Québec 2010
AIPCR · PIARC

XIII INTERNATIONAL WINTER ROAD CONGRESS

QUÉBEC, FEBRUARY 8 TO 11, 2010

WORLD ROAD ASSOCIATION
MONDIALE DE LA ROUTE
AIPCR PIARC

Québec

SUSTAINABLE WINTER SERVICE FOR ROAD USERS

Skid Resistance of Porous Asphalt Pavement under Winter Conditions

Kimio Maruyama

Civil Engineering Research Institute for Cold region

Senior Research Engineer

k.maruyama@ceri.go.jp

CERI
COLD REGION

Table of Contents

1. Background and Objective

(Background)

Porous asphalt pavements are used;

To reduce noise

To prevent hydroplaning and water splashing

Issues in snowy regions;

Winter skid resistance

(Objective)

Evaluate skid resistance of porous asphalt pavements under various conditions of snow and ice

Part 1. Laboratory tests

Part 2. Test track surveys

Part 3. Field survey on roads in service

1. Background and Objective

2. Method and Results

Part 1. Laboratory tests on skid resistance on artificially reproduced frozen road surface

Part 2. Test track surveys on skid resistance on frozen road surface

Part 3. Field surveys on skid resistance under various conditions of snow and ice

3. Conclusion

Method of Laboratory Tests

Measuring the Skid Resistance

Types of test pieces

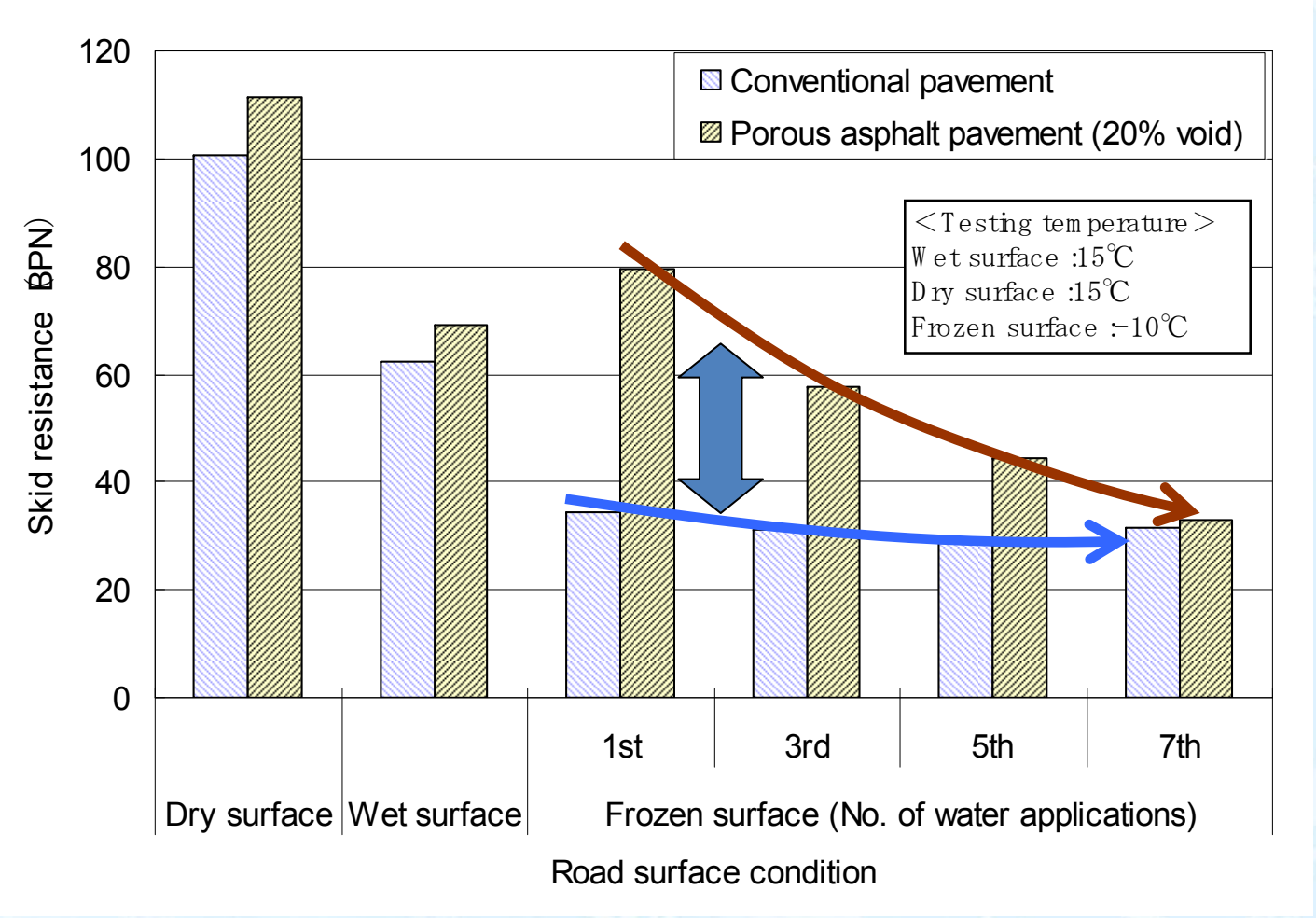
Pavement type
Porous asphalt pavement (20% void)
Conventional pavement

Test method:

- Spread water on the test piece every hour, in 7 separate applications, each of 45 ml of water.
- When the test piece surface becomes frozen, measure skid resistance using a portable skid resistance tester.
- Perform measurement after the 1st, 3rd, 5th, and 7th layer is applied.

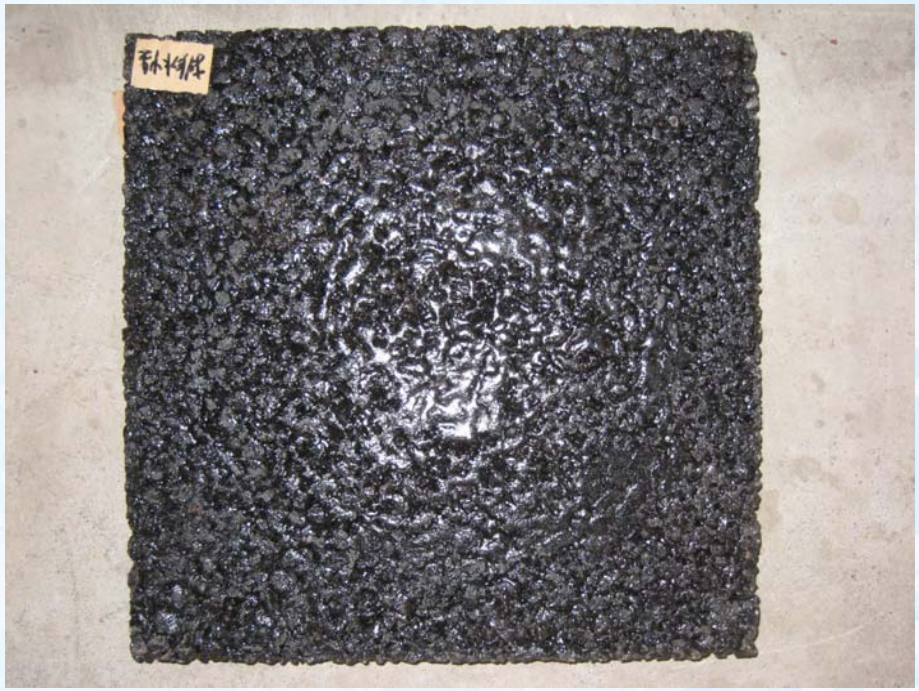
The 1st, 2nd and 3rd applications: Black ice
The 5th, 6th and 7th applications: Ice sheet

Laboratory Tests results



Results of the skid-resistance test

Laboratory Tests results (Frozen surface)



Porous pavement

Conventional dense-graded pavement

1. Background and Objective

2. Method and Results

Part 1. Laboratory tests on skid resistance on artificially reproduced frozen road surface

Part 2. Test track surveys on skid resistance on frozen road surface

Part 3. Field surveys on skid resistance under various conditions of snow and ice

3. Conclusion

Test Track Survey

Outline of the survey

Pavement type	Porous asphalt pavement (17% void)
	Porous asphalt pavement (20% void)
	Conventional dense-graded pavement
Surface condition	Black ice
	Ice sheet
	Compacted snow
Testing speed	30km/h
Tire	Studless winter tire (165/80R-13)

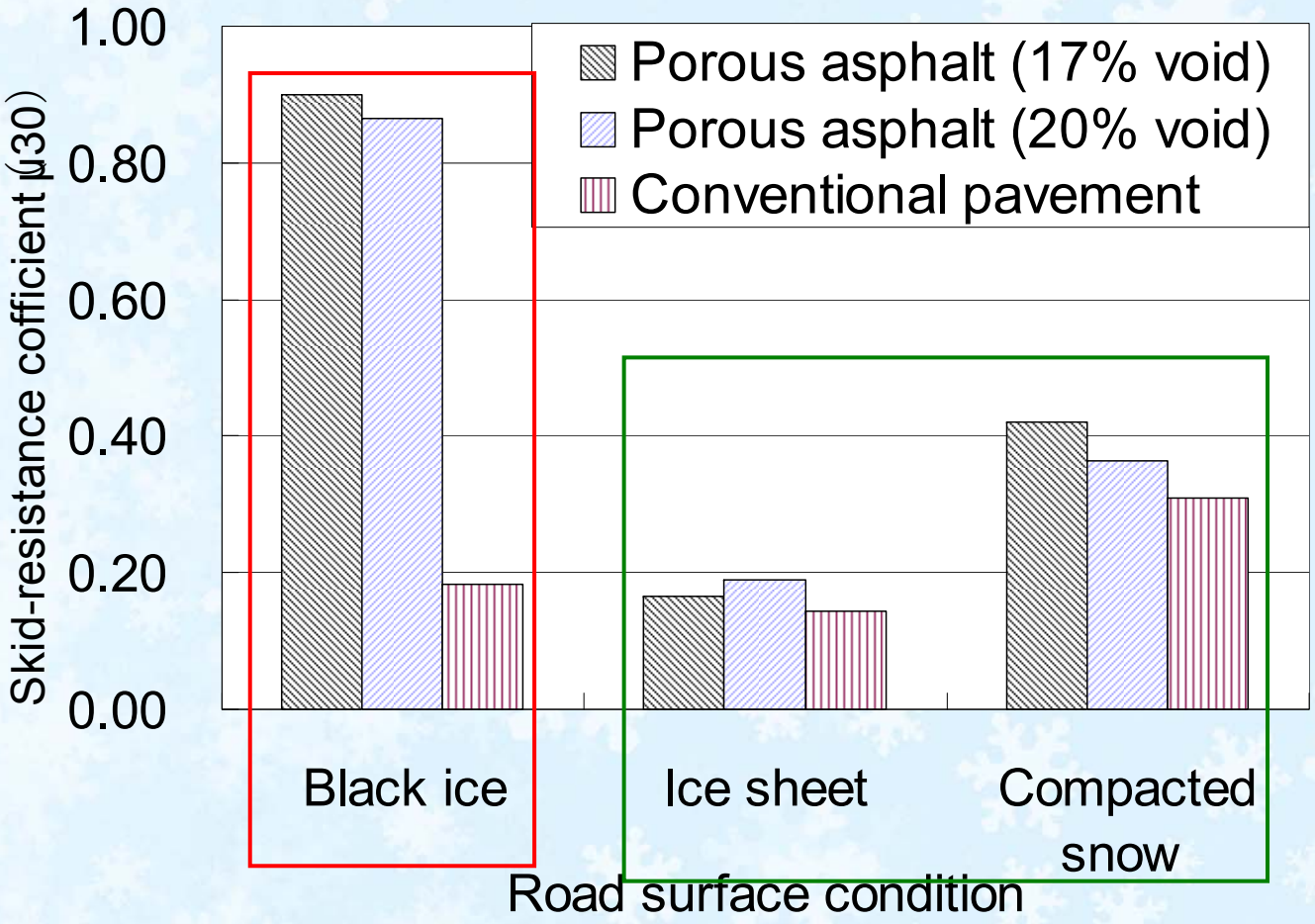
Tomakomai Winter Test Track

Method of Test Track Survey

Pavement type	Porous asphalt pavement (17% void)
	Porous asphalt pavement (20% void)
	Conventional dense-graded pavement
Surface condition	Black ice
	Ice sheet
	Compacted snow
Testing speed	30km/h
Tire	Studless winter tire (165/80R-13)

Skid-resistance test vehicle

Test Track Survey Results



Skid-resistance coefficient on test track

1. Background and Objective

2. Method and Results

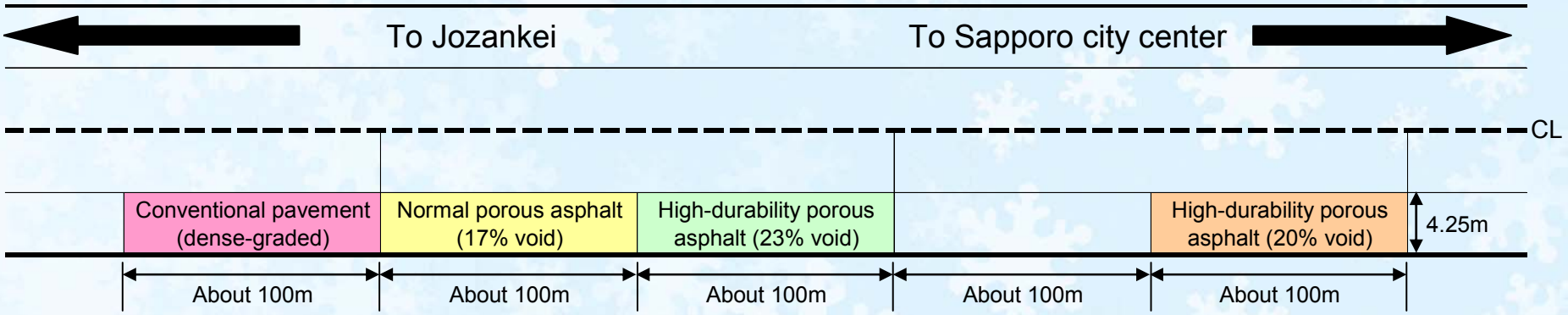
Part 1. Laboratory tests on skid resistance on artificially reproduced frozen road surface

Part 2. Test track surveys on skid resistance on frozen road surface

Part 3. Field surveys on skid resistance under various conditions of snow and ice

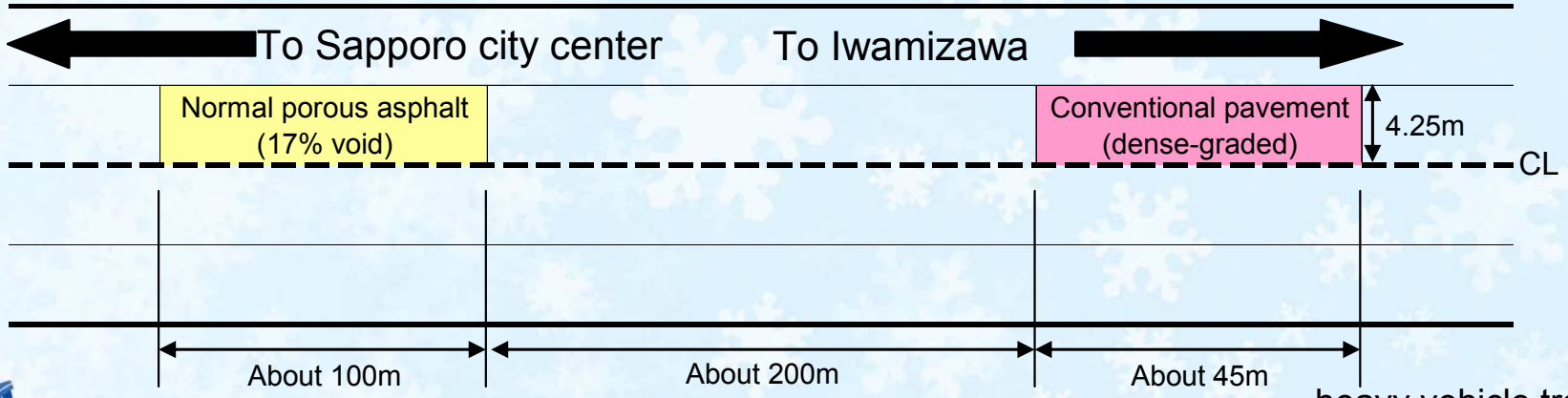
3. Conclusion

Outline of Field Survey Site



Plan view of field survey site A

heavy vehicle traffic:
3,000 vehicles/ day.



Plan view of field survey site B

heavy vehicle traffic:
3,000 vehicles/ day.

Method of Field Survey

Survey conditions (Site A)

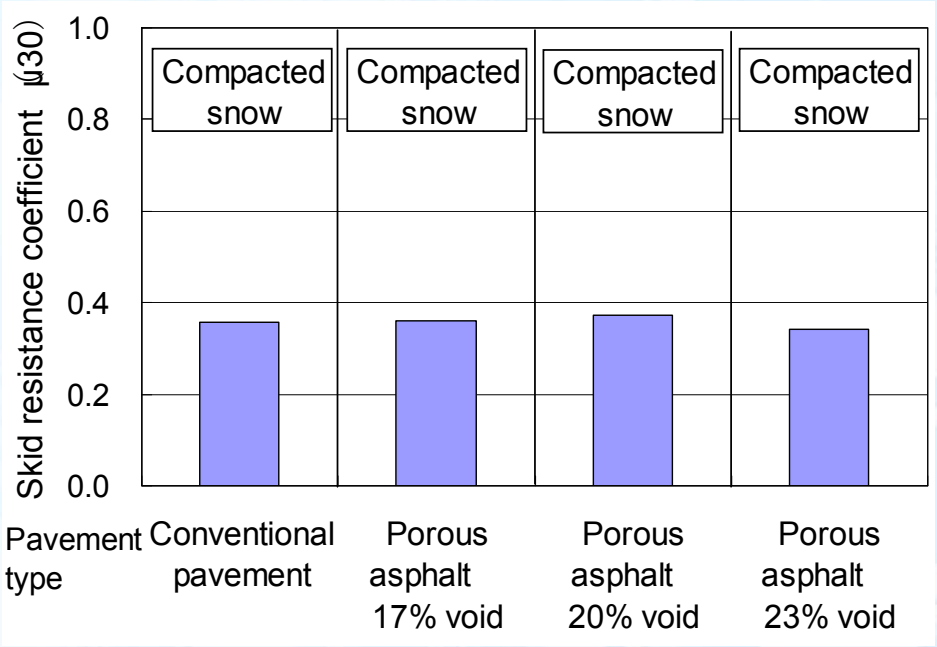
	Air temp.	Surface temp.	Conventional pavement	Porous asphalt (17% void)	Porous asphalt (20% void)	Porous asphalt (23% void)
Case 1	1.8℃	-4.5℃	Compacted snow	Compacted snow	Compacted snow	Compacted snow
Case 2	-0.2℃	-7.0℃	Shallow slush	Shallow slush	Shallow slush	Shallow slush
Case 3	-1.0℃	-10.0℃	Black ice on some parts of the pavement	Mostly dry	Black ice on some parts of the pavement	Mostly dry
Case 4	-0.6℃	-2.0℃	Ice sheet	Ice sheet	Black ice	Ice sheet
Case 5	-3.0℃	-6.2℃	Granular snow	Granular snow	Granular snow	Granular snow
Texture depth (mm)			0.27*	0.78	0.83	0.92

*Texture depth of conventional pavement is from data obtained at the CERI winter test track and is for reference only.

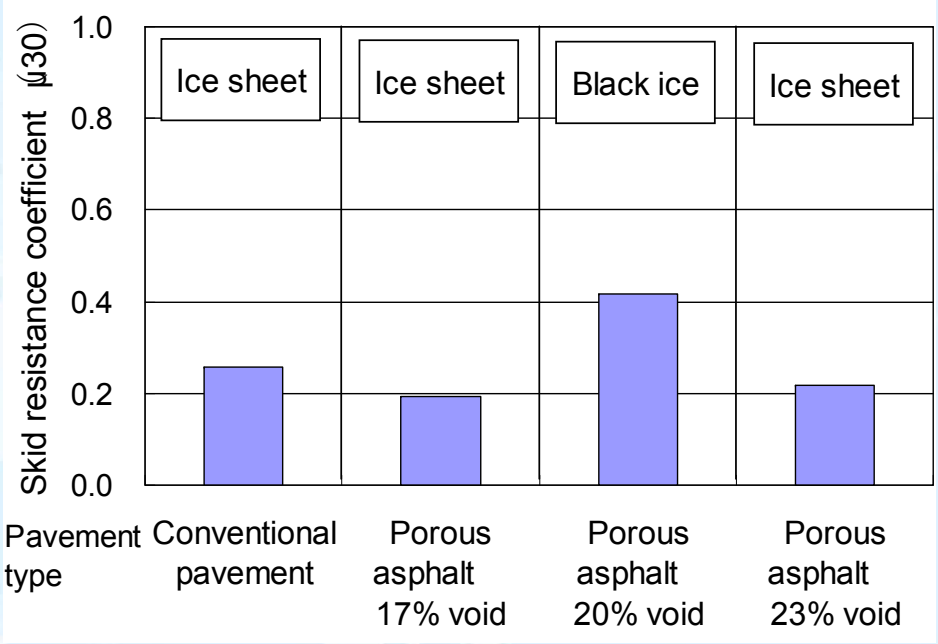
Survey conditions (Site B)

	Air temp.	Surface temp.	Conventional pavement	Porous asphalt (17% void)
Case 6	-8.4℃	-10.7℃	Black ice	Black ice
Case 7	-3.7℃	-4.5℃	Ice sheet	Ice sheet

Field Survey Results (1/7)

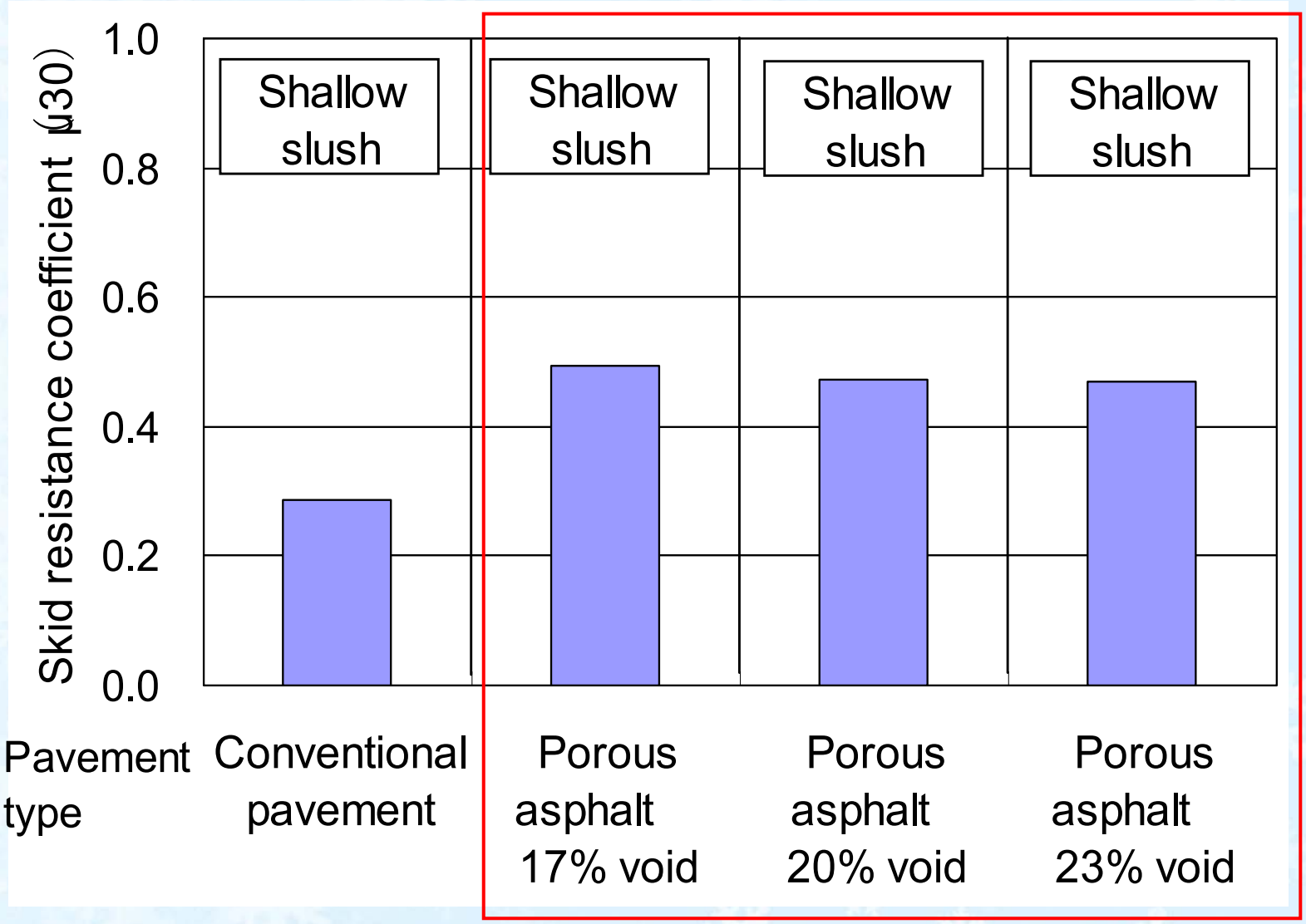


Case 1, Compacted snow condition



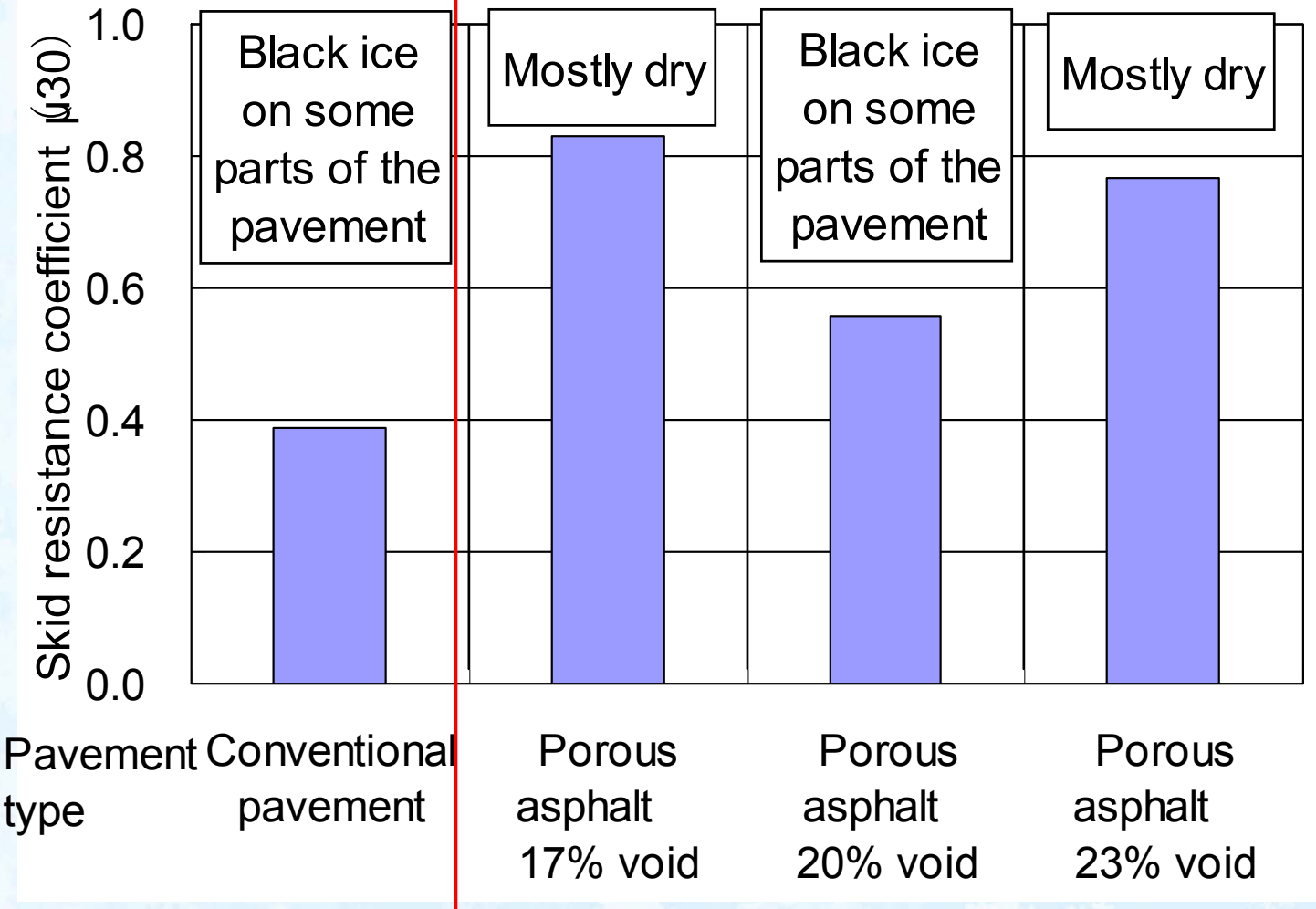
Case 4, Ice sheet

Field Survey Results (2/7)



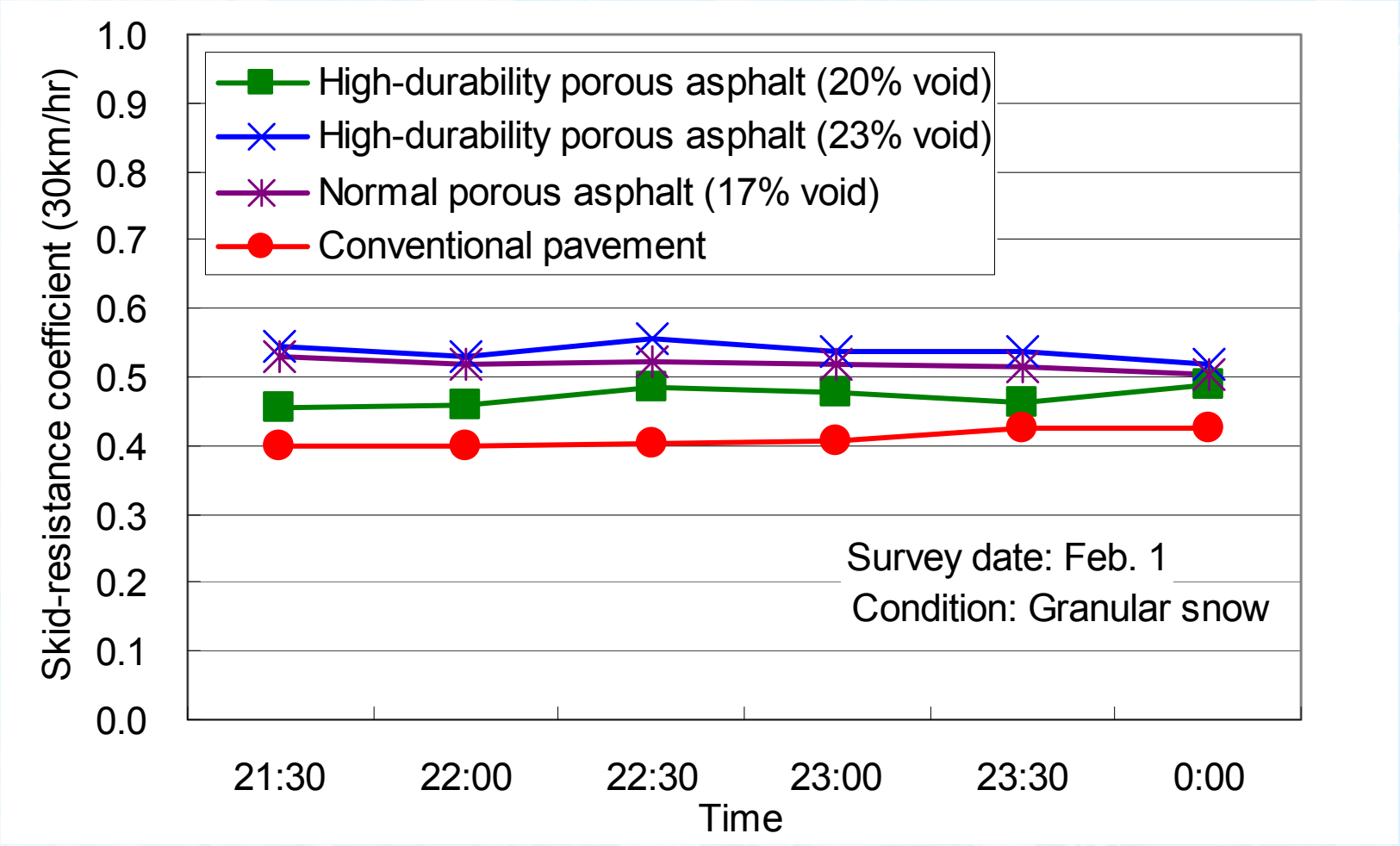
Skid-resistance coefficient on porous asphalt(Case 2, Shallow slush)

Field Survey Results (3/7)



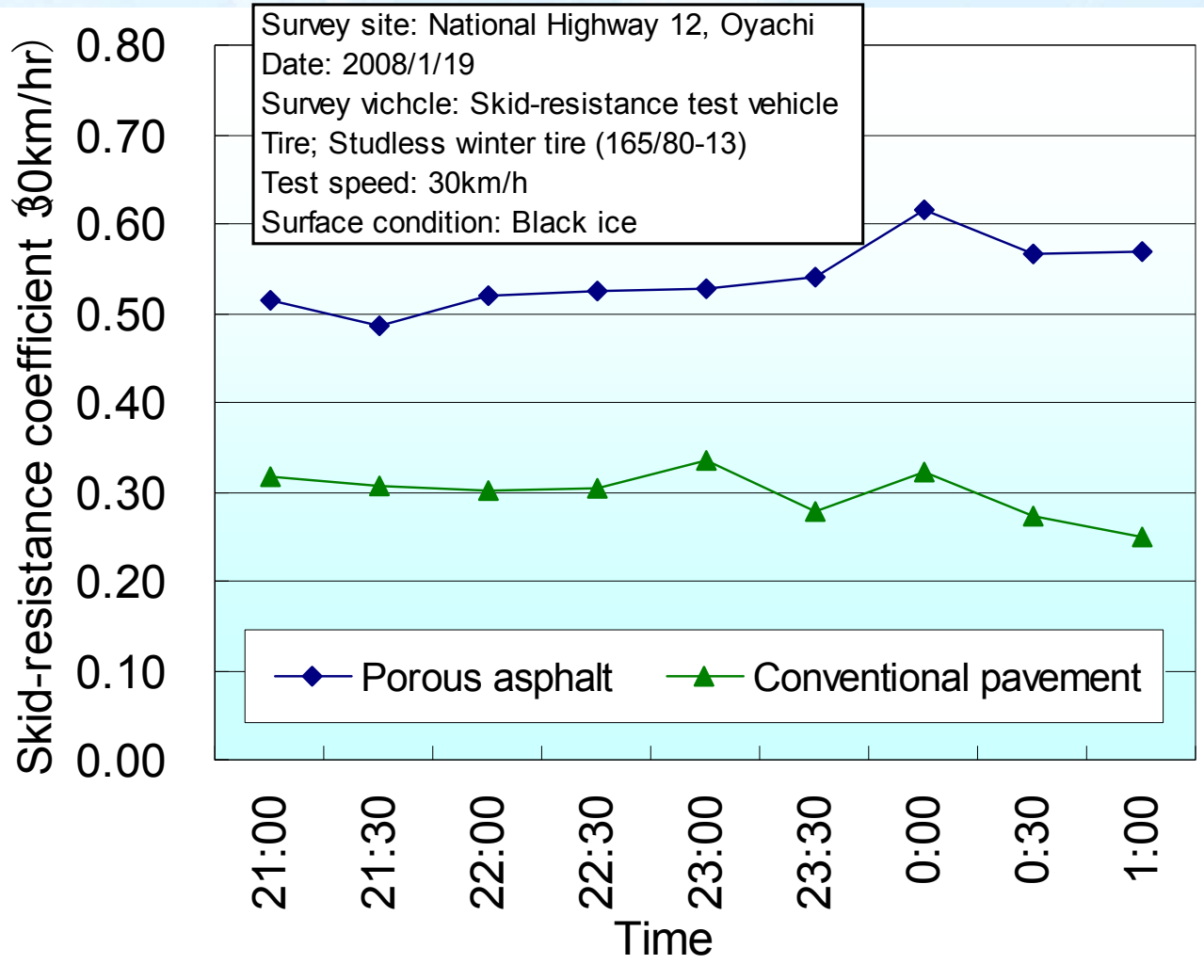
Skid-resistance coefficient on porous asphalt(Case 3, Left)

Field Survey Results (5/7)



Skid-resistance coefficient on porous asphalt (Case 5, Granular Snow)

Field Survey Results (6/7)



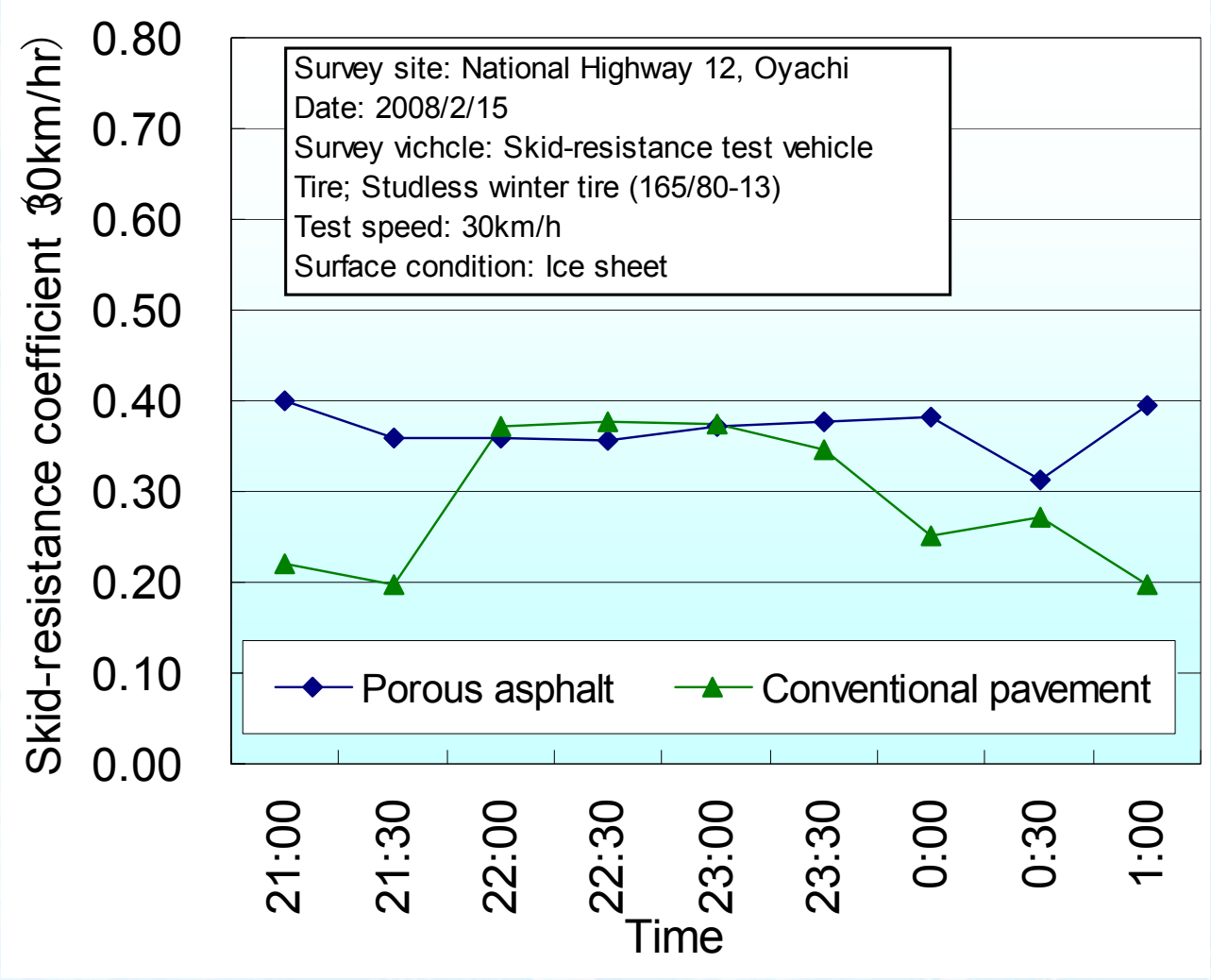
Skid-resistance coefficient on porous asphalt (Case 6)

Surface condition
(Case 6, Black ice, 21:30PM)

Porous pavement

Dense-graded pavement

Field Survey Results (7/7)



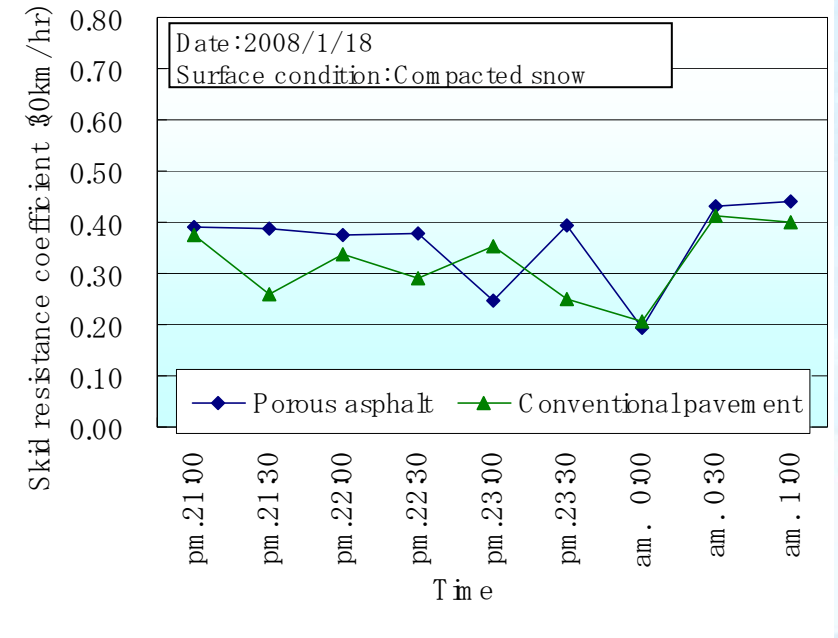
Skid-resistance coefficient on porous asphalt (Case 7)

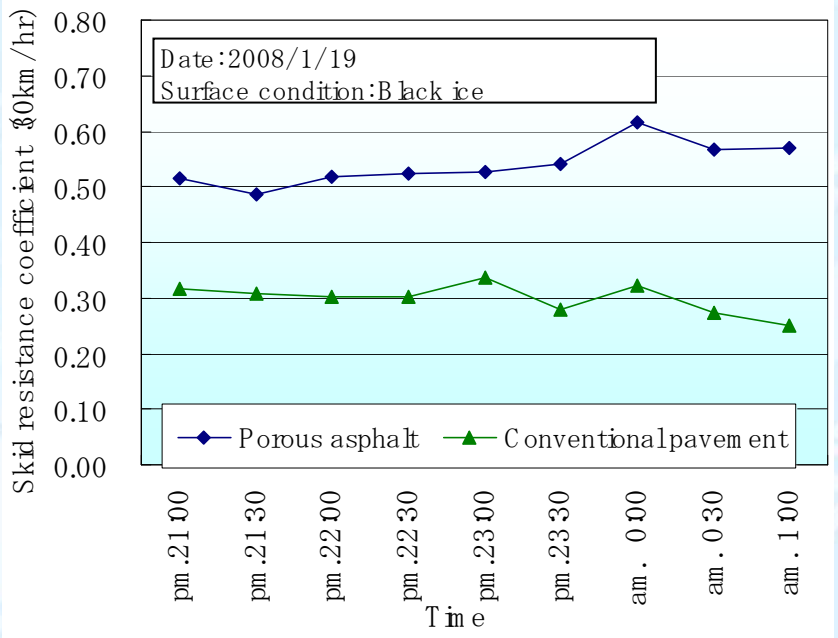
Surface condition
(Case 7, Ice sheet, 21:00PM)

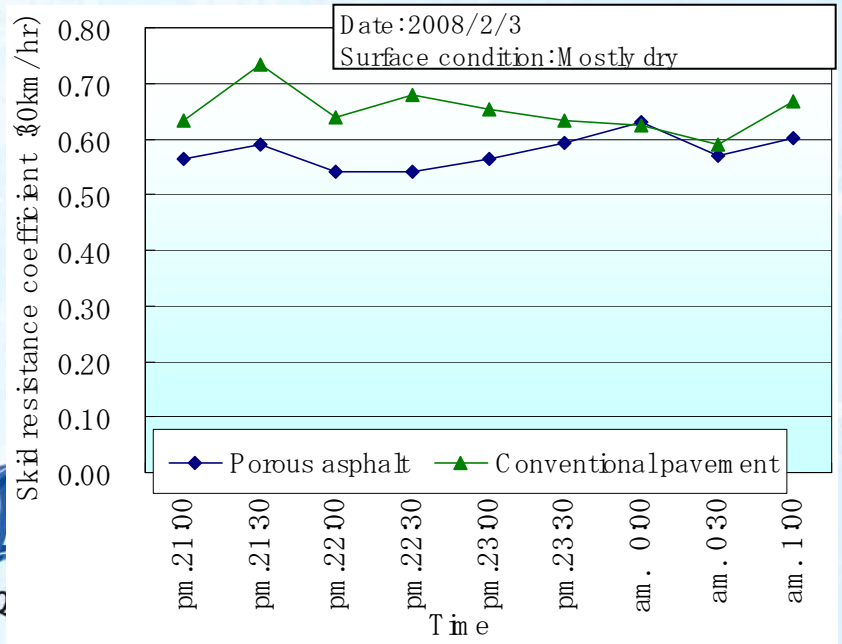
Porous pavement

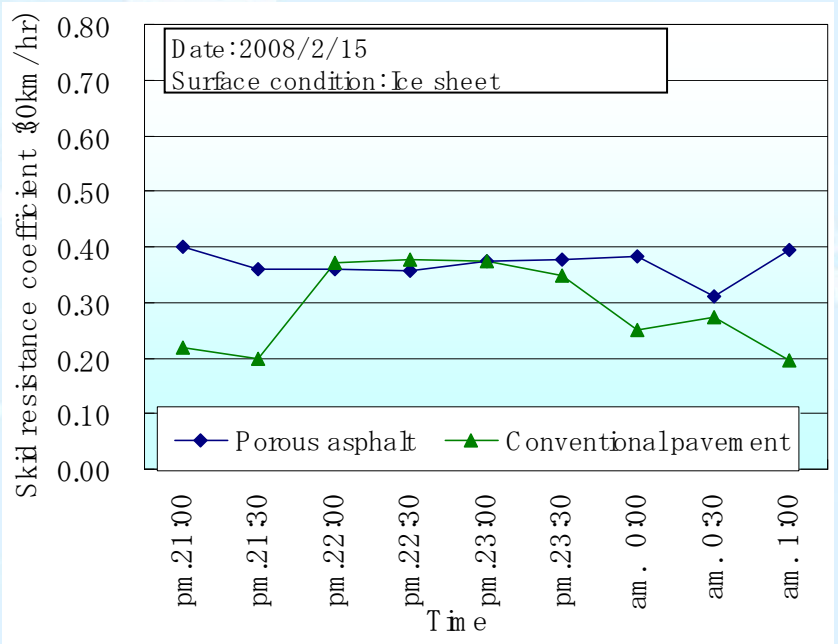
Dense-graded pavement

Field Survey Results (appendix)

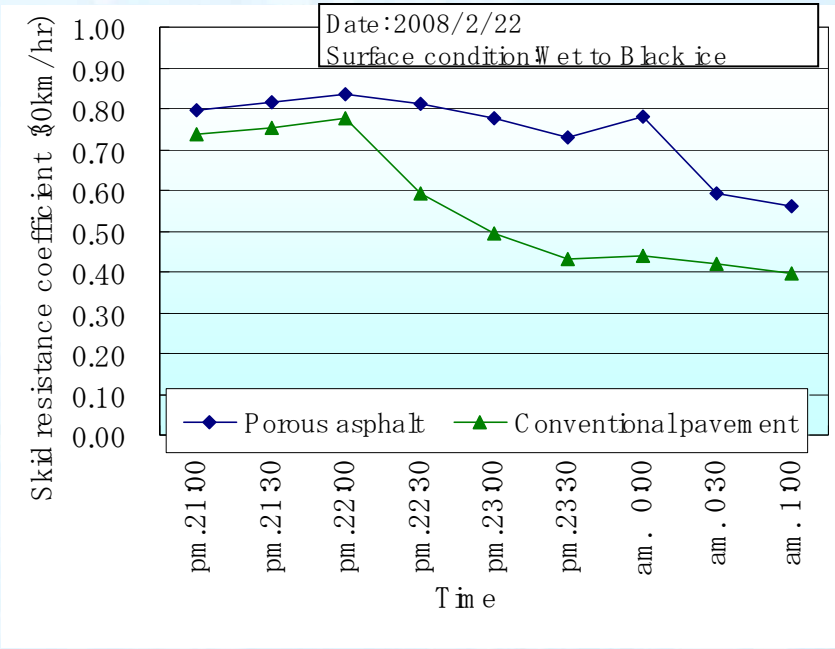


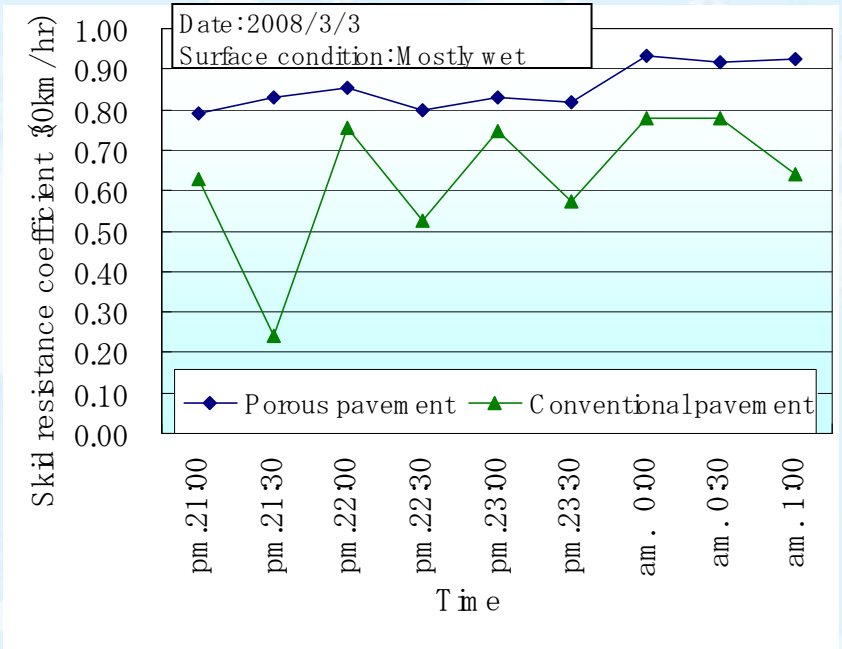






Field Survey Results (appendix)





3.Conclusion

Porous asphalt pavements retained the rough surface texture and skid resistance even when the road surface was black ice or shallow slush.

Porous asphalt pavements are expected to show improved skid resistance on winter roads in

a) early and late winter

b) regions with high snow-removal rates

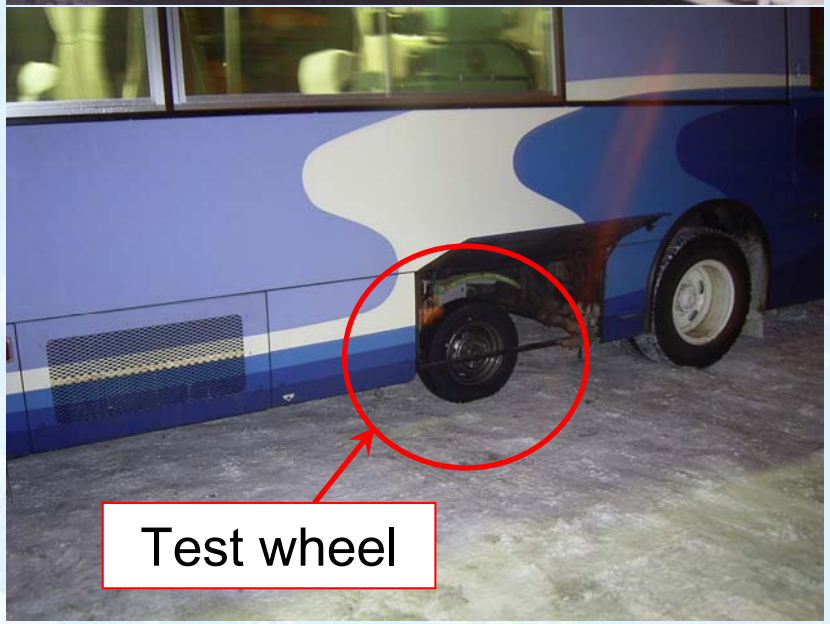
c) regions with relatively low snowfall

Sapporo Snow Festival

Thank you.
Je vous remercie.

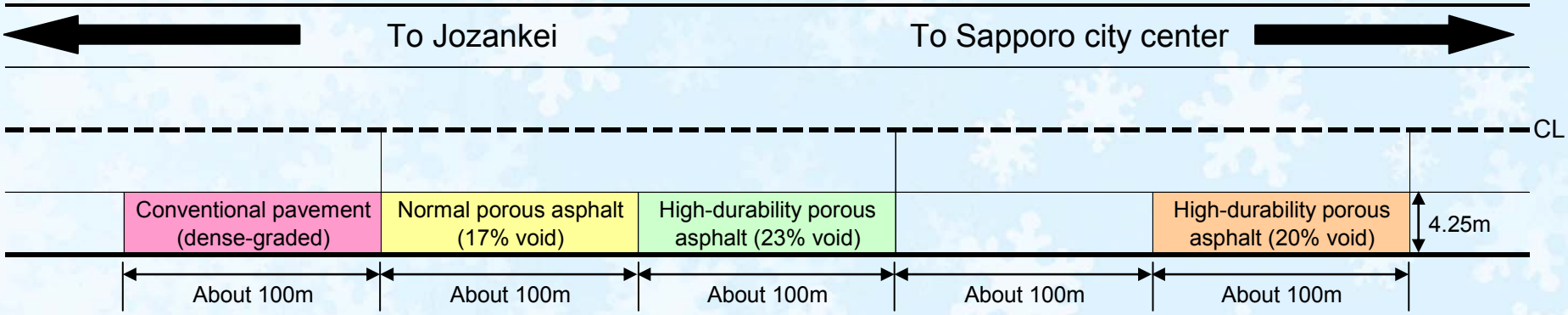
Method of Field Survey

Testing speed	30km/h
Tire	Studless winter tire (165/80R-13)



Skid-resistance test vehicle

Outline of Trial installation



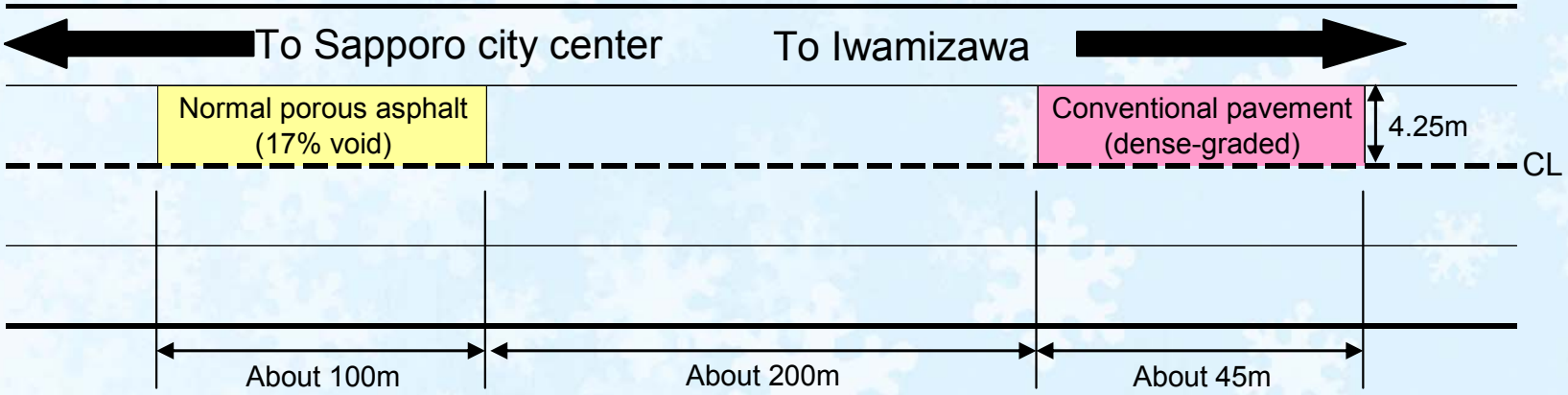
Plan view of field survey site A

heavy vehicle traffic:
3,000 vehicles/ day.

Outline of the test (Site A)

Test location	Nat'l Highway 230 (Ishiyama-dori St.), Sapporo City
Survey period	Dec. 2005 to March 2006 and Jan.2008 to March 2008
Pavement type	Conventional dense-graded pavement
	Porous asphalt pavement (17% void)
	Porous asphalt pavement (20% void)
	Porous asphalt pavement (23% void)
Test method	Test speed 30km/h
	Tire: studless winter tire (165/80R-13)

Outline of Trial installation



Plan view of field survey site B

heavy vehicle traffic:
3,000 vehicles/ day.

Outline of the test (Site B)

Test location	Nat'l Highway 12 (Oyachi), Sapporo City
Survey period	Jan. 2008 to March 2008
Pavement type	Conventional dense-graded pavement
	Porous asphalt pavement (17% void)
Test method	Test speed 30km/h
	Tire: studless winter tire (165/80R-13)