



CONFERENCIA INTERNACIONAL
SOBRE
VIALIDAD INVERNAL

Del 27 al 30 de junio de 2017

Mendoza - Argentina

Controlling Snowdrifts

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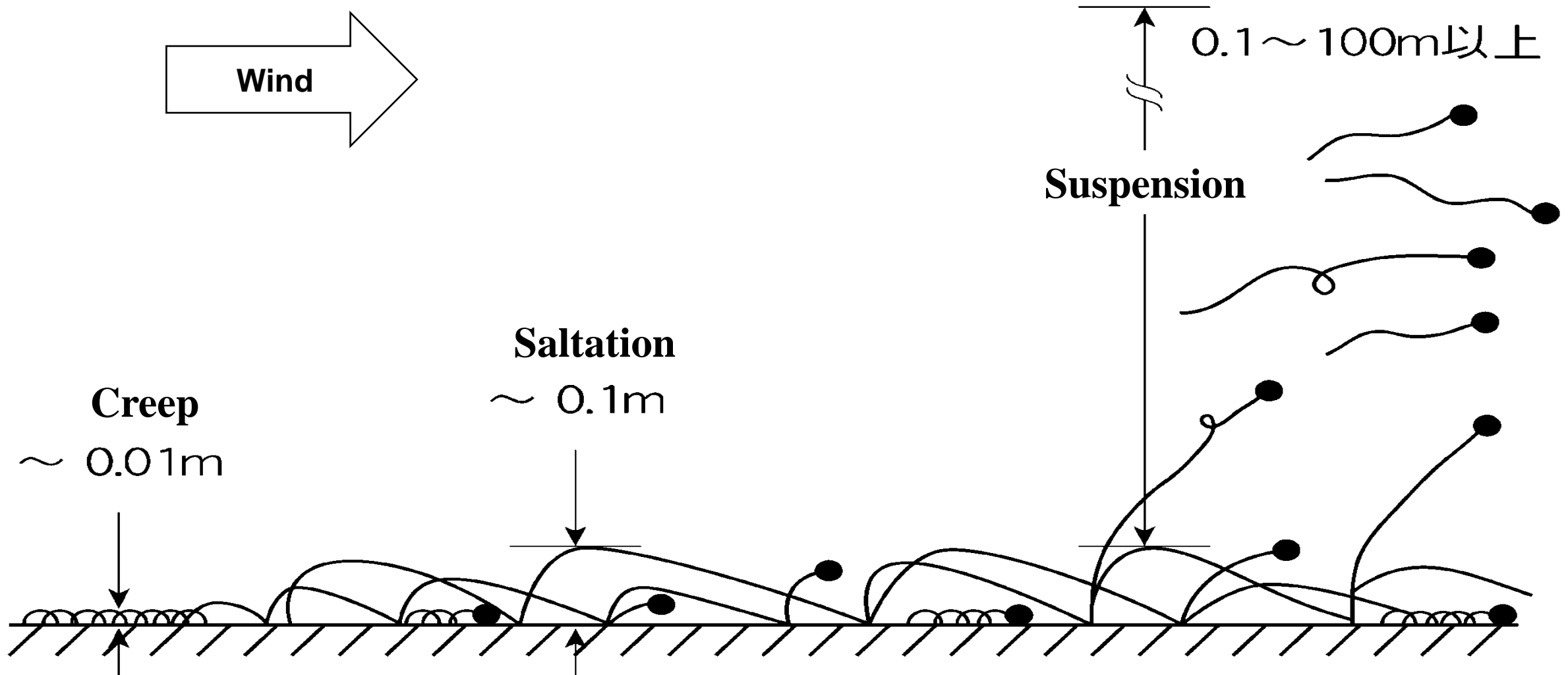
Contents

- I. Characteristics of blowing/drifting snow
- II. Snowdrift countermeasures



Snowdrift

Modes of Snow Transport





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I. Characteristics of blowing/drifting snow

Modes of snow transport

Saltation



Tabler (1986)



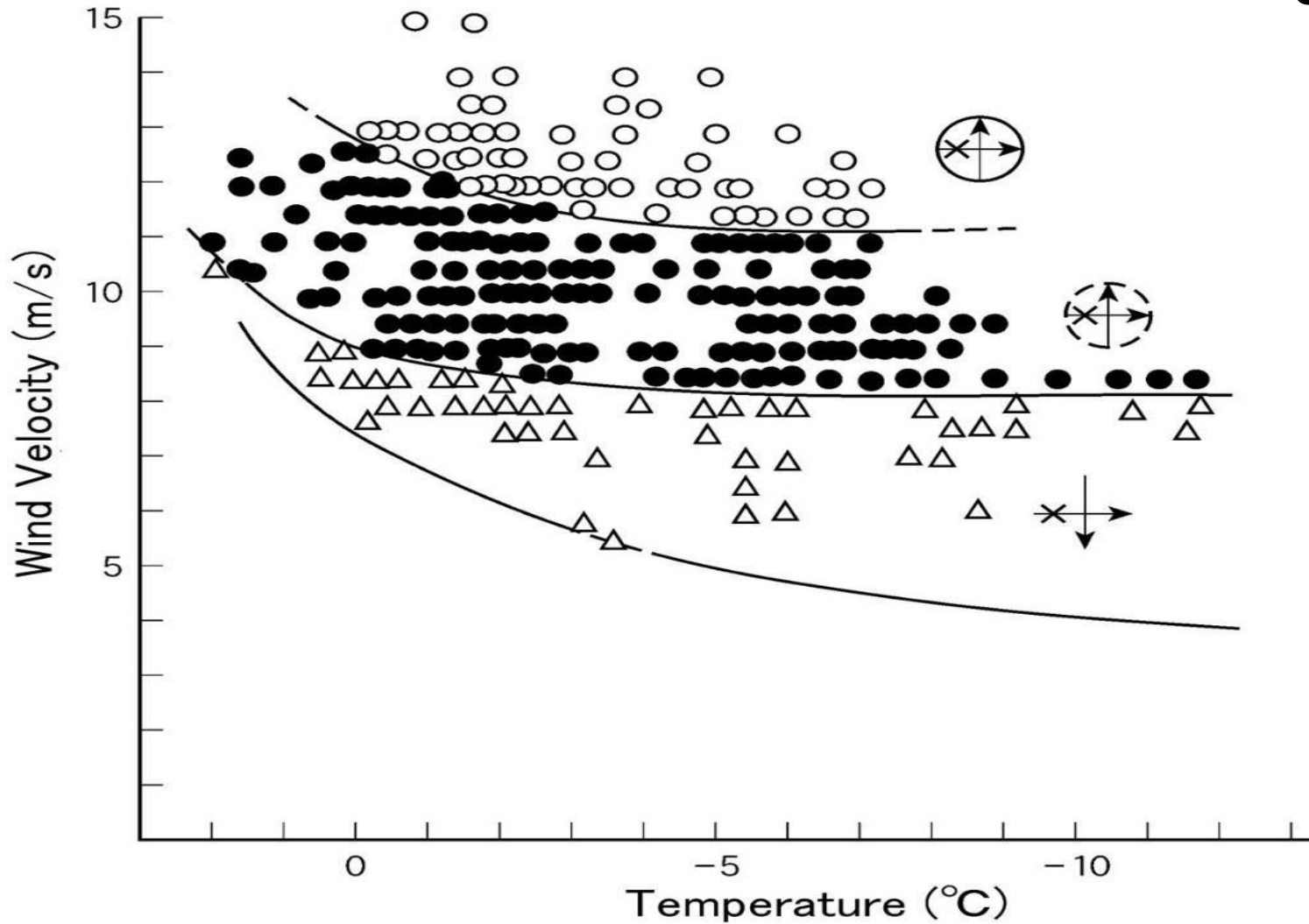
Suspension



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I. Characteristics of blowing/drifting snow

Weather conditions under which blowing snow occurs

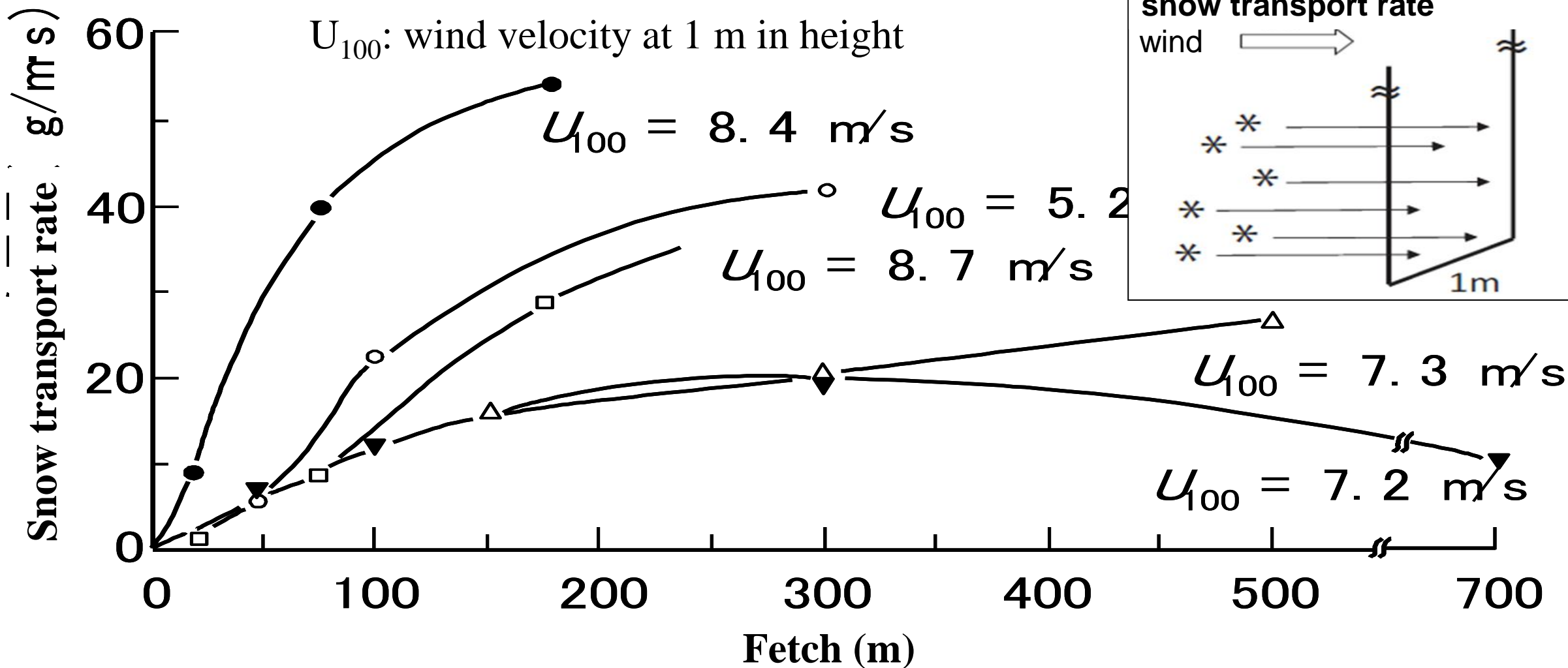


- continuous suspension
- intermittent suspension
- △ predominant saltation

(Takeuchi et al., 1986)

I. Characteristics of blowing/drifting snow

Horizontal distribution of snow transport rate



Typical snowdrift formation

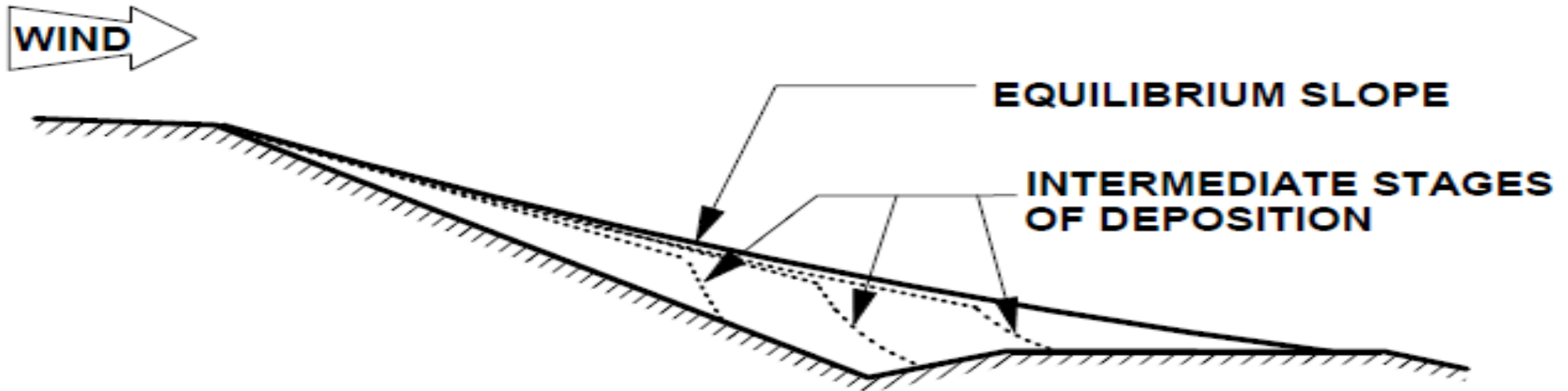
- Wind velocity decreases near obstacles, so the transport force is weakened and snow starts accumulating.
- Turbulent eddies cause snow particles to separate from the airstream. The particles accumulate to form snowdrifts.
- Snowdrifts often form around obstacles such as cuts, buildings and cars.



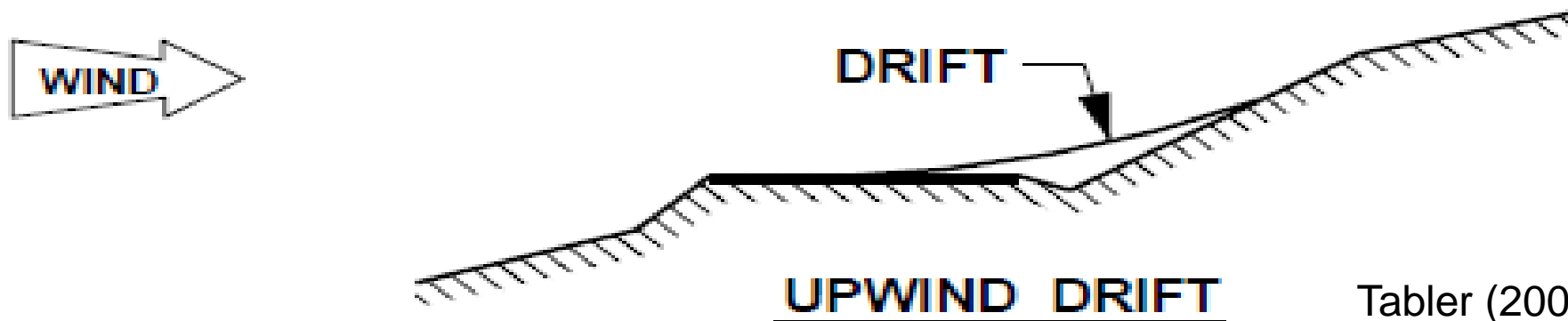
Photo by the Hokkaido Development Bureau



Snowdrift formation at a cut section



Tabler (2003)



Tabler (2003)



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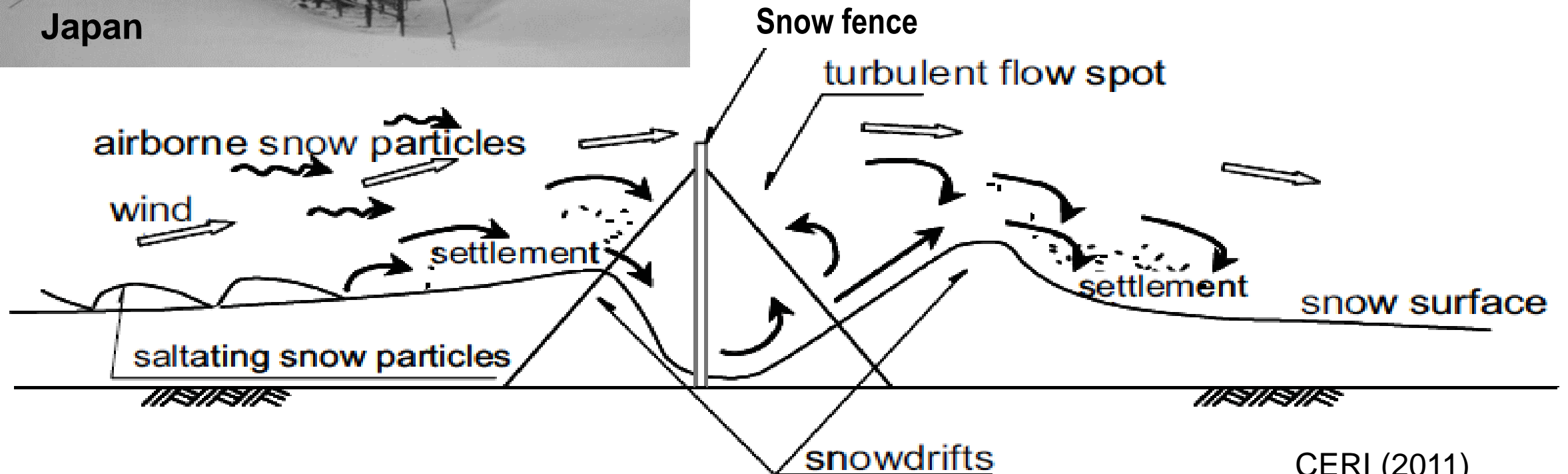
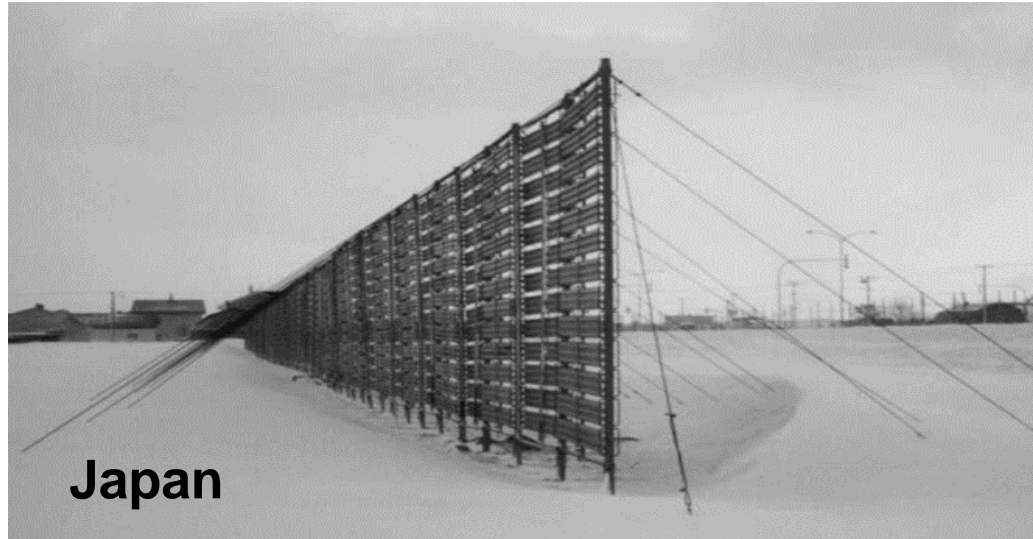
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Snowdrift

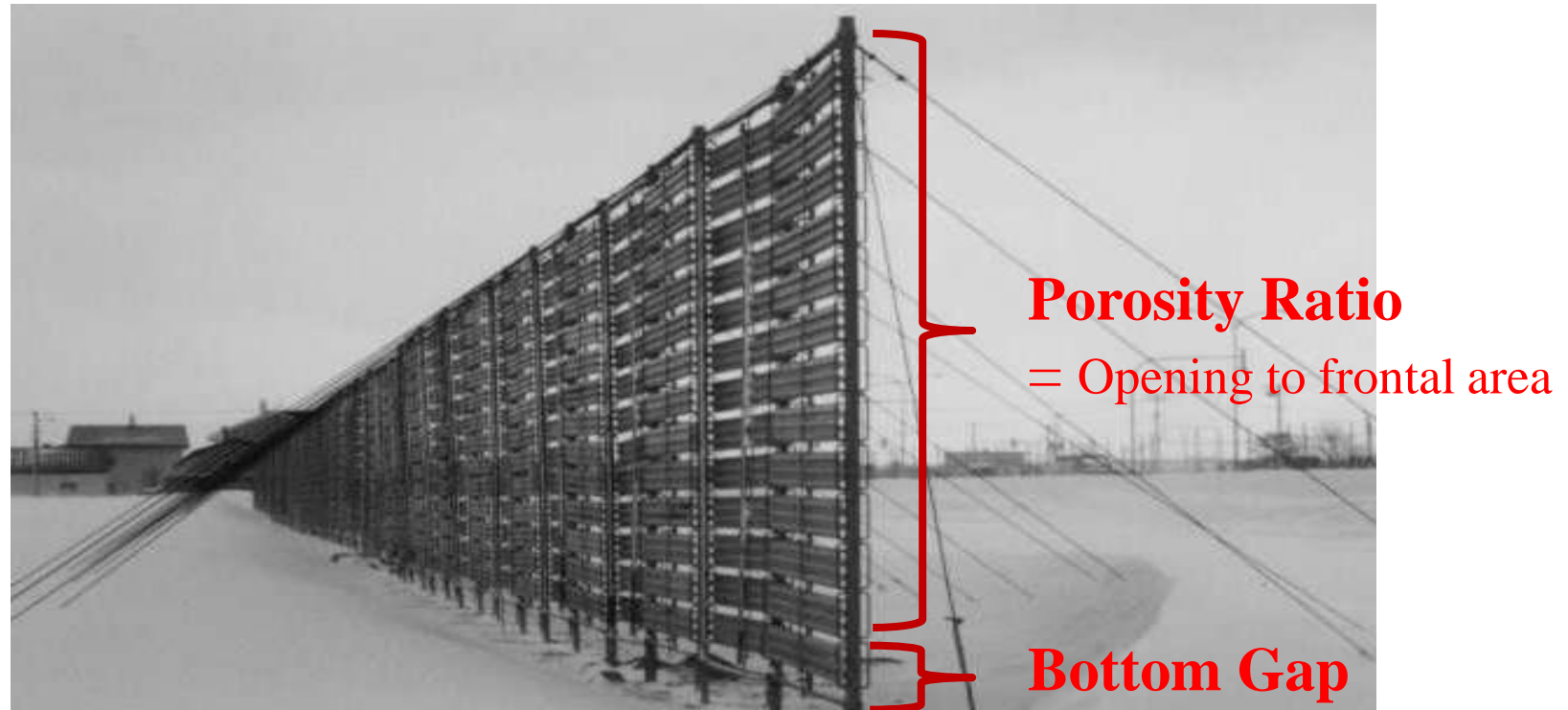
1. Snow fence



Characteristics of a snow fence

Bottom Gap: the space between the ground and the bottom of the slats

Porosity: the ratio of open area to total frontal area excluding the bottom gap

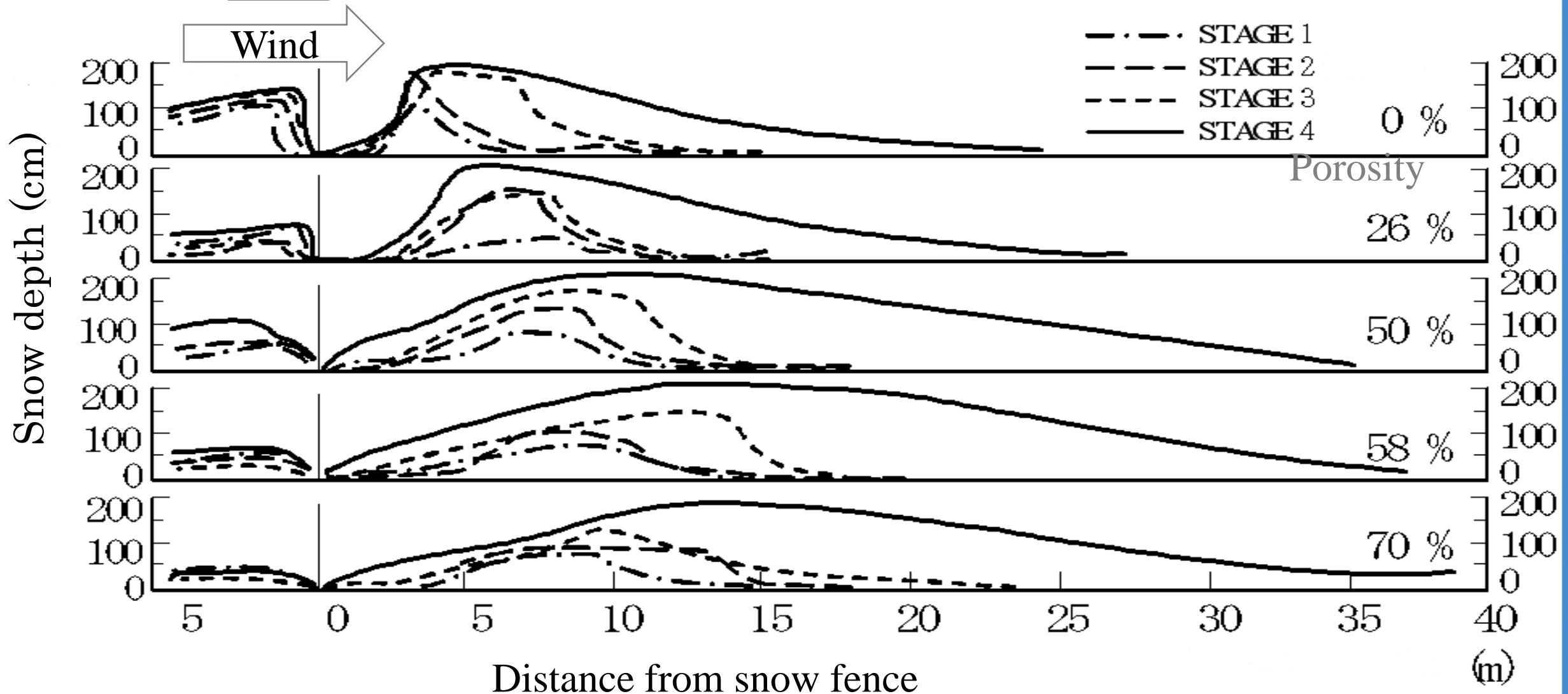




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II. Snowdrift countermeasures

Snow fence porosity and snowdrifts



Price (1961)

Porosity: 30% (Japan) - 50% (USA)

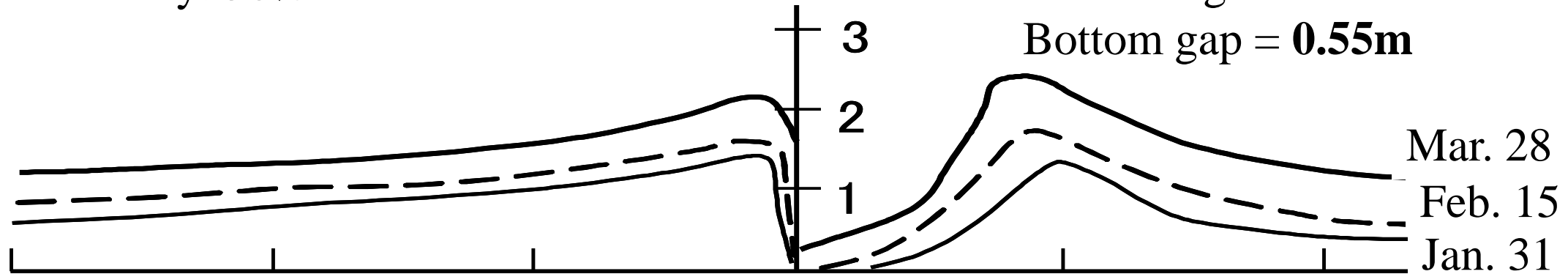
Bottom gap and snowdrift

Porosity: 30%

Fence (m)

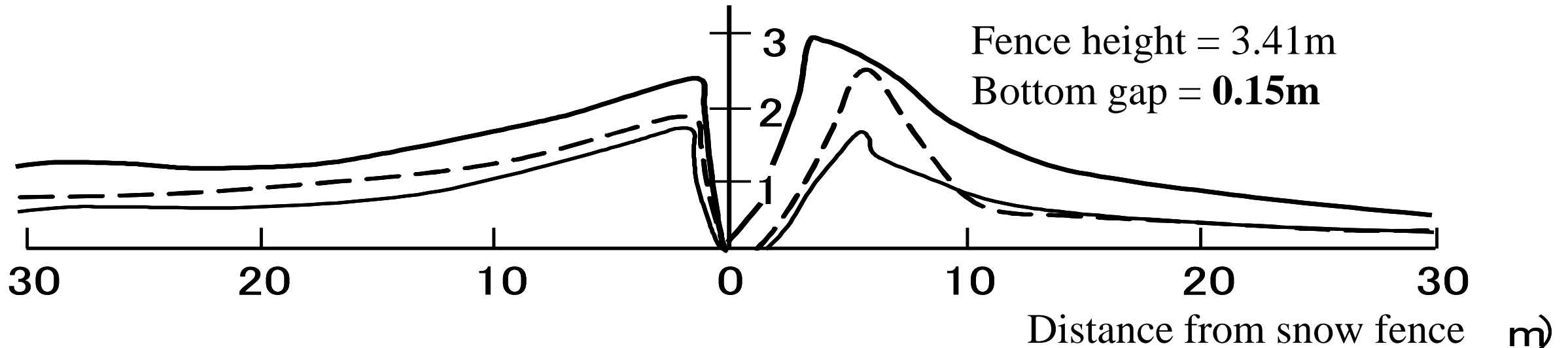
Fence height = 3.41m

Bottom gap = **0.55m**



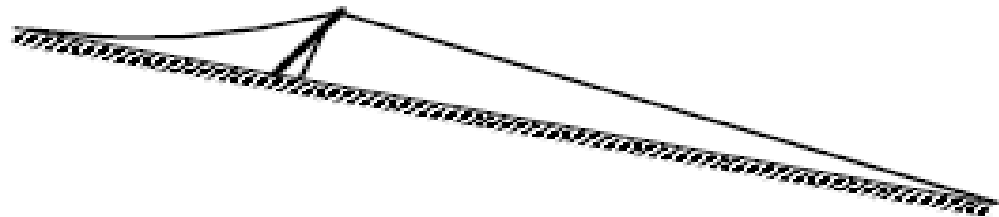
Fence height = 3.41m

Bottom gap = **0.15m**

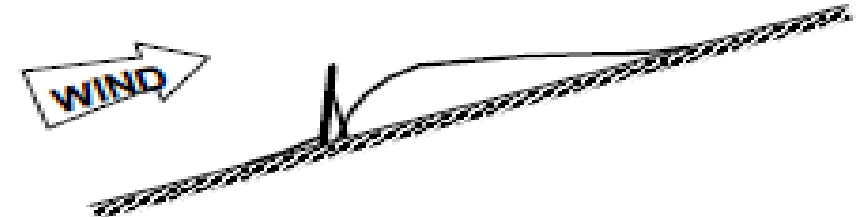


Bottom gap: 0.5 - 0.6m, to prevent burial, to maintain effectiveness

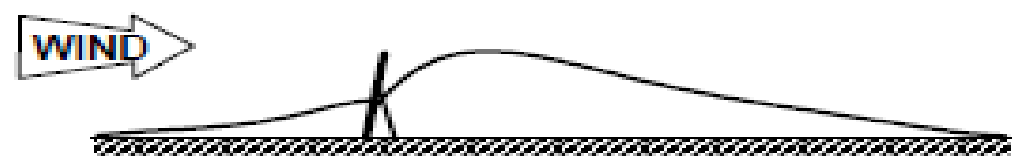
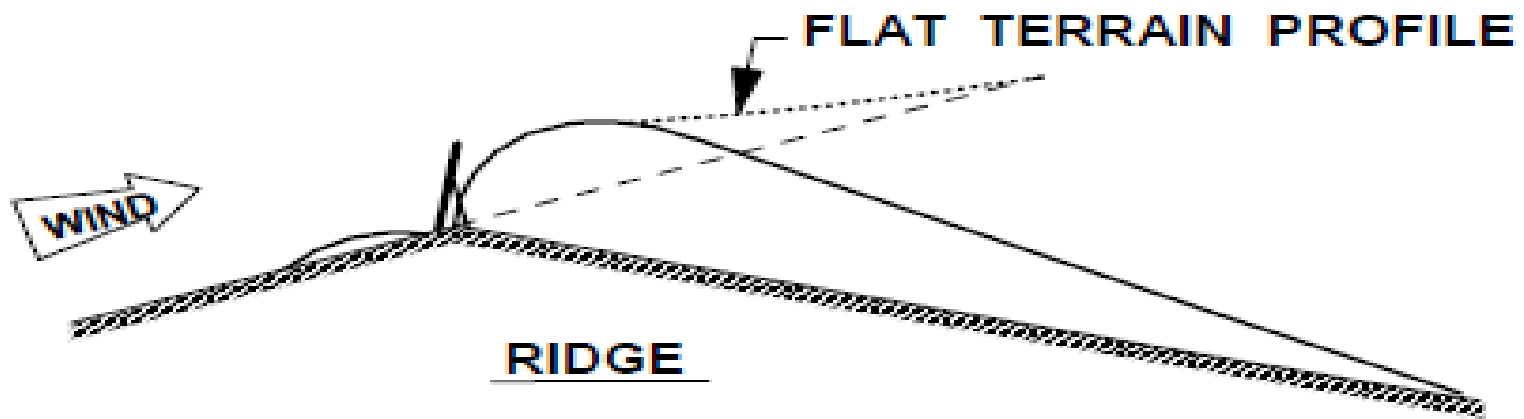
Effects of ground slope on the shape of equilibrium snowdrifts



DOWNWARD - SLOPING TERRAIN



UPWARD - SLOPING TERRAIN



FLAT TERRAIN

I-80: Site of 5 fences



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Before snow fence installation (1971)



I-80 Wyoming, U.S.A.

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After snow fence installation (1972 – present)



I-80 Wyoming, U.S.A.

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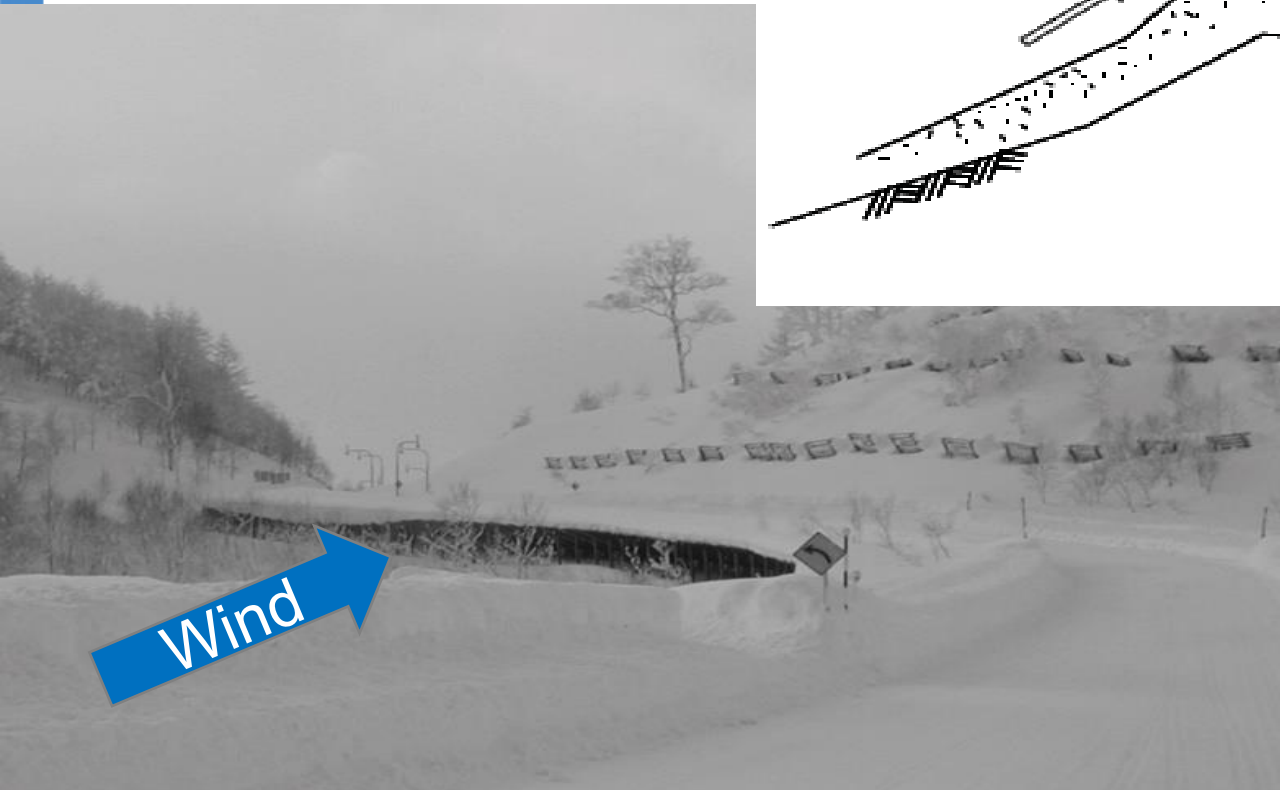
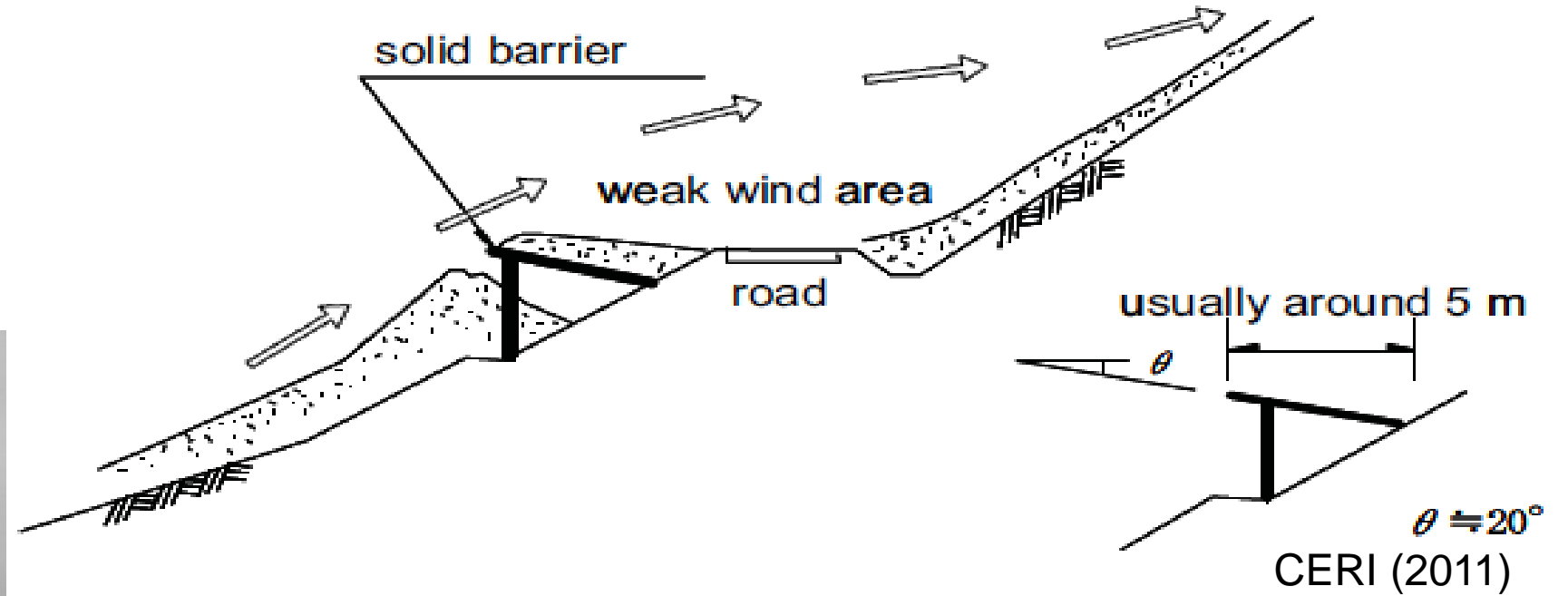
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II. Snowdrift countermeasures

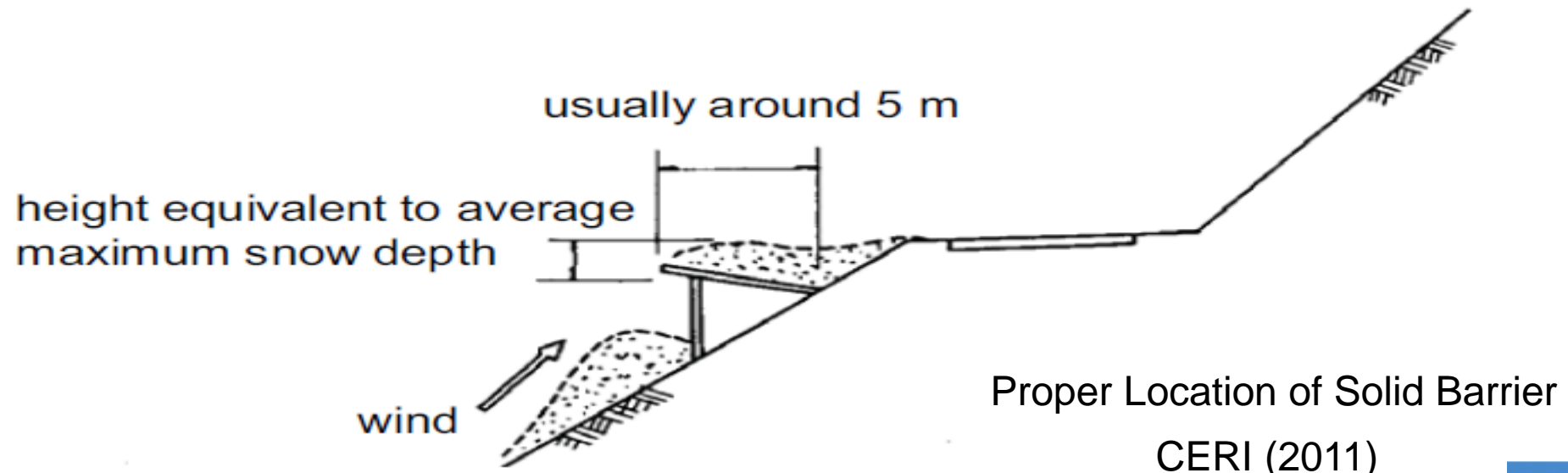
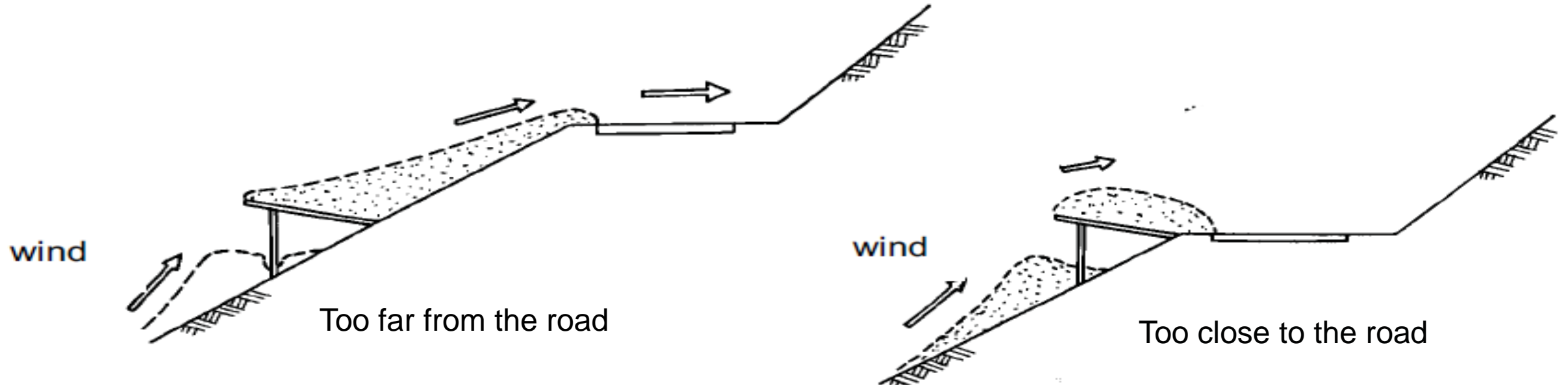
Solid barrier



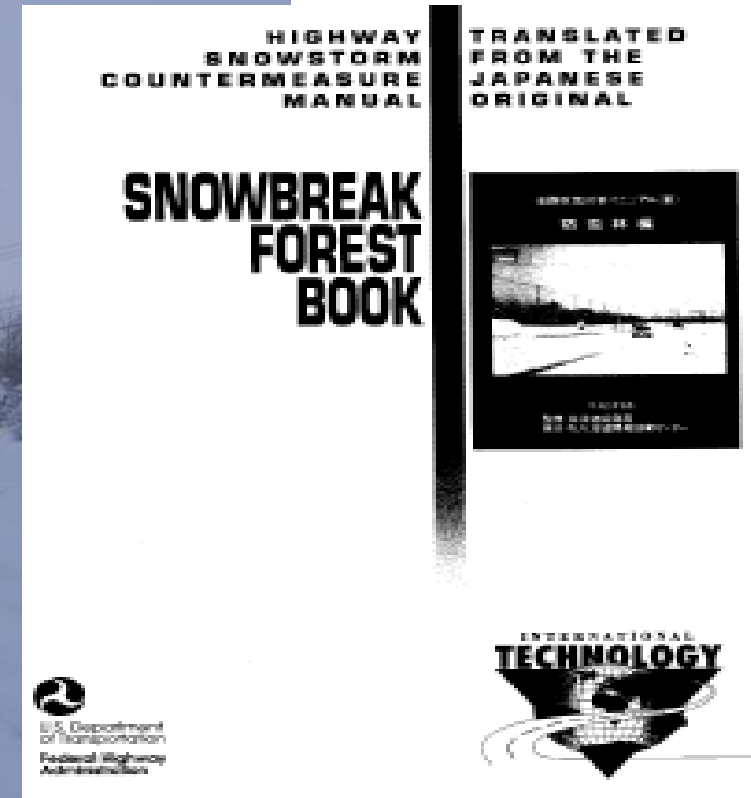


II. Snowdrift countermeasures

Location of solid barrier



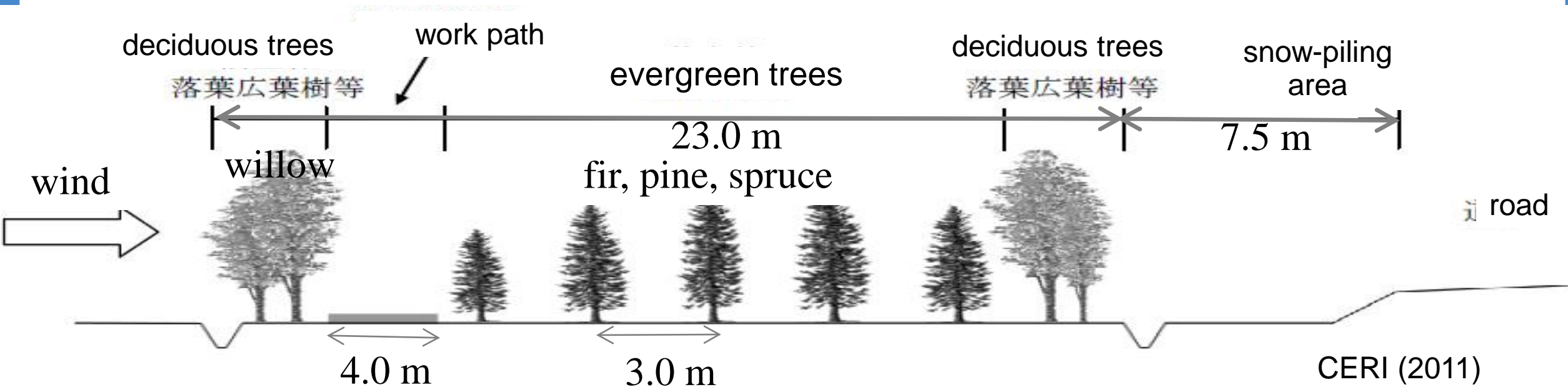
2. Snowbreak woods



<http://international.fhwa.dot.gov/Pdfs/SnowbreakForest.pdf>

Basic structure of snowbreak woods

The Highway Snowstorm Countermeasure Manual (2011 edition), Japan



Mean annual snow transport	Width of woods
20 - 30m ³ /m (7.0-10.5t/m)	11.0m
30 - 50m ³ /m (10.5-17.5 t/m)	23.0m
50m ³ /m or more (17.5t/m -)	32.0m

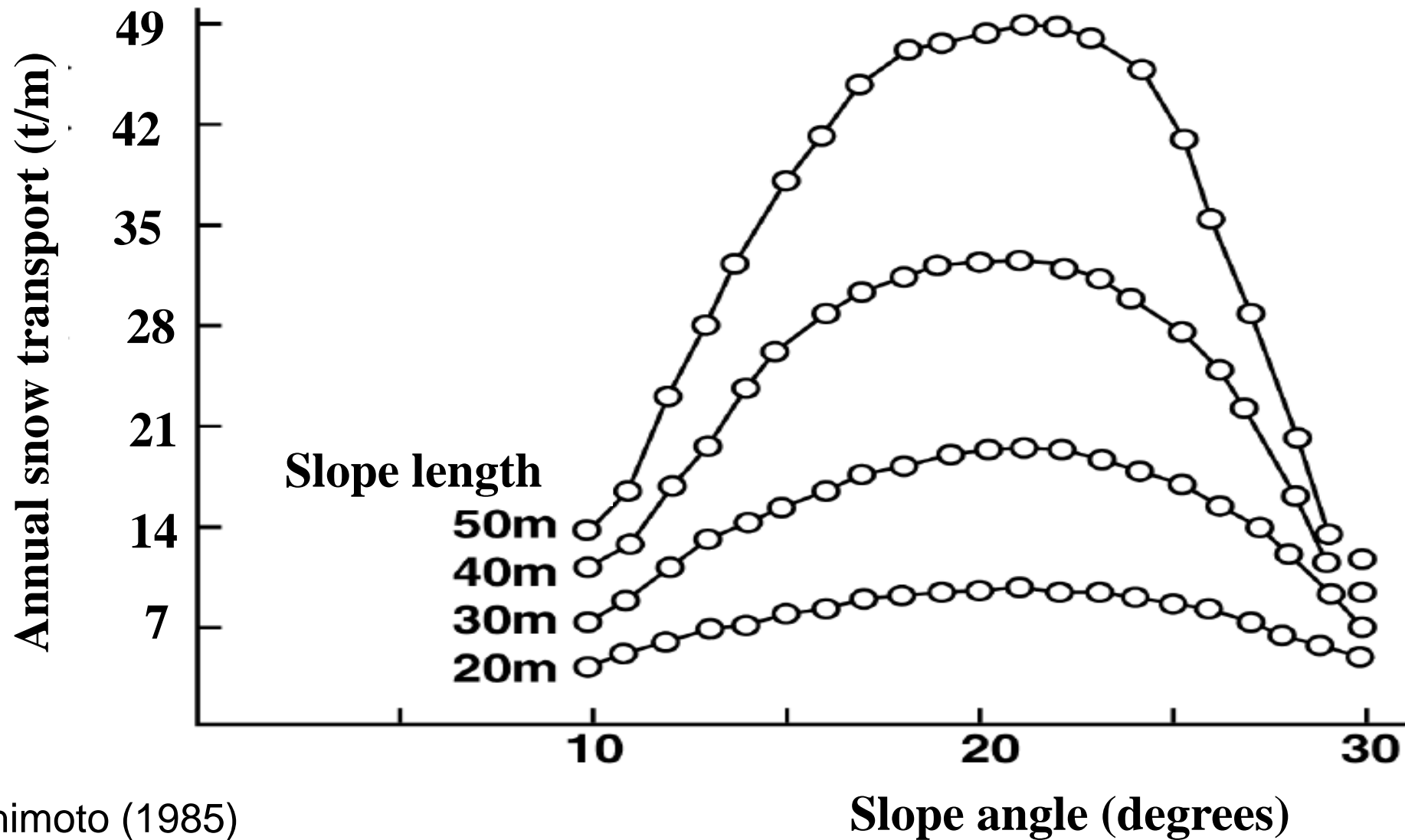
3. Drift-free cut

- Provides a gradient of 1 : 3 on the windward slope





Slope length of a drift-free cut



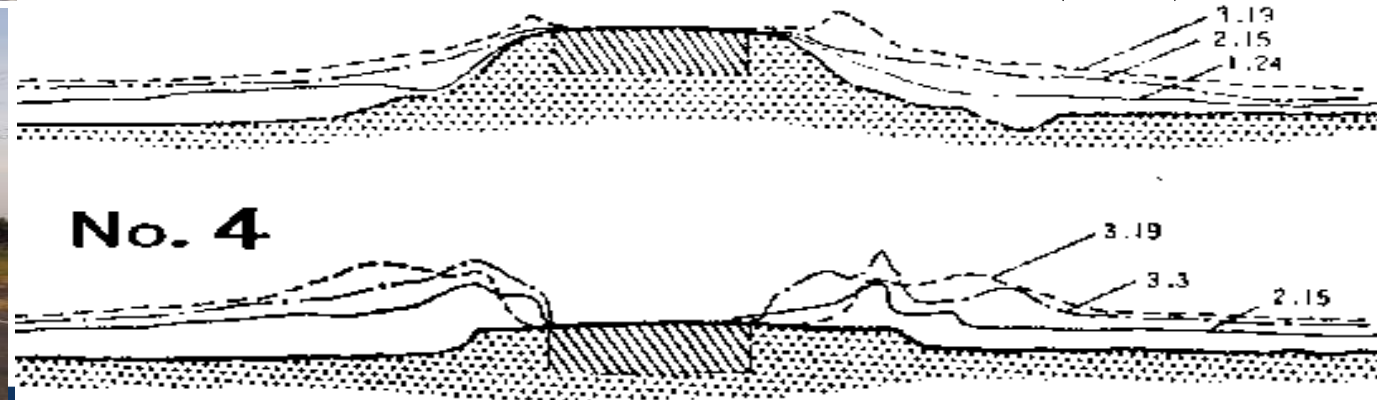
4. Drift-control fill

The fill height is 1.3 times the average maximum snow depth.

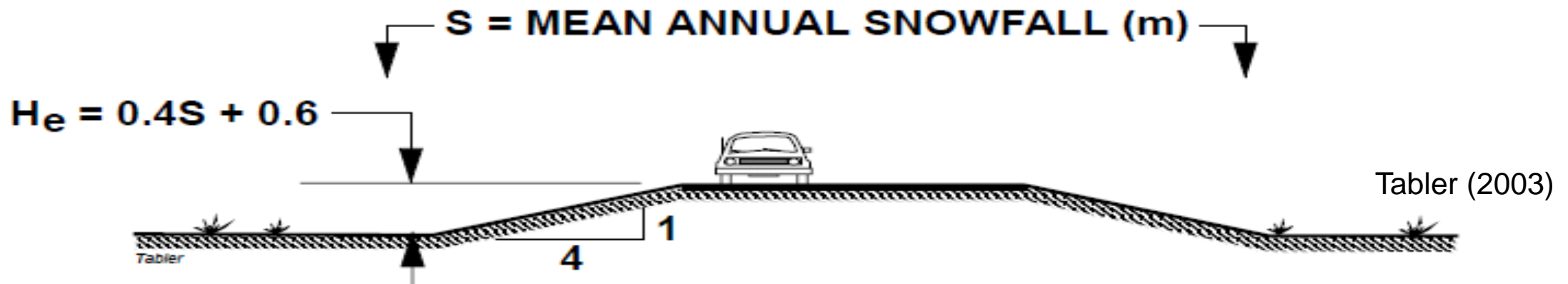


No. 1

Takeuchi(1973)



4. Drift-control fill (with a gentle slope)





Comparison of snowdrift between a fill section and a cut section

Before



Fill section

Feb. 07,
2012

Before



Cut section

After



Feb. 09,
2012



References

- ***Controlling Blowing and Drifting Snow with Snow Fences and Road Design***; R. D. Tabler 2003.
<http://sicop.transportation.org/Pages/DriftingandBlowingSnow.aspx>
- ***The Highway Snowstorm Countermeasure Manual (2011 Revised Edition -Abridged Edition-*** ; Civil Engineering Research Institute for Cold Region (CERI), PWRI.
http://www2.ceri.go.jp/fubuki_manual/index_e.htm

Thank you for your attention!

Gracias por su atención!