

Evaluation of the Speed Reduction Features by the Road Surface Condition at the Expressway

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HAMAOKA, Hidekatsu
Akita University, JAPAN

B a c k g r o u n d

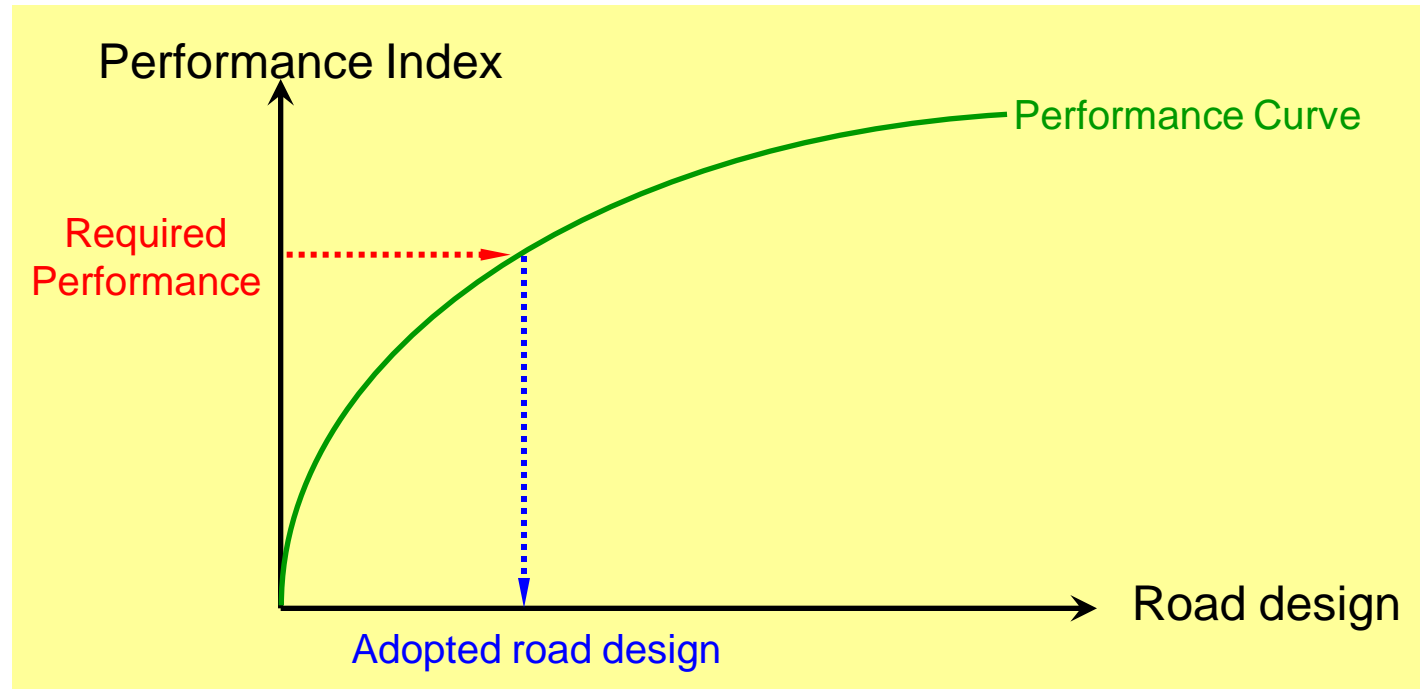
Japanese Road Structure Ordinance

- Classified into 15 types of road by two categories
 - + type of road (urban/local, expressway)
 - + **traffic volume**
- Problem to use “**traffic volume**” in the classification
 - + network problem
 - hard to establish hierarchy
 - it does not mean that road with higher traffic
has higher grade
 - traffic volume and grade has no relations

Importance to install the LOS oriented road hierarchy

Concept of LOS oriented design

Utilizing the Performance Curve to decide the road design



In order to realize this concept...

Importance to establish the performance curve

In this study...

Clarify the performance change by the road surface condition

Outline of the Data

Time Period	2001-2005
Section	<p>Akita North I.C. – Akita Central I.C. (10km)</p> <p>snowy region (many snowfall in winter) single lane in each direction no median (separated by the pole) 1 detector is installed in this section</p>
Collected data Data is obtained when road maintenance car pass the detector	<p>Road surface condition from the report of road maintenance driver at least one survey every day</p> <p>Traffic volume (veh./5min) from the detector installed in the expressway</p> <p>Travel speed (km/h) from the detector installed in the expressway</p>

Classification of Road Surface Condition

There are more than 20 types of road surface condition reported by the road maintenance driver

dry, half dry, dry with partial wet, dry with partial half wet, ...
wet, half wet, snow melting wet, wet with partial dry, ...
sherbet, thin sherbet, black/white sherbet, ...
snow, thin snow, snow with partial compacted snow, ...
compacted snow, compacted snow with partial snow, ...

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compacted snow, compacted snow with partial snow, ...

Reclassified into 5 major road surface condition

Number of the Data for each RSC

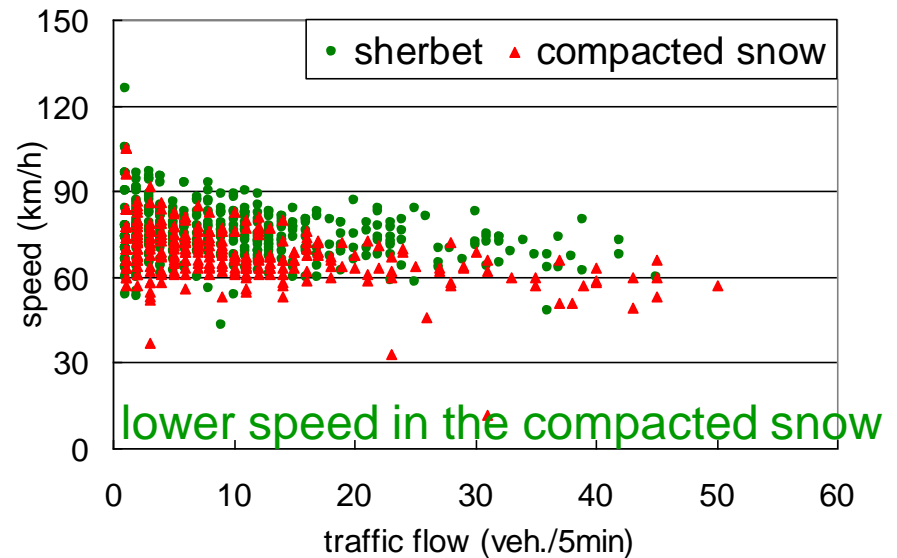
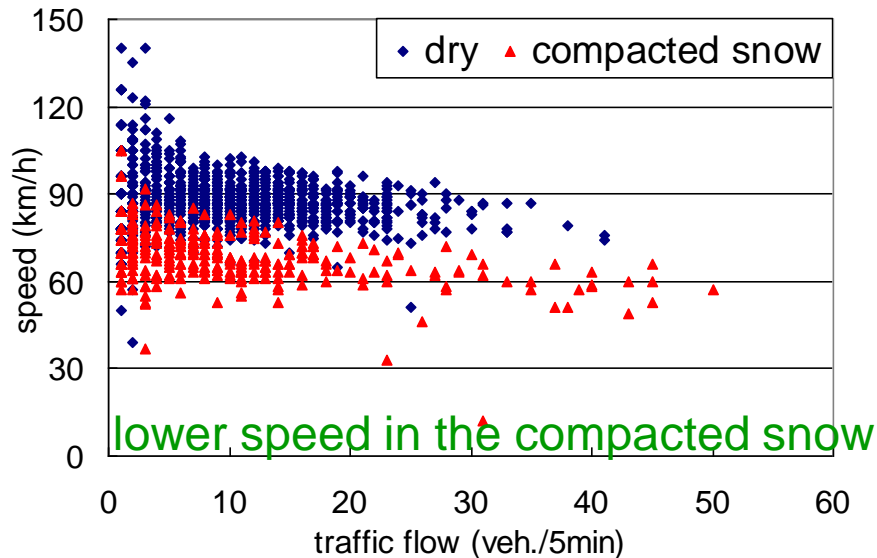
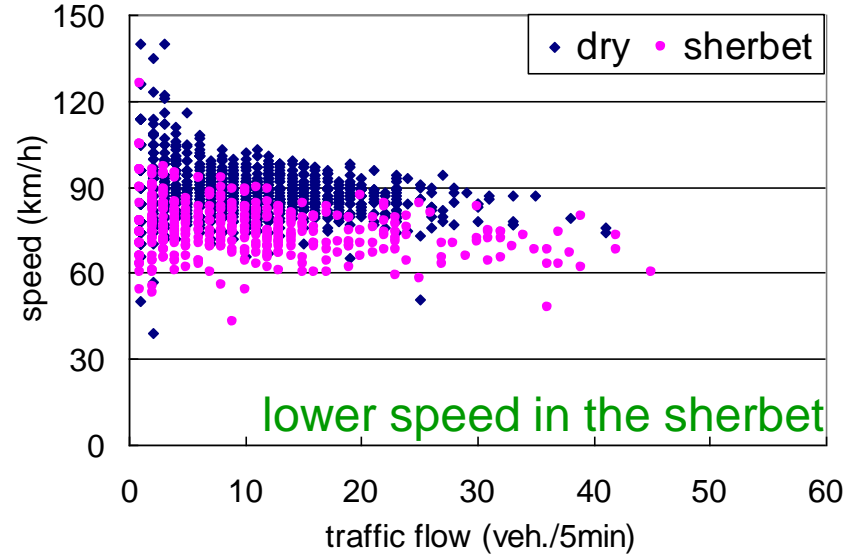
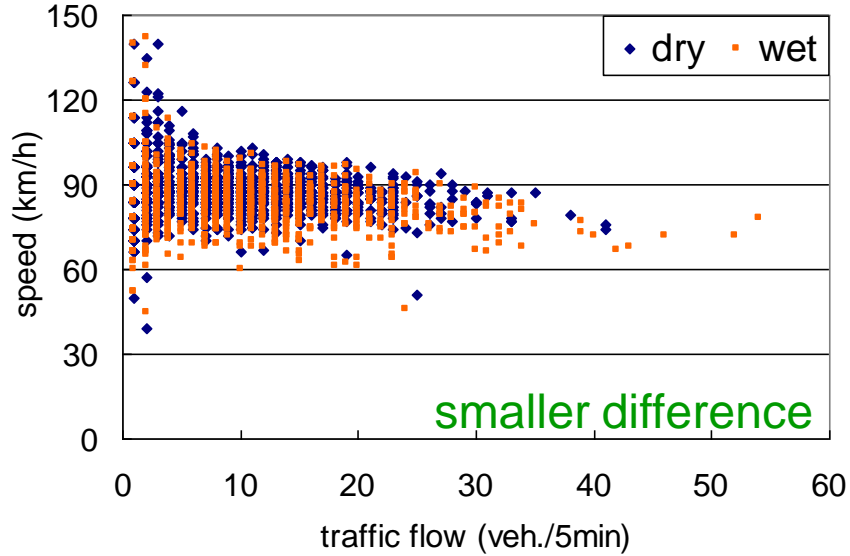
surface condition (winter)	dry	wet	sherbet	compacted snow	snow	total
2001	183	245	93	141	6	668
2002	277	245	64	56	8	650
2003	263	290	42	45	6	646
2004	240	229	90	19	2	580
2005	122	268	112	74	2	578
total	1085	1277	401	335	24	3122

surface condition (summer)	dry	wet	total
2005	775	222	997

↑
not in use because of the smaller number for "snow"

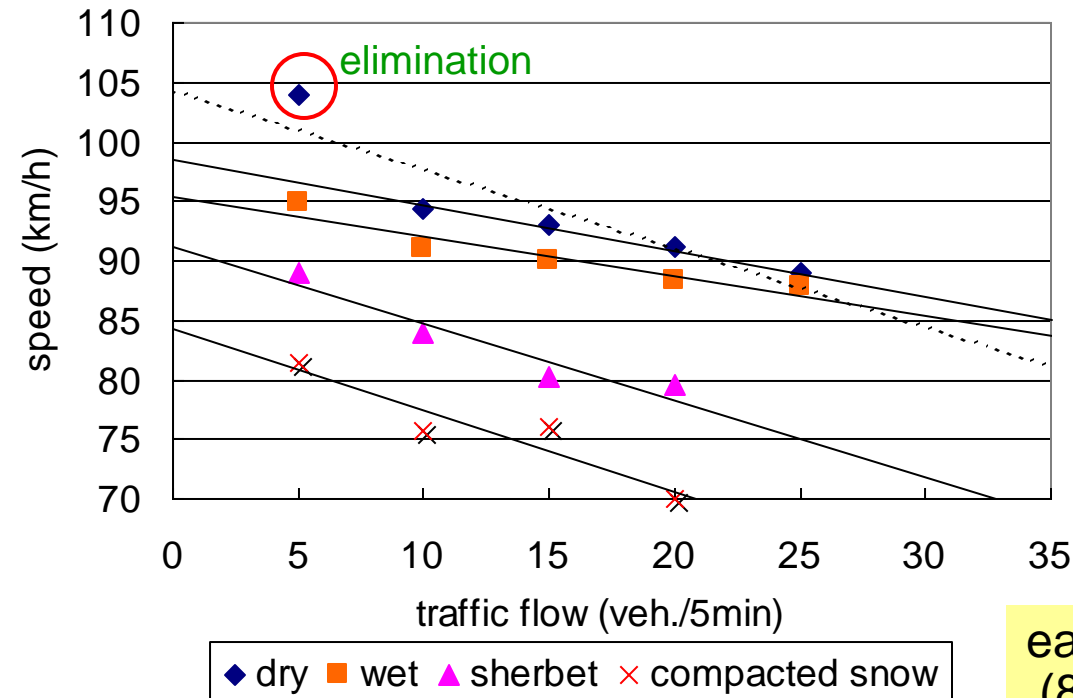
Summarize the yearly data in order to increase the number of data

Influence of the Road Surface Condition



Speed reduction: dry=wet < sherbet < compacted snow

Approximate Function



Result of regression analysis

surface condition	slope	intercept
dry	-0.36	98
wet	-0.33	95
sherbet	-0.65	91
compacted snow	-0.68	84

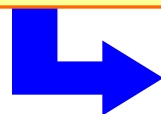
each speed data are averaged (85percentile speed) every 5 veh./5min

Comparison of the intercept (free flow speed):

dry > wet > sherbet > compacted snow

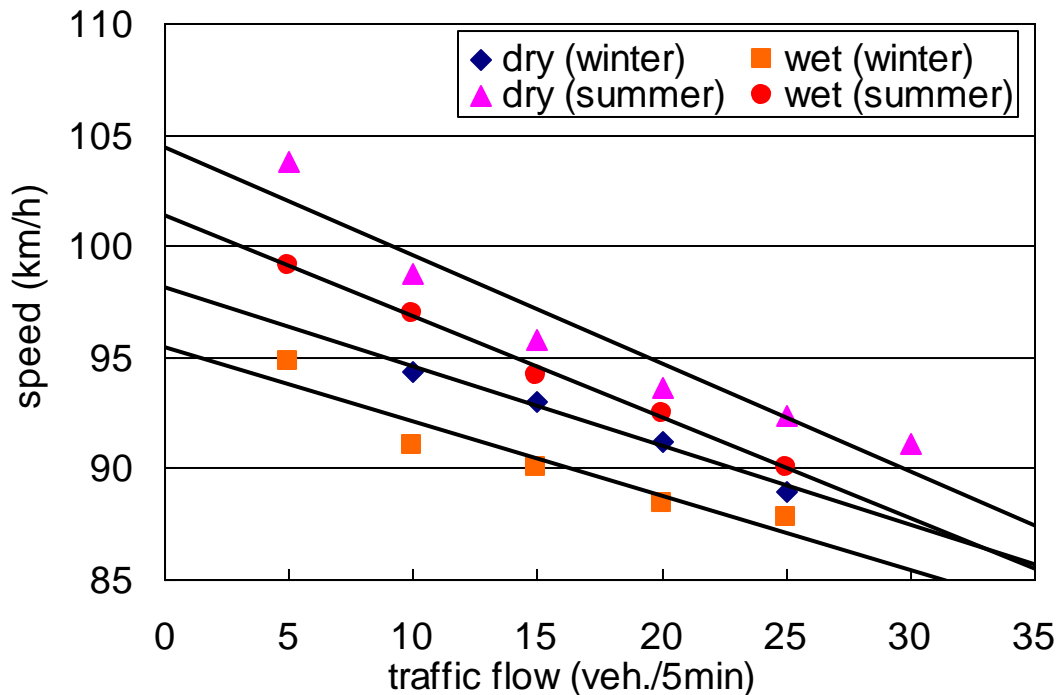
Comparison of the slope (speed reduction ratio):

compacted snow, sherbet > dry, wet



having larger effect to speed reduction

Comparison between the Season



Result of regression analysis

surface condition	slope	intercept
dry (winter)	-0.36	98
wet (winter)	-0.33	95
dry (summer)	-0.48	104
wet (summer)	-0.45	101

Seasonal effect

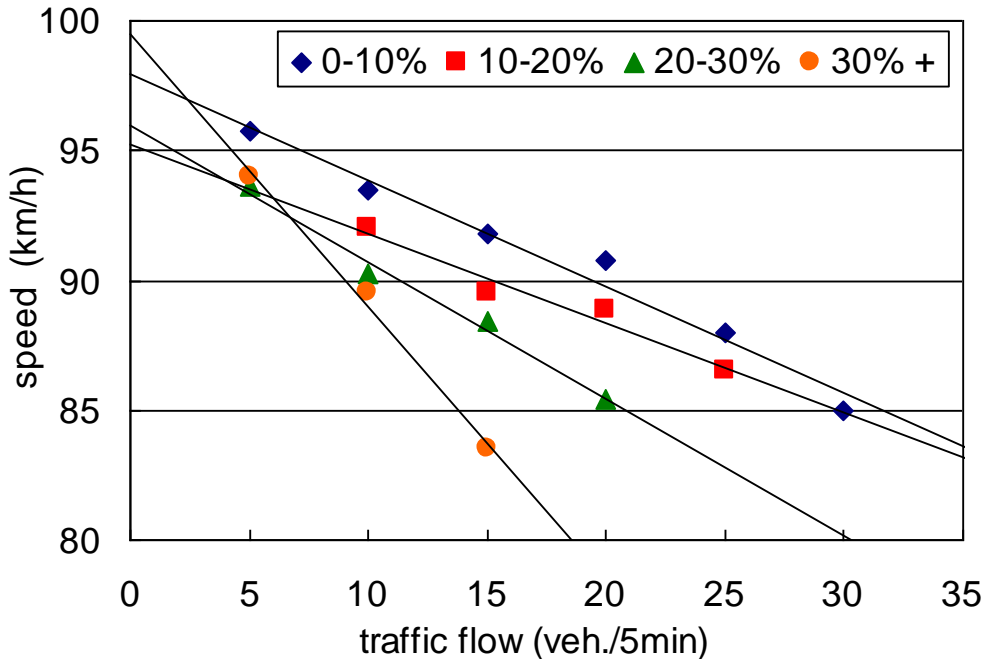
Intercept:

- slower speed in winter
- free flow speed decreases almost same

Slope:

- larger speed reduction ratio in summer

Approximate Function of HVR



Result of regression analysis

HVR	slope	intercept
0-10%	-0.41	98
10-20%	-0.34	95
20-30%	-0.53	96
30% +	-1.05	100

Comparison of the intercept (free flow speed):

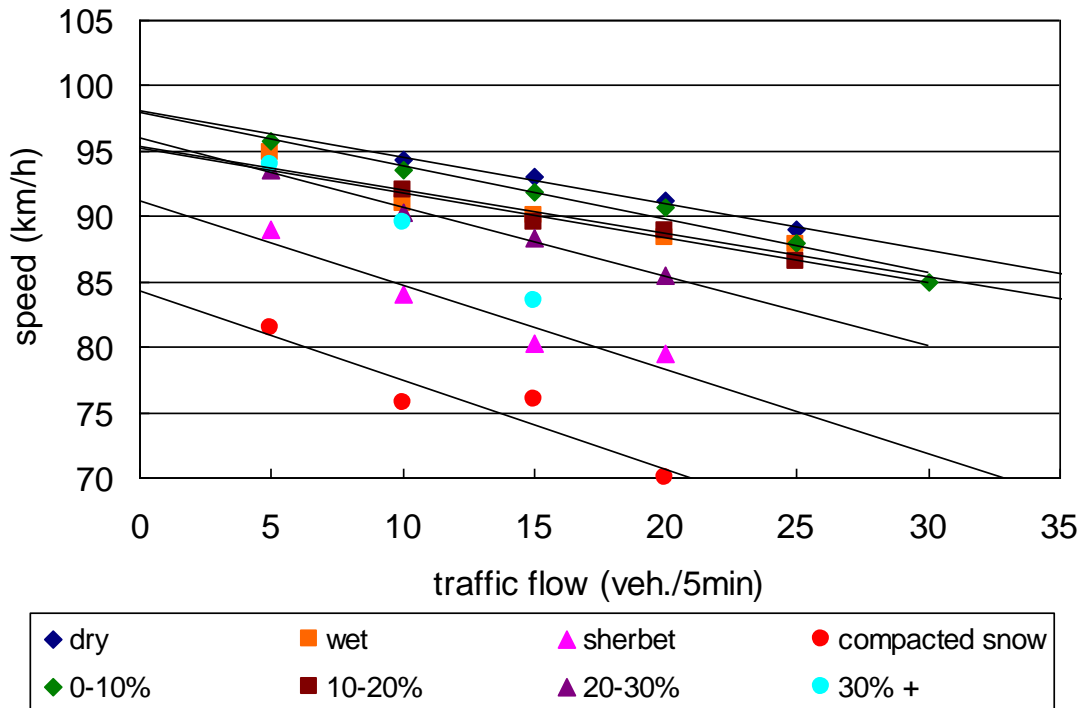
$30\%+ > 0-10\% > 20-30\% > 10-20\%$

Comparison of the slope (speed reduction ratio):

$30\%+ \gg 20-30\% > 0-10\% > 10-20\%$

Larger HVR has strong effect to speed reduction

Comparison between RSC and HVR



RSC	slope	intercept
dry	-0.36	98
wet	-0.33	95
sherbet	-0.65	91
compacted snow	-0.68	84

HVR	slope	intercept
0-10%	-0.41	98
10-20%	-0.34	95
20-30%	-0.53	96
30% +	-1.05	100

Comparison of the intercept (free flow speed)

Road Surface Condition: higher variance

Heavy Vehicle Ratio: lower variance

Comparison of the slope (speed reduction ratio)

Road Surface Condition: higher reduction ratio in the sherbet, snow

Heavy Vehicle Ratio: higher reduction ratio in the higher HVR

Conclusion

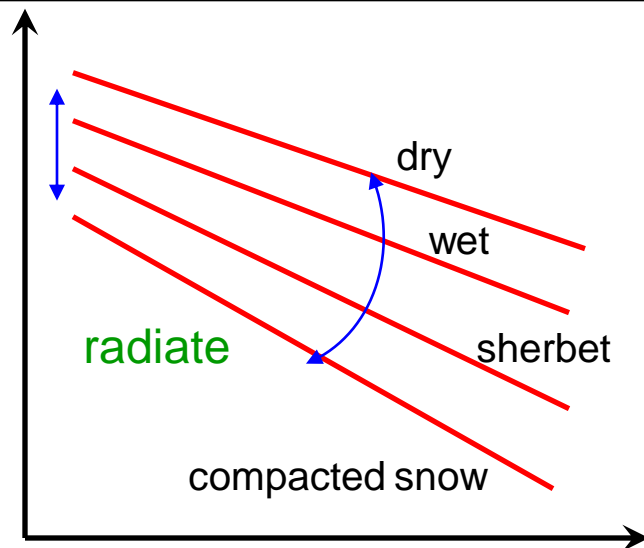
Effect of road surface condition

- speed reduction tend to large as road condition get worse
- there exists certain differences in the free flow speed

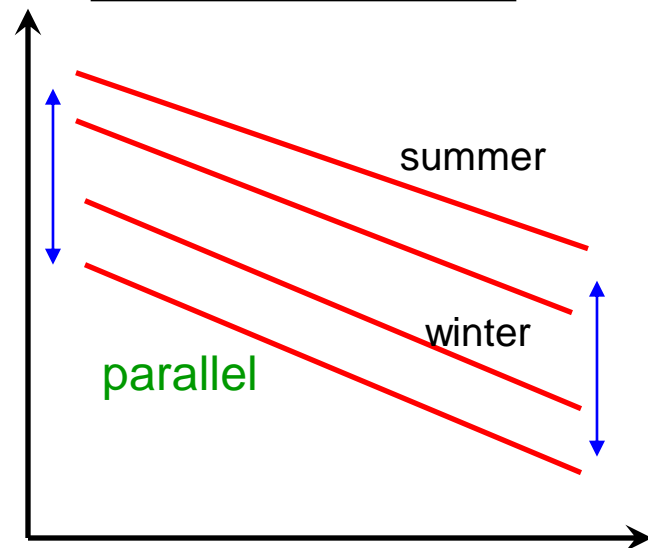
Effect of season

- there are the same speed reduction in the same road condition
- free flow speed decreases same amount
- parallel shape of the performance function

Effect of road surface condition



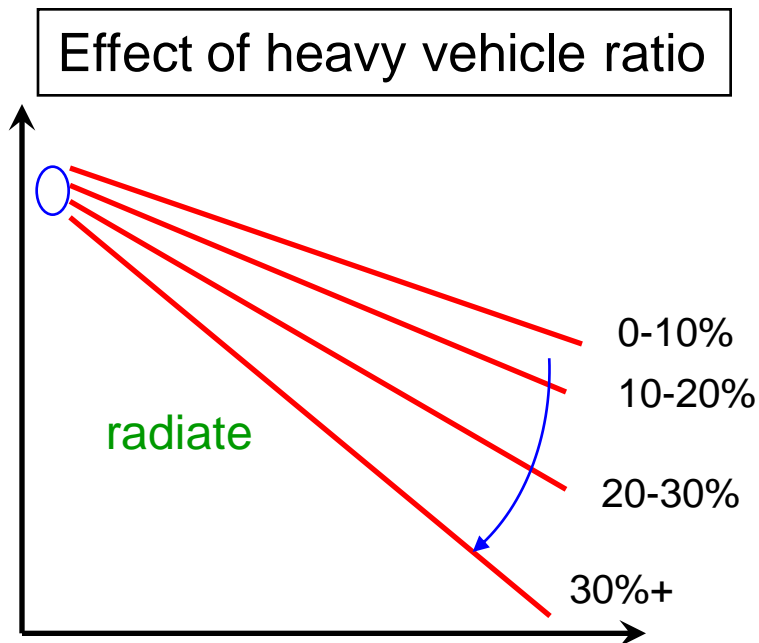
Effect of season



Conclusion (2)

Effect of heavy vehicle ratio

- speed reduction tend to large as heavy vehicle ratio increases
- free flow speed would be same regardless of heavy vehicle ratio
- having larger speed reduction ratio
compared to the road surface condition



Further Directions

Confirm the performance function

- increase the number of data
- increase the number of location
 - road surface condition
 - road geometry (increased number of lanes)

Compare with the other performance

- width of the lane
- existence of shoulder lane

Thank you for your attention!