Road Surface Management in Sapporo City -Policy and Practice in the Cold Region-

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Contents

• Administrative Strategy for M&R of Arterial Roads in Sapporo City

Winter Road Management in Sapporo City

1. Background



Rapid Growth of Population

road construction and development

Road facilities have been aging... repair and reconstruction will be more and more difficult.

1. Background

Operating Expenses and Length of City Roads



2. Policy

Fundamental Administration Policy on Road Management

(established in 2010.3)

[Project Planning for Facility Management]

- Road Bridges
- Large Scale Tunnels
- Large Scale Culverts and Sheds
- Pedestrian Bridges
- Pavements (established in 2012.3, revised in 2018.3)
- \cdot Others

3. Fundamental Policies

- 1. Setting management criteria based on road characters (e.g. traffic volume)
- 2. Securing driving safety with maintenance activities considering the environmental characteristics of snow and cold region
- 3. Minimizing life cycle costs with adequate repair treatments in an appropriate phase
- 4. Sustaining amendment of the plan based on present road conditions surveyed quantitatively

4. Planning Flow



5. Road Network Definition





6. Present Condition Survey (periodical)

- Quantitative inspection by a survey vehicle every three years
- Employing four indices: "Crack Ratio", "Rut Depth", "Unevenness σ", and "IRI"



Surface Condition Survey Vehicle

7. Determining Maintenance Criteria

(Acceptable Threshold of Surface Condition)

- Determining maintenance criteria by grouping the road network according to the total and truck traffic volume
- Weighting the criteria based on the traffic volume (High volume roads are more severe than low volume roads)

7. Determining Maintenance Criteria

Grouping		Group (Length, Ratio)			
		Track Traffic: High (One-way ADTT \geq 1,000)	Track Traffic: Low (One-way ADTT < 1,000)		
Total Traffic: High (ADT ≥ 20,000)		Group 1 110 km (19.2%)	Group 2 48 km (8.4%)		
Total Traffic: Low (ADT < 20,000)		Group 3 61 km (10.7%)	Group 4 353 km (61.7%)		

Criteria		Maintenance Threshold Values				
Group		Crack Ratio	Rut Depth	Unevenness σ	IRI	
1		2004	25 mm	5.0 mm	7.1 mm/m	
2		2070				
3		250/	30 mm	6.0 mm	8.5 mm/m	
4		23%				

7. Determining Maintenance Criteria

A schematic Illustration of 20% Crack Two longitudinal cracks on a lane



Rut Depth

Crack Ratio

An image example of 20-40 mm rutting





8. Deterioration Prediction

Prediction Model for Surface Deterioration

Development of linear regression models for surface deterioration prediction based on the inventory of survey data

Linear Regression Model for Surface Deterioration Prediction

Road Class	Item	Unit	Prediction Model	Initial Value
Arterial Road	Crack Ratio	%	$C_{i+1} = 1.065C_i + 0.845$	0.0%
	Rut Depth	mm	$W_{i+1} = 0.991W_i + 0.656$	0.0 mm
	Unevenness σ	mm	$\sigma_{i+1} = 0.999\sigma_i + 0.108$	1.0 mm
	IRI	mm/m	$IRI_{i+1} = 1.012IRI_i + 0.141$	1.5 mm/m

* C_i, W_i, σ_i , IRI_i indicate values obtained in the surveyed year.

i+1 stands for the values in the next year.

8. Deterioration Prediction



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9. LCC Analysis

Surface Condition (Crack Ratio)



LCC = Users' Expenses + Administrators' Expenses



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10. Maintenance and Rehab Method

Repair Methods

- Inject sealants into cracks at crack ratio of 10%
- Mill and overlay surfaces and/or binder courses exceeding maintenance criteria
- Wearing Course:
 - Group 1 and 3: Polymer modified Asphalt Type II
 - Group 2 and 4: Recycled Asphalt



Injection of Sealants



Mill and Overlay



10. Maintenance and Rehab Method

Surface Distress Identification





http://www2.ceri.go.jp/jpn/iji/taikyuusei_handbook/form.html

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10. Maintenance and Rehab Method

Injection of Sealants for Crack Repair





10. Maintenance and Rehab Method

Construction Joint Distress



How to repair: L-type Joint Sealing



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11. PDCA Cycle for Sustainable Implementation





1. Snow Removal & Hauling Operation

Snow Removal

Pushing snow to the side of the road

- 1 Fresh snow plowing push new-fallen snow aside
- ② <u>Widening operation</u> widening the road widths that have been narrowed
- ③ **Surface leveling operation** flatten rough surfaces

Hauling

(4) Snow hauling - hauling piled snow to disposal sites

1. Snow Removal ① Fresh Snow plowing



1. Snow Removal ② Widening Operation





Widening of the effective road width by piling up the road snow on the snowbank.

1. Snow Removal ③ Surface Leveling Operation





Grinding and removal of the snow/ice covering road surface to flatten

1. Snow Removal ④ Snow Hauling



Loading up the road shoulder snow on dump trucks



Hauling the snow to disposal sites or thawing facilities





2. Countermeasure of Icy Roads

- **①**Sprinkling anti-icing chemicals and anti-skid materials
- **2** Placing sandboxes (free of use)
- ③ Installing road heating systems (de-icing)





3. Overview of Snow-related Projects

Summary (as of Oct. 1, 2017)

- Roadway snow removal 5,514 km Snow disposal sites 73 3,025 km Thawing Facilities Walkway snow removal 11 Snow hauling (Arterial) 1,376 km Anti-icing (roadway) 1,068 km Snow hauling (Residential) 3,084 km Anti-icing(walkway)) 311 km *with regional collaboration (other **Sandbox** 1,214 than school roads) **Road heating** 550 Intersection snow clearing 16,255
- ·1972
 - the Winter Olympic Games
- Rapid Growth of Population

 Development of snow-related project

<u>A problem is to secure the snow removal system and treatment</u> <u>facilities for the socio-economic situations with aging road facilities</u> <u>and decreasing working-age population.</u>

4. Sustainable Snow Removal System

Brief History of Snow Removal System

- 1992 Establishment of Multi-zone System (route oriented -> area oriented)
 - * Deployment of snow removal teams conducting the roadway and walkway snow removal and the hauling operations comprehensively.

2010 Integration Summer and Winter Road Maintenance, Consolidation of Multi-zones

- * Contract term : Nov. to Mar. \Rightarrow Oct. to Sep. (annually)
- * Road patrol, pavement maintenance, and weeding operation of the river fronts are included.
- * Number of zones: 39 to 23
- -> Contribution to employment stabilization, retaining human resources, and maintaining necessary equipment

5. Maintenance of Snow Treatment Facilities

Snow Treatment Facilities

Thawing Facilities (Capacity \approx 1,000,000 m³) 0.8 billion JPY/yr

Road heating systems (installed \approx 220,000 m²) 1.9 billion JPY/yr

-> Some of the road heating systems have gradually been suspended since 1998.

Rearrangement of Road Heating operation

1988~ installed in arterial roads with a slope over 4% (against the limitation of studded tires use)

1998~ suspended on some roads with a slope less than 6% (due to the development of studless tires and anti-icing chemicals, and the improvement of pavement surfacing materials)

6. Suspended of Road Heating

Overview

<u>Total Area \approx 300,000 m²</u> <u>Suspended Area \approx 100,000 m²</u>

 \Rightarrow Currently Working \simeq 220,000 m²

Alternatives of Road Heating System

Increase of the frequency of sprinkles of anti-icing chemicals (1~2 times/day -> 4 times/day)

* Effective duration of the chemicals is about 6 hours

 Improvement of the function of pavement surfaces (replacing the wearing course by stone mastic asphalt)
 * increase of tire-surface friction, residual effect of anti-icing

chemicals

⇒ Further performance improvement on treatments of icy roads!!

Questions ?

- Thank you for listening
- If you have any questions,
 I would be happy to answer them