall in any 1 km section
2.5 Vehicles, soil, rock or other debris that compromises safety	Roadway clear and no material < 0.5 m outside of pavement edge
2.6 Vehicles, soil, rock or other debris not compromising the safety of road users	No unsightly material on/in pavement, shoulder or drainage facilities
Signalization and Safety Devices	
2.7 Road Signs are present, clean, visible and undamaged	No tolerance allowed
2.8 Pavement Markings	All markings visible at 100 m
2.9 Existing Guardrail	No section missing and/or damaged in any 1 km section
2.10 Guide Posts and guide barriers	Present, clean, visible and undamaged in any 1 km section
Winter maintenance	
2.11 After snowfall normal traffic movement shall be restored	< 15 cm of ice-pack or snow on roadway in any 1 km section
2.12 After traffic is restored	Place grit/salt mixture on roadway in any 1 km section
2.13 After roadway is cleared and daytime temperatures rise above freezing	Remove snow and ice from roadway, shoulders and drainage facilities
Road durability	
3.1 Cracks wider than 3mm	< 20 m in in any 1 km section
3.2 Raveling or stripping of aggregate on road surface	< 10 m^2 in in any 1 km section
3.3 Height of Shoulders vs. height of pavement	< 7.5 cm drop off in any 20 m length in any 1 km section
3.4 Culverts including inlet and outlet ditches for 3m on each end	< 20 % obstructed at any culvert
3.5 Bridge deck drainage system	Drains and scuppers shall allow unobstructed drainage at each bridge
3.6 Waterway under bridge	Clear of debris up to 100 m upstream of each bridge
3.7 Bridge damage not covered under routine maintenance	Damage on each bridge not covered under routine maintenance documented
3.8 Standing Water on roadway surface	Less than 20 m^2 water > 5 cm deep 3 hrs. after rainfall in any 1 km section
3.9 Standing water on paved and unpaved shoulders	Less than 40 m^2 ponding water more than 10 cm deep 6 hrs. after rainfall
3.10 Lined and unlined drains adjacent to the roadway	< 50% obstructed or impeding free water flow in any 1 km section
3.11 Erosion or damage in or adjacent to drainage structures or cut or fill slopes	No structural damage or eroded sections that impede or divert free flow

Example: Georgia

Defect Type		Performance Indicator		Threshold	Penalty
Performance Indicators, non-compliance results in 100% penalty		1	Potholes, diameter	>20 cm	
		1.1	Potholes and/or Edge breaks amount	>5 units	100%
		2	Drop-off; Height difference	>75 mm	100%
		3	Missing Traffic Sign related to Safety Element	1 unit	100%
		4	Missing Guardrails and parapets providing emergency safety measures	1 unit	100%
Pavement	Potholes, Edge Break	1	Potholes, diameter	≤20 cm	10%
		1.1	Potholes, Edge breaks amount	≤5 units	
		1.2	Edge Break, maximum width allowed	>75mm	
		1.3	Response time, potholes and edge break	10 days	
	Cracking	2	Cracks, maximum width allowed	5 mm	6%
		2.1	Response time-Crack sealing >5 mm	2 days	
	Rutting	3	Rutting, maximum depth allowed	30 mm	6%
		3.1	Rutting >30mm Response Time	30 days	
	Raveling	4	Raveling on the sections rehabilitated under this project	0 m^2	5%
		4.1	Raveling on the maintenance sections	>5% m^2	
		4.2	Raveling - Response Time	30 days	
Shoulders	Cleanliness	5	Cleanliness of road carriageway and shoulders when safety hazard. Response time	12 hours	8%
		6	Cleanliness of road carriageway and shoulders when no safety hazard. Response time	10 days	
	Drop-off	7	Drop-off; Height difference pavement vs shoulders > 25mm and < 75mm acceptable length/km	100 m	8%
		7.1	Drop-off; Response time: Excess length with drop-off > 25mm and < 75mm	15 days	
Drainage	Ditches	8	Road side ditches and lined drains. Response time when damaged/blocked	3 days	6%
		9	Other ditches. Response time when standing water	7 days	
	Culverts	10	Response time to culverts requiring cleaning or repair	30 days	6%

Example: Georgia (continued)

Defect Type		Performance Indicator		Threshold	Penalty
Road side	Vegetation Control	11	Up to 3m from road edge Maximum Height Vegetation	20 cm	5%
		11.1	Response time - Vegetation Control	5 days	
Safety	Signs	12	Road signs	0 defects	10%
		12.1	Response time - damaged signs; No safety element	30 days	
		12.2	Response time - damaged signs; Safety element - May be Temporary replacement	1 days	
	Guardrails and parapets	13	Guard Rail and parapets- true to line and level, undamaged, rust free, paint in good order	0 defects	10%
		13.1	Response time – Guardrails and parapets - provide emergency safety measures	2 days	
		13.2	Guard rails and parapets. Response time - Permanent repairs	14 days	
	Road Markings	14	Traffic markings, visibility	70 %	8%
		14.1	Traffic markings - Response time, restore to 100%	60 days	
Structures	Retaining Walls	15	Retaining walls; Structural damage of instability	60 days	3%
		16	Retaining walls; Damage or blockage to drainage	15 days	
	Bridges	17	Bridge Bearings and Expansion Joints; Free of dirt and debris; Properly sealed; Free draining; River Beds	-	3%
		17.1	Response time - Expansion Joints and River Beds	30 days	
	Steel Structures	18	Steel structures - Sound, safe and Corrosion free; paint in good condition	-	3%
		18.1	Response time - Steel Structures minor repairs to structure or paint	14 days	
		18.2	Response time - Steel Structures major repairs to structures or paint	90 days	
	Concrete Structures	19	Concrete structures - Free of damage, no spalling, no exposed reinforcement, no signs of rebar corrosion	-	3%
		19.1	Response time - Concrete Structures Minor Repairs	14 days	
		19.2	Response time - Concrete Structures Major Repairs	60 days	

Example: China (Yunnan)

Defect type	Performance Standard	Deduction
Drains and ditches	• No more than 10% of the cross section of a drain or ditch is obstructed at any location • Lined ditches do not have structural damage and are firmly contained by surrounding soil or material	30%
Vegetation control	• Height is <10cm within 5m of the edge of the pavement or side drain • No vegetation obstructs the view of road signs • No vegetation is located in structures or sealed surfaces • Vertical clearance of vegetation over the pavement is >6m	20%
Retaining walls	• Retaining walls are stable, without damage and weep holes are clear	10%
Slopes and fences	• Slopes are intact with no loose rocks and free of erosion • Fences are in good repair with no missing sections	10%
Greening	• Trees, flower beds are properly tended and fertilised and trees are whitewashed as needed	10%
Block/alligator cracks	• No cracks >3mm wide • Total area of cracks is ≤20m^2 per 1km section	50%
Longitudinal/ transverse cracks	• No unsealed cracks >3mm wide • Total length of unsealed cracks ≤100m per 1km section	50%
Potholes	• No potholes >15cm diameter or >3cm depth • Total number of potholes is ≤5 per 1km section	50%
Ravelling	• Total area of ravelling is ≤20m^2 per 1km section	50%
Rutting	• No ruts >3cm deep • Total length of rutting is ≤25m per 1km section	50%
Depressions	• No depressions >3cm depth • Total area of depressions is ≤20m^2 per 1km section	50%
Shoving	• No shoving >3cm height difference • Total area of shoving ≤20m^2 per 1km section	50%
Bleeding	• Total area of bleeding is ≤20m^2 per 1km section	50%
Edge break	• No loose or breaking pavement edges • Pavement width is at least 95% of design width as mentioned in contract	50%
Cleanliness	• No soil, debris, trash, other objects or oil/chemical spills on pavement or shoulder	10%
Shoulder	• Length of shoulder continuously higher or >3cm lower than pavement does not exceed 25m in any 1 km section	30%

Example: China (Yunnan-continued)

Defect type	Performance Standard	Deduction
Bridges	• Guardrails are present and not deformed • All metal parts of the overall structure are painted or otherwise protected and free of corrosion • The bridge deck is clean and the deck material is fully intact and bolted down • The drainage system is in good condition and fully functional • Expansion joints are clean and in good condition • There are no obstacles to the free flow of water under the bridge and up to 100m upstream • The clearance under the bridge is according to design • There is no erosion around bridge abutments and piers	50%
Culverts	• No more than 10% of the cross section is obstructed at any location in the culvert • There is no structural damage and culverts are firmly contained by surrounding soil or material	20%
Tunnels	• Lighting, ventilation and emergency equipment are fully operational • The drainage system is in good condition and fully functional • Footpaths are clear of debris and in good repair • External structures are in good repair and clear of vegetation	50%
Signs	• Information signs are present, complete, clean, legible, and structurally sound • Warning and traffic signs are present, complete, clean, legible, structurally sound and clearly visible at night	20%
Horizontal demarcation	• Horizontal demarcation is present, legible and firmly attached to pavement	20%
Guardrails	• Guardrails are present, clean, without structural damage • No guardrail sections are missing	20%
Lighting	• Lighting is functioning with no more than 5% of total lights unserviceable	20%
Traffic Signals	• Traffic signals are functioning with no lights unserviceable	50%
Kilometre posts	• Kilometre and guidance posts are present, complete, clean, legible and structurally sound	10%

Example: Bangladesh

Item	Performance Standard	Measurement/Detection	Deduction
Cleanliness	• The road surface is clean and free of soil, debris, trash and other objects	• Visual inspection	10%
Depressions	• There shall be no depressions with a height difference of more than 30 mm	• Visual inspection	50%
Potholes	• There are no potholes with a diameter greater than 150 mm or deeper than 30 mm • There are no more than five (5) potholes in any continuous 1,000m section	• Visual inspection • Ruler (to check pothole size)	50%
Patches	• Patches are square or rectangular, are level with surrounding pavement, are made using materials similar to those used for the surrounding pavement, and do not have cracks wider than three (3) mm	• Visual inspection (for detection of shape and material used • Ruler (to check if patch is level with surrounding pavement • Small transparent ruler (for crack width)	50%
Cracks	• Mesh or block cracks with a width >6 mm do not cover more than 5m2 of any 100 meter road section • The total length of longitudinal cracks with a height difference greater than 10 mm, a width greater than 6 mm or having branches, is not more than 5 meters in any 100 meter road section	• Visual inspection • Small transparent ruler (for crack width and height difference)	50%
Rutting	• There are no ruts deeper than thirty (30) mm • Ruts are present in less than 25 percent of the road length under contract.	• 2 rulers (horizontal ruler of 3m length placed perpendicularly across lane; rut depth measured as space between horizontal ruler and lowest point of rut, using a small ruler with scale in mm)	50%
Raveling	• The area affected by raveling does not exceed 20% of any 100 meter section	• Visual inspection	50%
Edge damage	• There are no loose pavement edges, or pieces of pavement breaking off at the edges	• Visual inspection	50%
Pavement width	• The pavement width must be at least 5.5 meters wide	• Measuring tape (measuring the distances between the parts of the road edge closest together in any 50m section)	50%
Shoulders	• The shoulder is not continuously more than 30mm lower than the pavement in any 10m section • The shoulder is not continuously higher than the pavement in any 50m section • Shoulders are not obstructed by material • Road shoulders are outward sloping	• Visual inspection • Ruler	50%
Ditches and drains	• No more than 10% of the cross section is obstructed at any spot in a drain or ditch • Lined ditches do not have structural damage and are firmly contained by surrounding soil or material	• Visual Inspection	30%
Culverts and similar	• No more than 10% of the cross section is obstructed at any spot in the culvert • There is no structural damage and culverts are firmly contained by surrounding soil or material	• Visual Inspection	30%

Example: Bangladesh (continued)

Item	Performance Standard	Measurement/Detection	Deduction
Bridges	• Guardrails are present and not deformed. • All metal parts of the overall structure are painted or otherwise protected and free of corrosion • The bridge deck is clean and the deck material is fully intact and bolted down • The drainage system is in good condition and fully functional • Expansion joints are clean and in good condition • There are no obstacles to the free flow of water under the bridge and up to 100 meters upstream • The clearance under the bridge is according to design • There is no erosion around bridge abutments and piers	• Visual inspection	50%
Retaining walls	• Retaining walls are stable and without damage	• Visual inspection	50%
Concrete Barriers	• There are no cracks wider than 1.5 mm • There is no scaling or pop-outs • There is no unsound concrete • There is no widespread deterioration of the surface	• Visual inspection	50%
Slopes and embankments	• The embankment does not have deformations or erosion • Cut slopes are stable and/or adequate retaining walls and slope stabilization measures are in place	• Visual inspection	20%
Vegetation	• There is no vegetation in case of Culvert headwalls, Culvert pipes, Weigh pits, Lined channels, Sealed surfaces, Bridge decks • Vegetation height is less than 75 mm in case of Shoulders, Medians, Traffic islands and verges, Rest areas (including around rest area furniture), Side drains, Surface water channels with gradient < 3%, Culvert ends, Mileposts, Signposts, Bridge end and culvert markers, Guardrails, Sight rails, Lighting Columns, Bridge abutments • Vegetation height is less than 300 mm in case of Large vegetated areas, Surface water channels with longitudinal gradient ≥ 3%	• Ruler	25%
Vegetation clearance	• The vertical clearance between the road surface and the lowest point of tree or other plant is more than 2.5 metres	• Measuring tape	25%
Signs	• Information signs are present, complete, clean, legible, and structurally sound • Warning signs are present, complete, clean, legible, structurally sound and clearly visible at night • Traffic signs are present, complete, clean, legible, structurally sound and clearly visible at night	• Visual inspection	20%
Horizontal demarcation	• Horizontal demarcation is present, legible and firmly attached to pavement • Micro spheres are firm and visible	• Visual inspection	20%
Guardrails	• Guardrails are present, clean, and without any significant damage • Corrosion does not exceed more than 75% of the surface area • The thickness of the guardrails is more than 2.4 mm • The thickness of the pole is more than 3.5 mm	• Visual inspection	20%
Milestones	• Milestones and guidance posts are present, complete, clean, legible and structurally sound • Milestones and guidance posts are surface painted or otherwise covered	• Visual inspection	10%

Different Service Levels

- Some countries use differing service levels
  - For different road classes or existing road conditions
  - With the aim of reducing costs (for lower service levels)

- Avoid having too many sets of performance standards
  - Armenia: 3 service levels, for 3 road classes, for 3 road conditions: 9 performance standards for each defect – very little price difference

- Should result in significant cost difference vs condition difference
  - Do not necessarily change each threshold, only those that have cost implications
  - Response times (especially winter maintenance)
    - 4 hours or 2 days makes difference in amount of equipment required
  - Overall pavement thresholds
    - IRI<5 or IRI<6 can mean delay in treatment of 1 year or more
  - Specific defects often too little impact
    - 5 potholes/km or 7 potholes/km will have little impact on cost

Example: Armenia

Index code	Index name, defect content	Condition estimation	Maintenance level		
			high	middle	satisfactory
1.1.1	Shoulder (Curb) is higher than traffic lane edge	Good	Forbidden	Forbidden	Forbidden
		Satisfactory	Forbidden	Forbidden	Forbidden
		Bad	Forbidden	Forbidden	Forbidden
1.1.2	Shoulder (Curb) is lower than traffic lane edge for more than 5cm (lm/km) Defect elimination time - 10 days.	Good	Forbidden	100 (150,200)	150 (200,250)
		Satisfactory	50 (100,150)	100 (200,300)	200 (250,300)
		Bad	-	- (300, 400)	250 (350,450)
1.1.3	Rough Shoulder (Curb) (slopes, wash away having up to 7cm depth) on l. km, not more than m^2 Defect elimination time - 10 (15, 20) days.	Good	30 (60, 100)	50 (100, 200)	70 (150, 300)
		Satisfactory	40 (70, 150)	75 (150, 250)	100 (200, 350)
		Bad	- (300,500)	150 (400,600)	200 (500, 700)
1.1.4	Shoulder (Curb) grass higher than 10 cm, branches preventing visibility, lower for 1,2 (lm/km): Defect elimination time – 5 (7, 10) days.	Good	Forbidden	30 (50,100)	50 (80,250)
		Satisfactory	20 (50, 100)	40 (80,150)	60 (100,200)
		Bad	- (80, 150)	75 (150,200)	100 (200,400)
1.2.1	Not cleaned side ditches (water drifts, slope landslide), (lm/km). Defect elimination time - 3 (5, 7) days.	Good	50 (100,200)	80 (150,250)	100 (250,450)
		Satisfactory	100 (200,300)	150 (300,400)	200 (400,600)
		Bad	150 (300,400)	200 (400,600)	300 (600,800)
1.2.2	Chutes filled with rain water drifts (% of total length of chute). Defect elimination time is 5 (7, 10) days.	Good	10 (25, 40)	20 (30, 50)	30 (40, 60)
		Satisfactory	20 (40, 50)	30 (50, 70)	40 (60, 80)
		Bad	-	60 (70, 80)	70 (80, 90)
1.2.3	Water penetration under chute as a result of its separate ring sinking (% of total length of chute). Defect elimination time - 7 (10,15) days	Good	6 (10,20)	10 (20, 30)	15 (25, 40)
		Satisfactory	10 (25,35)	10 (40, 50)	30 (50, 60)
		Bad	-	30 (50, 60)	40 (60, 70)
1.3.1	Grass in median higher than 15cm, Traffic (visibility) preventing branches (lm/km). Defect elimination time - 3 (5, 7) days.	Good	Forbidden	100 (200, 300)	200 (300, 400)
		Satisfactory	100 (200,300)	175 (250, 400)	225 (350, 500)
		Bad	-	200 (300, 400)	300 (400, 500)
1.4	Garbage and foreign items on traffic lane, shoulder (Curb) and slopes, occurring more often, than (m) Defect elimination time - 1 (2, 5) day.	Good	400 (300, 200)	300 (250, 150)	100 (75, 50)
		Satisfactory	250 (200, 100)	200 (150, 100)	100 (75, 50)
		Bad	-	100 (75, 50)	100 (50, 30)
2.1	Potholes on 1000 m^2 of carriageway, not more than (m^2). Defect elimination time: 5 days- good, 7 days – satisfactory, 10 days- bad.	Good	5 (10, 15)	7,5 (15, 20)	10 (20,30)
		Satisfactory	7,5 (15, 20)	10 (20,30)	15 (30,40)
		Bad	10 (20,30)	20 (30, 40)	30 (40,50)
2.2	Gravel surface roughness (slopes, rain water flow track with depth not more than 5cm. Defect elimination time - 7 days.	Good	5(10,20)	7,5 (15, 20)	10 (20,30)
		Satisfactory	7,5 (10, 20)	10 (20,30)	15 (30,40)
		Bad	10 (20,30)	20 (30, 40)	30 (40,50)
2.3	Raw cracks (longitudinal or transverse) with width more than 3mm (lm/km) Defect elimination time - 15 (20, 25) days.	Good	100 (200, 300)	200 (300, 400)	300 (400, 500)
		Satisfactory	250 (350, 450)	400 (500, 600)	500 (700, 800)
		Bad	500 (700, 800)	700 (800, 1000)	1000 (1400, 1600)

Example: Armenia (continued)

Index code	Index name, defect content	Condition estimation	Maintenance level		
			high	middle	satisfactory
3.1.1	Drifts, silt sediment in pipe (for rectangular pipe by acting height, and for circle one by diameter). Defect elimination time - 5 (10, 20) days	Good	Forbidden	1/10 (1/5,1/2,5)	1/6 (1/4,1/3)
		Satisfactory	1/10 (1/20,1/25)	1/5 (1/4,1/3)	1/4 (1/3,1/2)
		Bad	1/5 (1/4,1/5)	1/41/3,1/2)	1/3 (1/2,1/2)
3.1.2	Pipe bed inlet and outlet filling at a distance of 5m from the main part, grass with a height not more than 30cm (bed surface of %). Defect elimination time - 5 (10, 20) days.	Good	Forbidden	10 (25,30)	25 (30,40)
		Satisfactory	15 (20,30)	20(30,40)	30 (40,50)
		Bad	20 (30,40)	30 (54,50)	40 (50,50)
3.2.1	Garbage along railing/parapet with layer width of not more than (cm). Defect elimination time - 3 (5,10) days.	Good	Forbidden	10(20,30)	20(30,40)
		Satisfactory	10 (20,30)	20(30,40)	30(40,50)
		Bad	20 (30,40)	30(40,40)	40(50,50)
3.2.2	Plugging up of culverts of bridge, overpass traffic lanes, culvert holes situating under side walks with total number of %. Defect elimination time - 3 (5, 10) days.	Good	Forbidden	10 (20,30)	20(30,40)
		Satisfactory	10 (20,30)	20(30,40)	25(40,40)
		Bad	20 (30,40)	-	-
3.2.3	Bent, not painted, dirty barriers and guardrails of not more than % from total length. Defect elimination time - 3 (5, 10) days.	Good	Forbidden	10 (15,20)	15 (20,30)
		Satisfactory	5 (10,20)	10(20,30)	20(30,40)
		Bad	10 (20,30)	20(30,40)	30(40,50)
3.2.4	Drifts preventing water flow over the whole bay of the bridge, bushes on the distance of 25m from the bridge by high water horizon of % from total area. Defect elimination time - 10 (15, 20) days.	Good	Forbidden	Forbidden	10 (15,20)
		Satisfactory	5 (10,20)	10 (15,20)	20 (25,30)
		Bad	10 (20,30)	20(30,40)	30(40,50)
4.1	Bent, crooked, damaged road signs with general number of %. Defect elimination time - 3 (5, 10) days.	Good	Forbidden	Forbidden	10 (15,20)
		Satisfactory	10 (15,20)	20(30,40)	30(40,50)
		Bad	20 (30,40)	30(40,50)	40(50,50)
4.2	Bent, crooked, not painted protectors having hanging or lowered bearing, reflectors absence, % of protector length. Defect elimination time - 3 (5, 10) days.	Good	Forbidden	Forbidden	10 (15,20)
		Satisfactory	10 (20,30)	20(30,40)	30(40,50)
		Bad	20 (30,40)	30(40,50)	40(50,50)
4.3	% of total number of bended, not painted, having no reflectors delineations. Defect elimination time - 3 (5,7) days	Good	10 (20,30)	20(30,40)	30(40,50)
		Satisfactory	10 (20,30)	20(30,40)	30(40,50)
		Bad	20 (30,40)	30(40,50)	40(50,50)
4.4	Absence of horizontal and vertical road marking in separate places 1m/km. Defect elimination time - 5 (7,10) days.	Good	Forbidden	30(100,150)	50(180,200)
		Satisfactory	50 (100,175	75 (150,200)	100 (200,300)
		Bad	-	-	-

Example: Armenia (continued)

Index code	Index name, defect content	Condition estimation	Maintenance level		
			high	middle	satisfactory
1.1.1	Snow layer on curb with a thickness of not more than cm. (curbs having not improved surface are mentioned in the first brackets), (the second brackets accordingly concern republican and local roads) Defect elimination time - 3 (5, 7) days	Good	Forbidden (4) (6,7)	5(7) (7,10)	7(10), (10,12)
		Satisfactory	5(7) (7,10)	7(10), (10,12)	10(13), (12,14)
		Bad	7(10), (10,12)	10(13), (12,14)	15 (for all) (16,18)
	After traffic lane cleaning, curb cleaning time not more than (time)	Good	6(8,10)	8(10,12)	10(12,15)
		Satisfactory	8(10,12)	10(12,15)	1(1.5, 2) day
		Bad	1(2, 3) day	2(3,4) days	3 (4,5) days
1.1.2	Snow mound on the curb before snow melting, not more than (time)	Good	10 (14,20)	15(20,24)	1(2,3) day
		Satisfactory	15(20,24)	1(2,3) day	1.5(3,4)
		Bad	2(3,4) days	3 (4,5) days	4 (>5 days)
2.1	Snow layer on traffic lane, the thickness is not more than cm (not improved surfaces are given in the first brackets), (second brackets accordingly refer to republican and local roads) Defect elimination time not more than 4 (10,24) hours.	Good	3(5) (5, 7)	5(7) (7,10)	7(10), (10,12)
		Satisfactory	5(7) (7,10)	(7,10)	(10,12)
		Bad	10 (15,24)	15(20) (1day,2days)	20(25) (2days,3days)
2.2	% of icing or pressed - hardened snow on traffic lane that is not processed with salt-sand on 1000 m2 of surface. Defect elimination time after cooling (hardening) – 4(6,10) hours (the brackets correspond to republican and local roads)	Good	10(15,20)	15(20,25)	20(25,30)
		Satisfactory	15(20,25)	20(25,30)	25(30,35)
		Bad	30(for all)	40(for all)	50(for all)
3.1.1	% of total number of culverts plugged up with ice. Defect elimination time - 5 (10, 20) days	Good	5(10,15)	10 (15,20)	20(25,30)
		Satisfactory	10 (15,20)	20(25,30)	30 (40,50)
		Bad	20(25,30)	30 (40,50)	30 (40,50)
4.1	% of total number of road signs and reflectors not readable because of snow. Defect elimination time - 1 (2, 3) days	Good	5(10,15)	10 (15,20)	20(25,30)
		Satisfactory	10 (15,20)	20(25,30)	30(40,50)
		Bad	20(25,30)	30 (40,50)	30 (40,50)

Management performance

- Different plans and reports to be prepared by contractor
  - At start
    - Work Program
    - Operational Plan (routine + winter)
    - Quality Assurance Plan
    - Health and Safety Management Plan
    - Environmental Management Plan
    - Risk Management Plan
    - Traffic Management Plan
  - Monthly Report
    - Maintenance activities carried out
  - Annual Data Report
    - Updates to inventory data for each road
    - Condition data for each road
    - Traffic counts for each road
- Payment deductions if not prepared and submitted (on time)

Group Work

- What activities should be covered under the performance-based payments?
  - List at least 10 activities
- What indicators and thresholds are appropriate?
  - List at least 10 standards (indicators and thresholds)
- Are these SMART?