TRB NOISE 2007 SLO

ADC40 Annual Summer Meeting,
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San Luis Obispo, CA

Latest results of quiet pavement studies in Europe and Asia - Findings from study tours April-May 2007

By Ulf Sandberg, Chalmers University of Technology
and the Swedish National Road and Transport Research Institute (VTI)

Studies by Hong Kong officials during the European tour

Acknowledgements

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- The author is grateful for the permission by the EPD to present this work

- The author is also grateful to Chalmers University of Technology for sponsoring the participation in the ADC40 summer meeting

Travel locations and routes

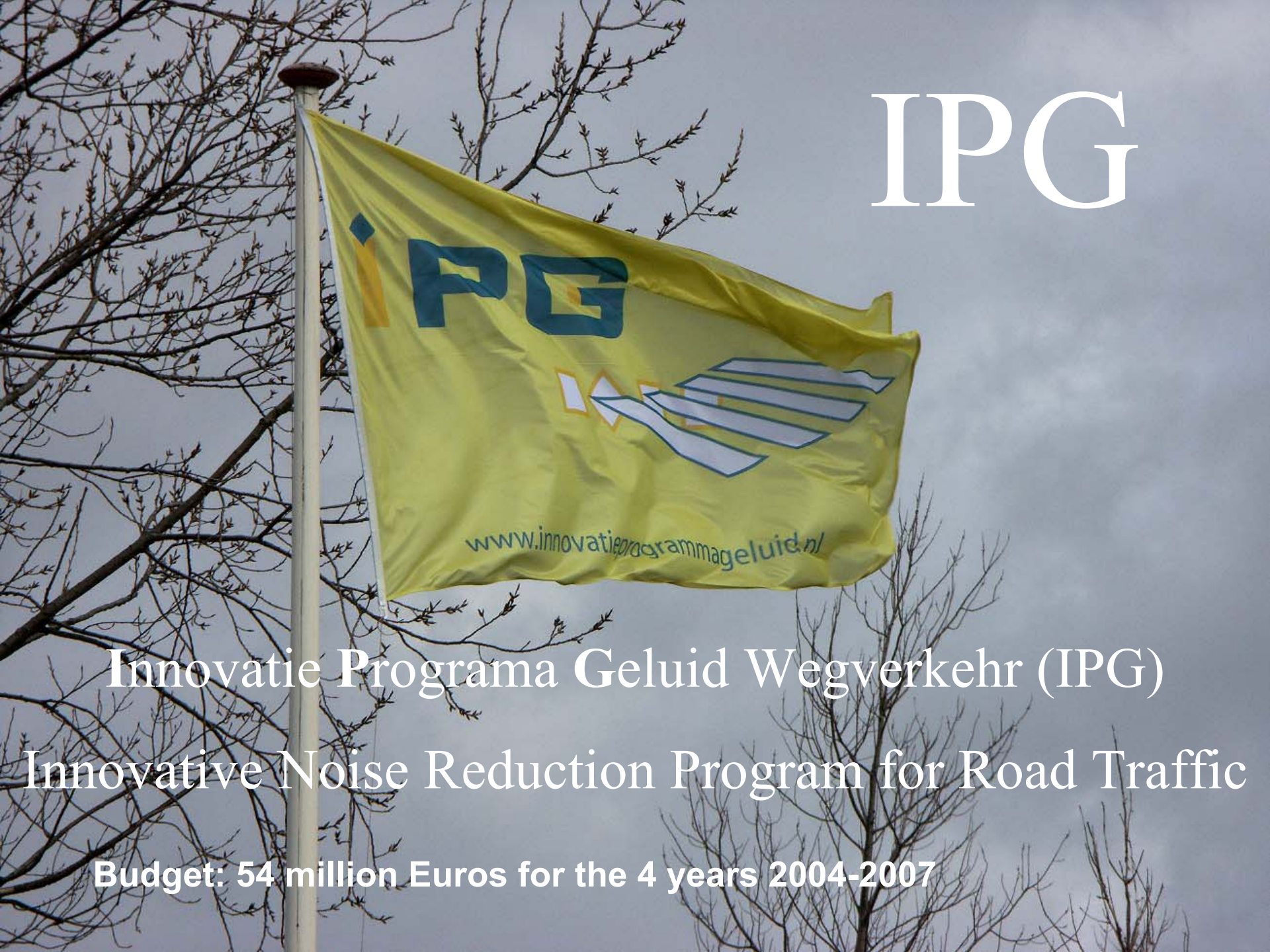
The Netherlands

Dutch paving policy: use porous asphalt on all national roads

Single layer ”ZOAB”: ≥40 mm thick, 16 mm max aggr.size, voids content target 20 %

Porous asphalt currently laid on 70 % of the national highway system.

Target: 100 % by 2010



IPG

Innovatie **P**rograma **G**eluid Wegverkehr (IPG)

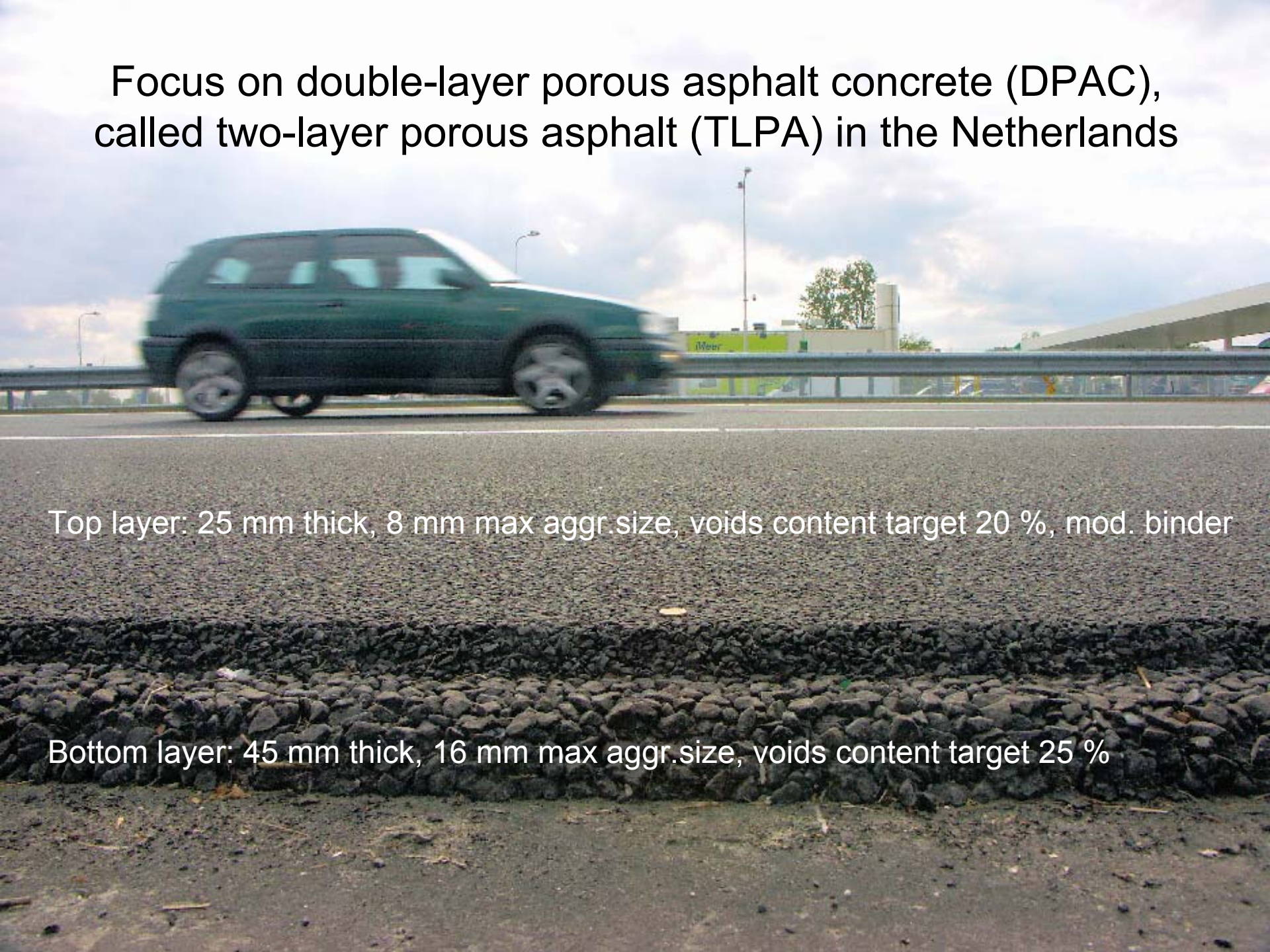
Innovative Noise Reduction Program for Road Traffic

Budget: 54 million Euros for the 4 years 2004-2007


This day probably
something went wrong….

The Kloosterzande test track

Focus on double-layer porous asphalt concrete (DPAC), called two-layer porous asphalt (TLPA) in the Netherlands



Top layer: 25 mm thick, 8 mm max aggr.size, voids content target 20 %, mod. binder

Bottom layer: 45 mm thick, 16 mm max aggr.size, voids content target 25 %

TLPA currently laid on 100 km (65 miles) of motorways

Noise reduction goal (TLPA pavements implemented at the end of 2007):

6 dB(A) initially;

4 dB(A) as a lifetime average (at least 7 years)

Drop in noise reduction: 0.20 – 0.25 dB(A) per year

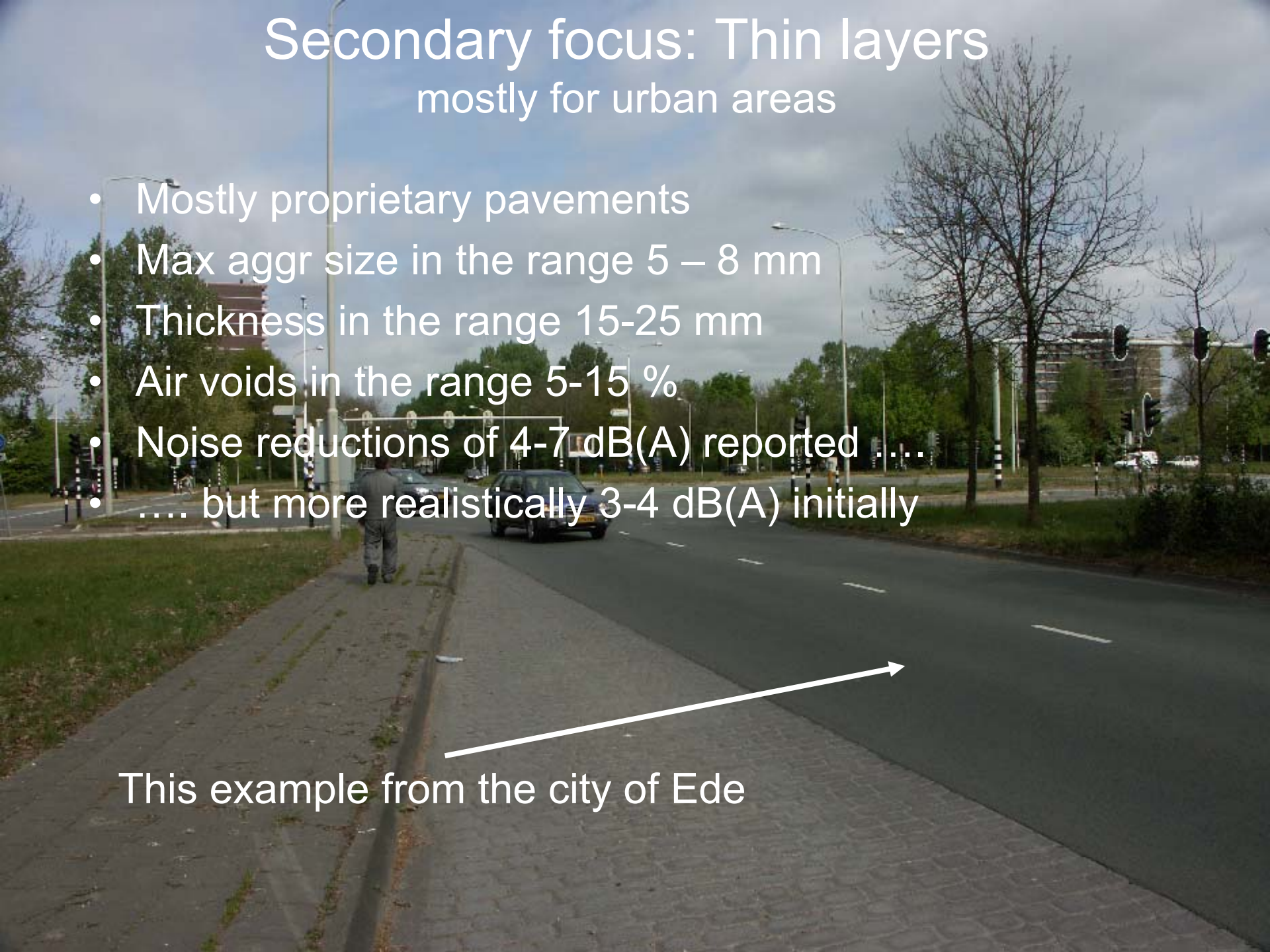
Goal seems to be essentially achieved now in 2007

Reference pavement: Dense asphalt concrete 0/16 (similar to HMA 5/8”)

Secondary focus: Thin layers

mostly for urban areas

- Mostly proprietary pavements
- Max aggr size in the range 5 – 8 mm
- Thickness in the range 15-25 mm
- Air voids in the range 5-15 %
- Noise reductions of 4-7 dB(A) reported ….
- …. but more realistically 3-4 dB(A) initially



This example from the city of Ede

”Microflex 0/6” in Ede

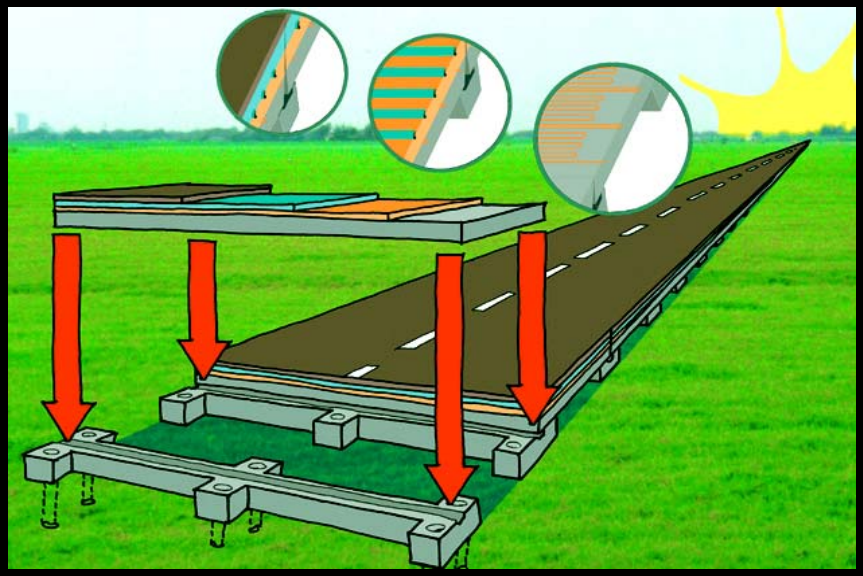
- Proprietary pavement, made by Heijmans Infrastructuur
- Max. aggr. size: 6 mm
- Thickness: appr. 20 mm
- Air voids: appr. 13 % (when new)
- Noise reduction: appr. 4 dB(A) at 50 km/h

Futuristic designs still under trial

- Modieslab
- Rollpave
- Poroelastic road surface

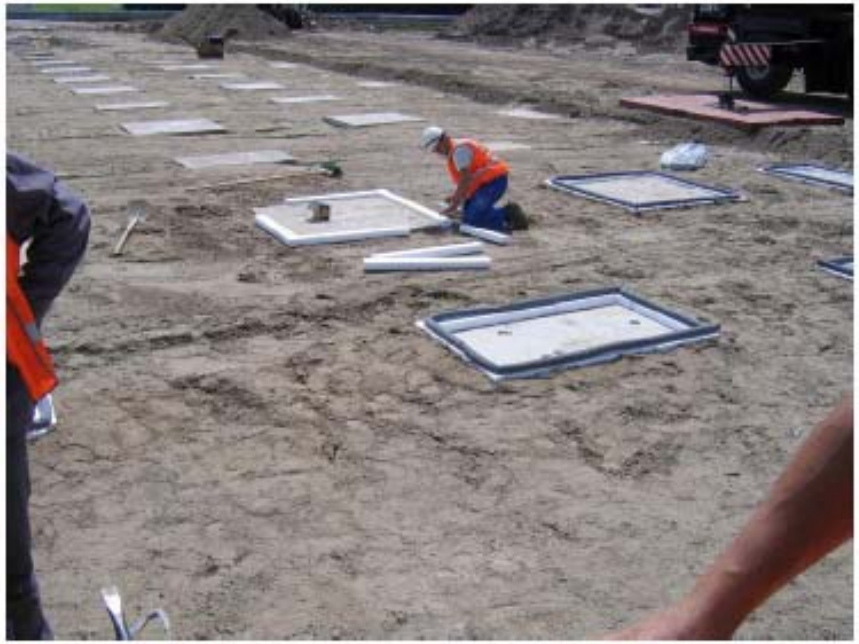
Modieslab

(Courtesy of Jasper der Kooij)



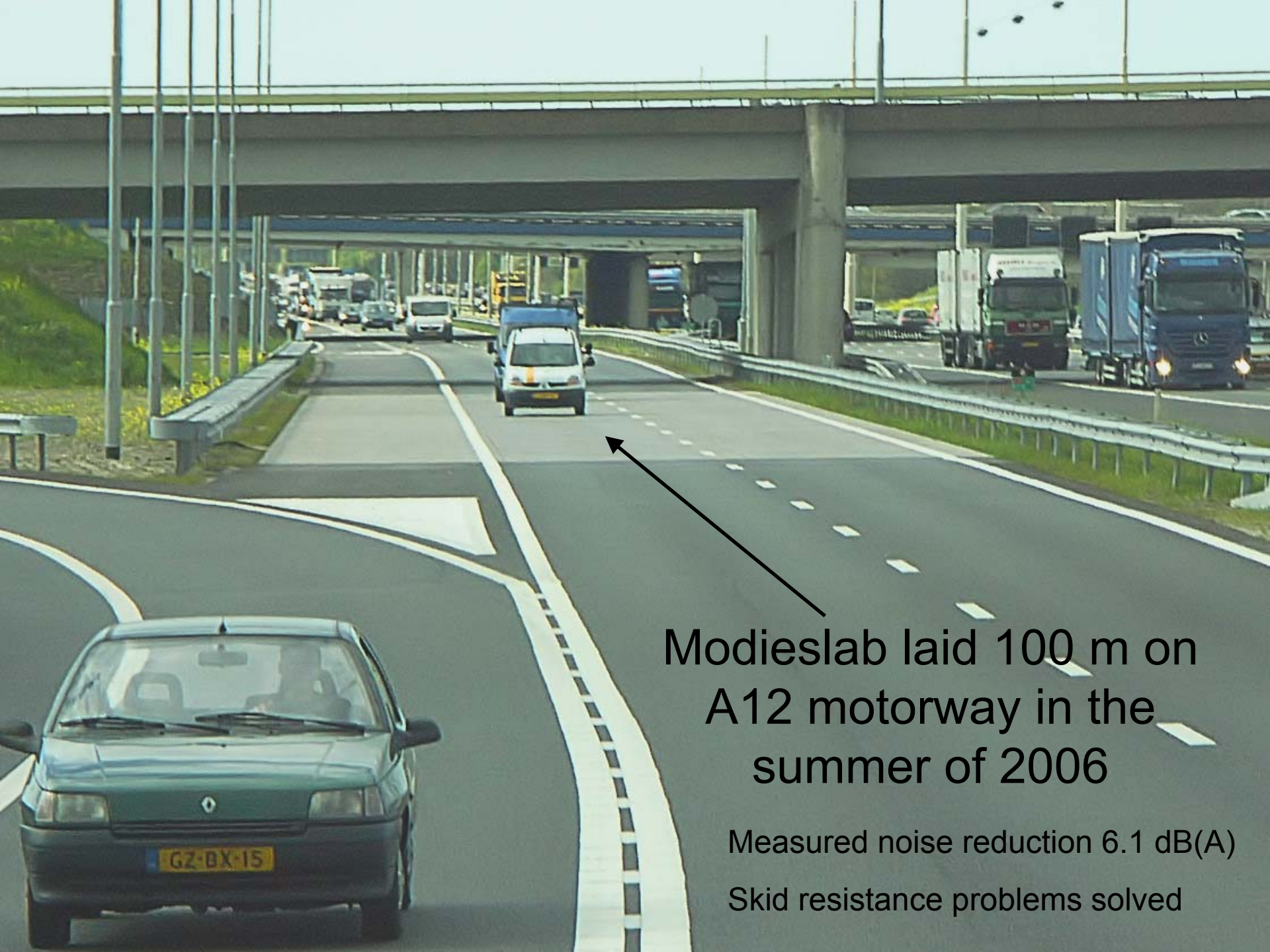
(a) Installation of foundation piles

(b) Installation of pile caps on top of piles



(c) Backfilling of ground around piles and

(d) Installation of concrete slab on top of

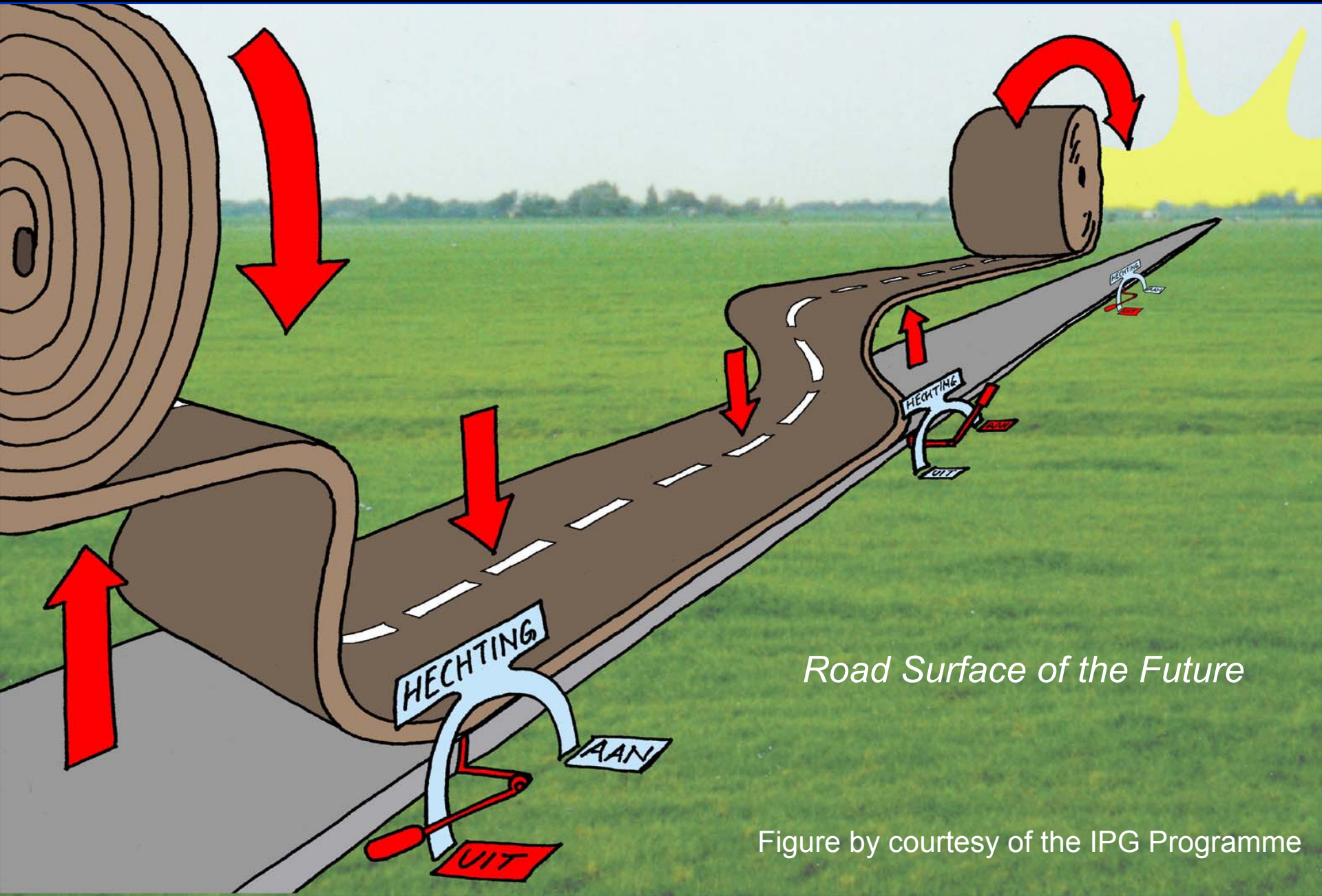


Modieslab laid 100 m on A12 motorway in the summer of 2006

Measured noise reduction 6.1 dB(A)

Skid resistance problems solved

Rollpave – using “The Adhesive Road” concept



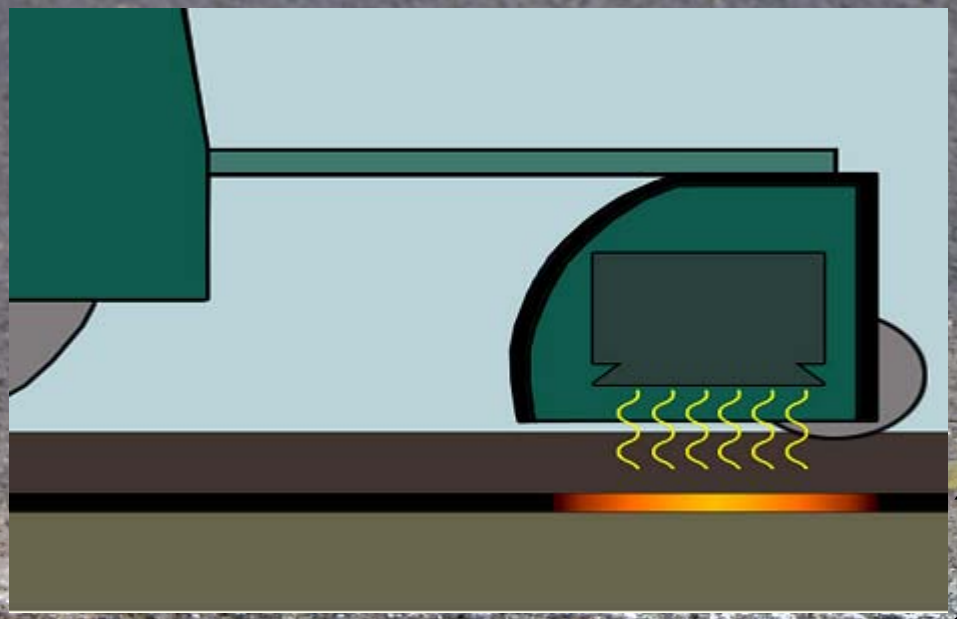
Road Surface of the Future

Figure by courtesy of the IPG Programme

On a yard, 30 rolls, each 50x3.75 m (165'x12'), were constructed

These were brought out on the motorway, rolled out and glued, to cover 500 m of two lanes + shoulder of motorway surface

"The rollable road" – from Road Surface of the Future



Binder melted by electromagnetic heating of wire mesh

- 30 mm thick single layer porous asphalt, 8 mm max aggr.
- The goal was a noise reduction of 6 dB(A)
- The measured noise reduction was 4+ dB(A)

- New construction made in winter weather January 2007
- New construction in a curve to be made in summer 2007
- Joints will be improved

The actual site of the Rollpave full-scale experiment:

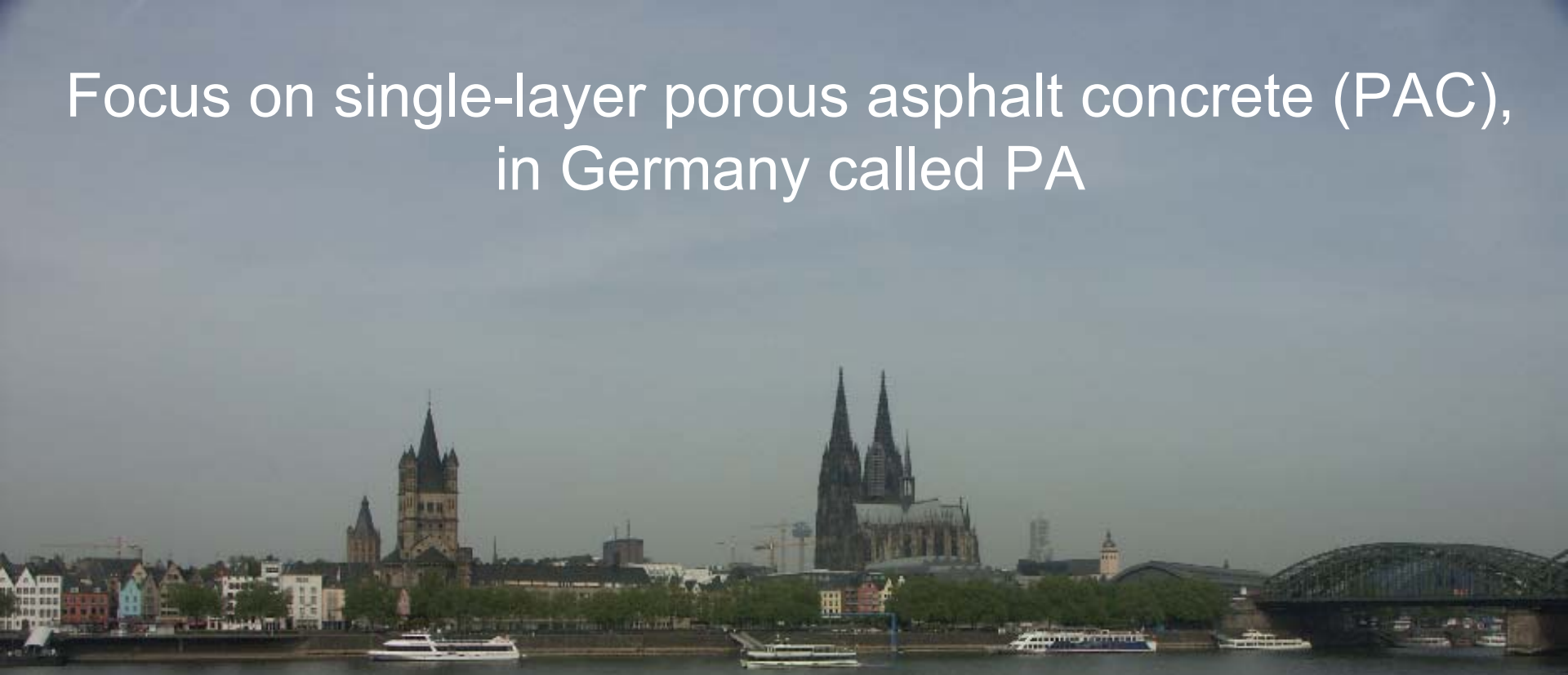
500 m on the A35 motorway


Tests at Kloosterzande test track with poroelastic surfaces impor-ted from Japan. Coop. with PWRI
NOTE: The picture is not from the current test site; it is from Japan
The author at the poroelastic test section at Public Works Research Institute in Japan
Initial noise reduction 7-10 dB(A)
New test constructions will be made in October 2007

Germany

Shift in German paving policy on motorways: Abandon the burlap drag cement concrete; replace with SMA or other treatments with higher texture

Focus on single-layer porous asphalt concrete (PAC), in Germany called PA



45 mm thick, 8 mm max. aggr.size (some oversize up to 11 mm),

voids content target 22-28 %, actual > 22 %, mod. binder

Comprehensive testing ongoing on various roads in Bavaria

Further work to reduce clogging is conducted in ”Leiser Verkehr 2”

Results of monitoring noise reduction versus time

For previous generation of PA 0/8:

Initial noise reduction: 6-7 dB(A) (= 5-6 dB(A) compared to Dutch ref surface)

Drop with time: 0.4 dB(A) per year

For new generation of PA 0/8:

Initial noise reduction: 7-9 dB(A) (= 6-8 dB(A) compared to Dutch ref surface)

Drop with time: 0.25 dB(A) per year

PRODUCTION OF POROUS CEMENT CONCRETE

Data kindly supplied by Nina Sliwa at the German Federal Highway Research Institute (BASt)

Thickness 80 mm

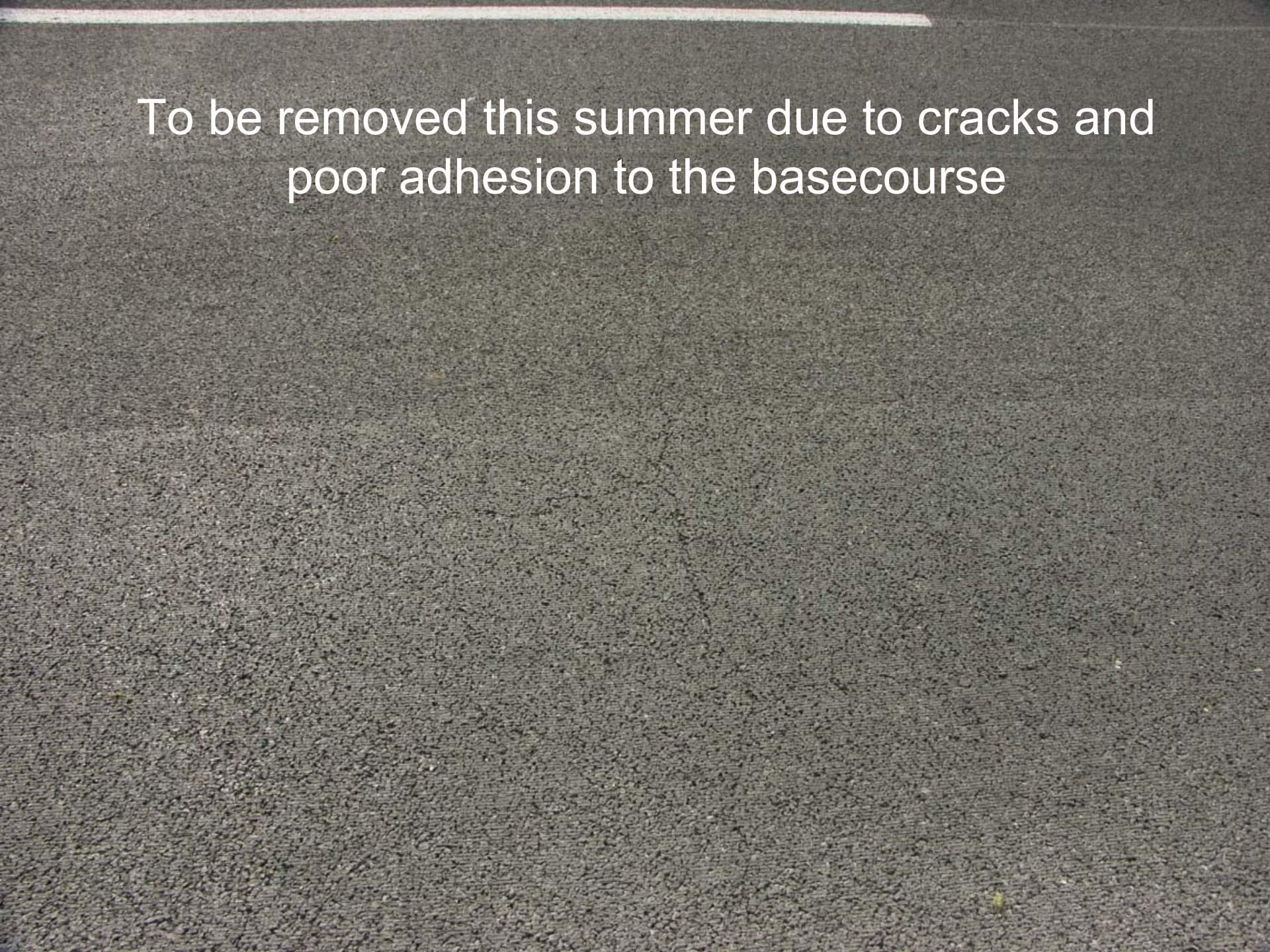
High-grade chippings 5/8 mm

PSV > 53

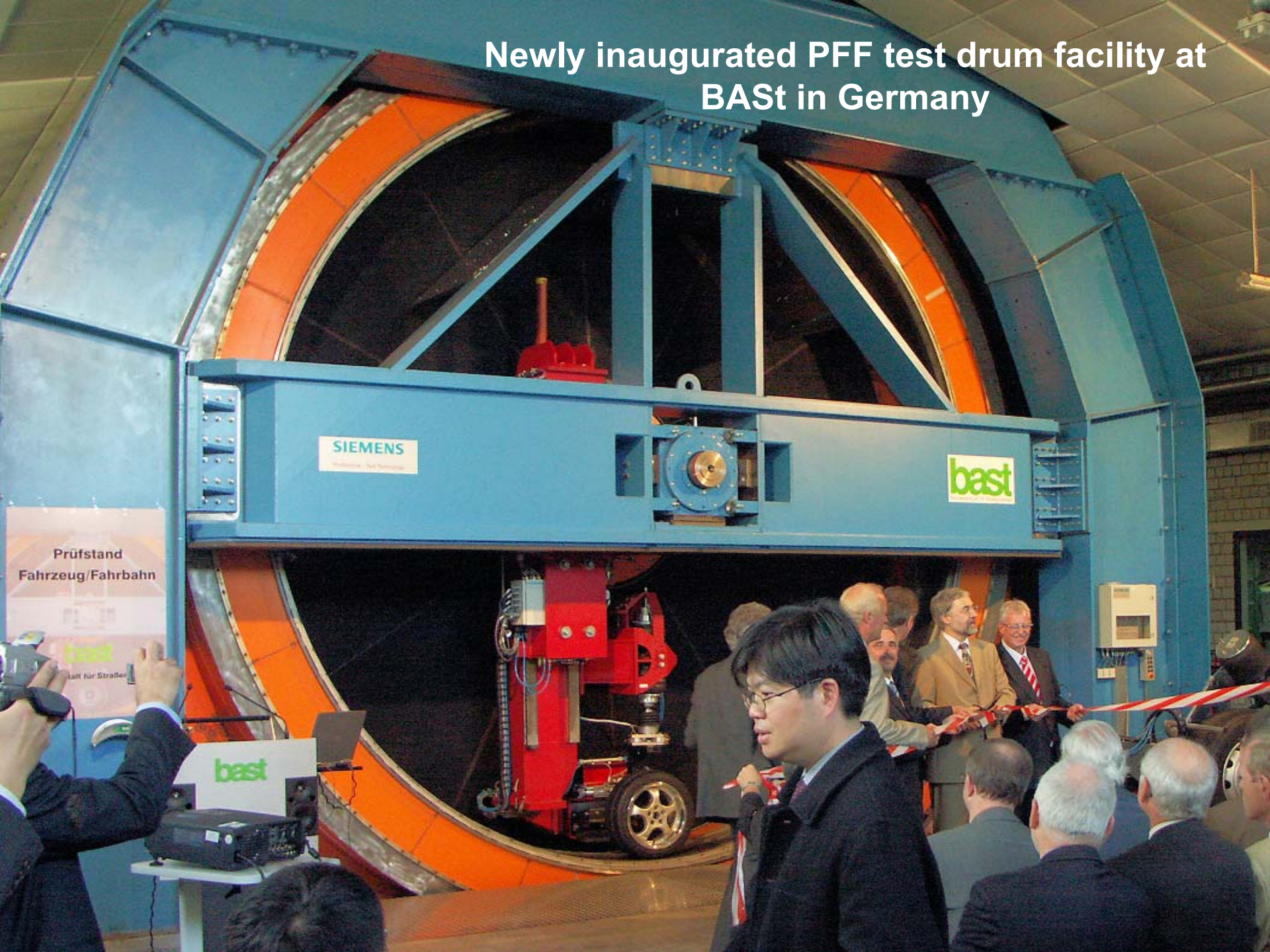
Void content 25 % (vol.)

Production with a modified asphalt finisher after application of a special adhesive

Porous cement concrete smoothed by diamond grinding


To be removed this summer due to cracks and poor adhesion to the basecourse

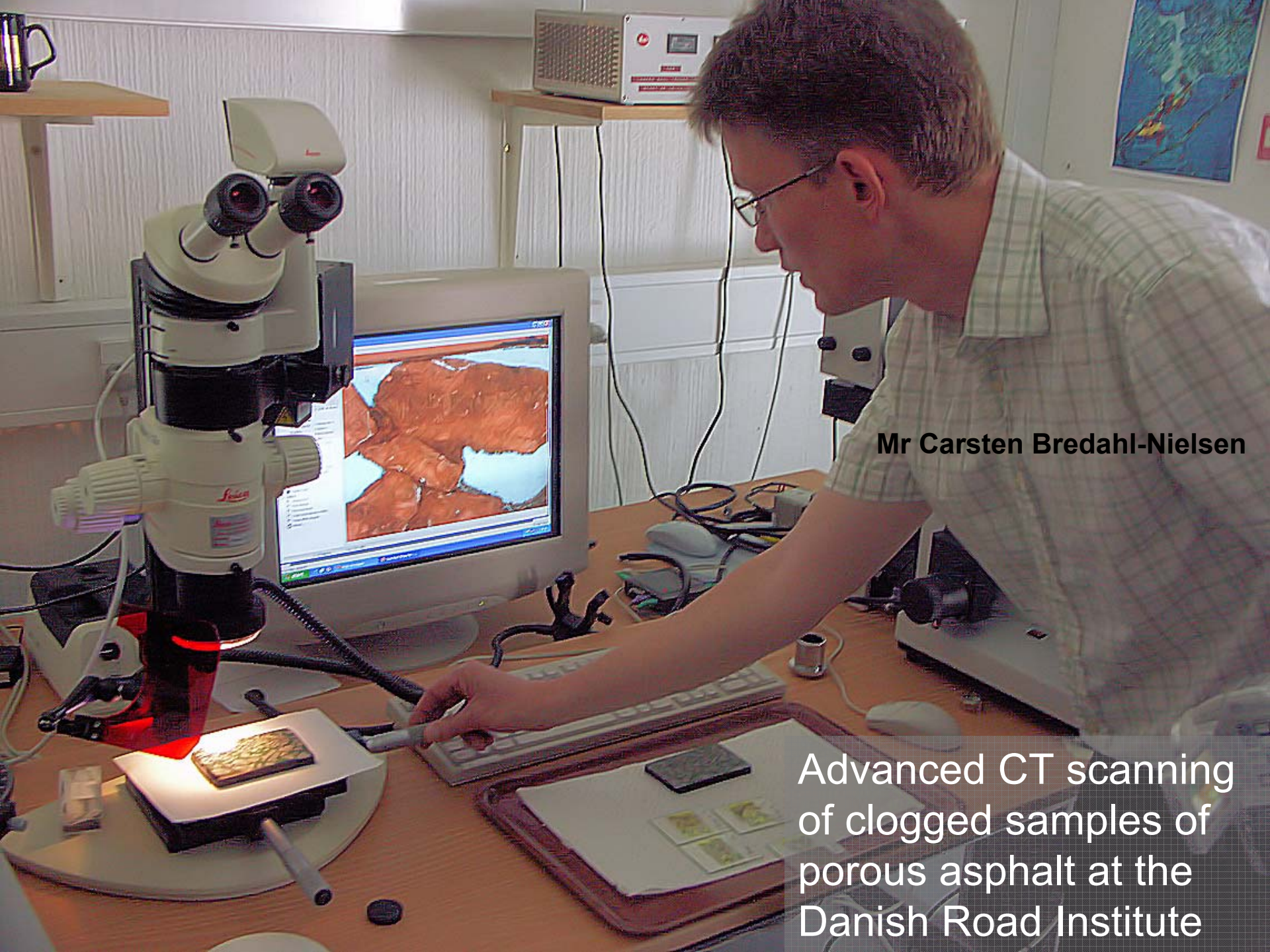
Newly inaugurated PFF test drum facility at BASt in Germany



Samples of ”quiet” thin layers from DRI in Denmark to be tested

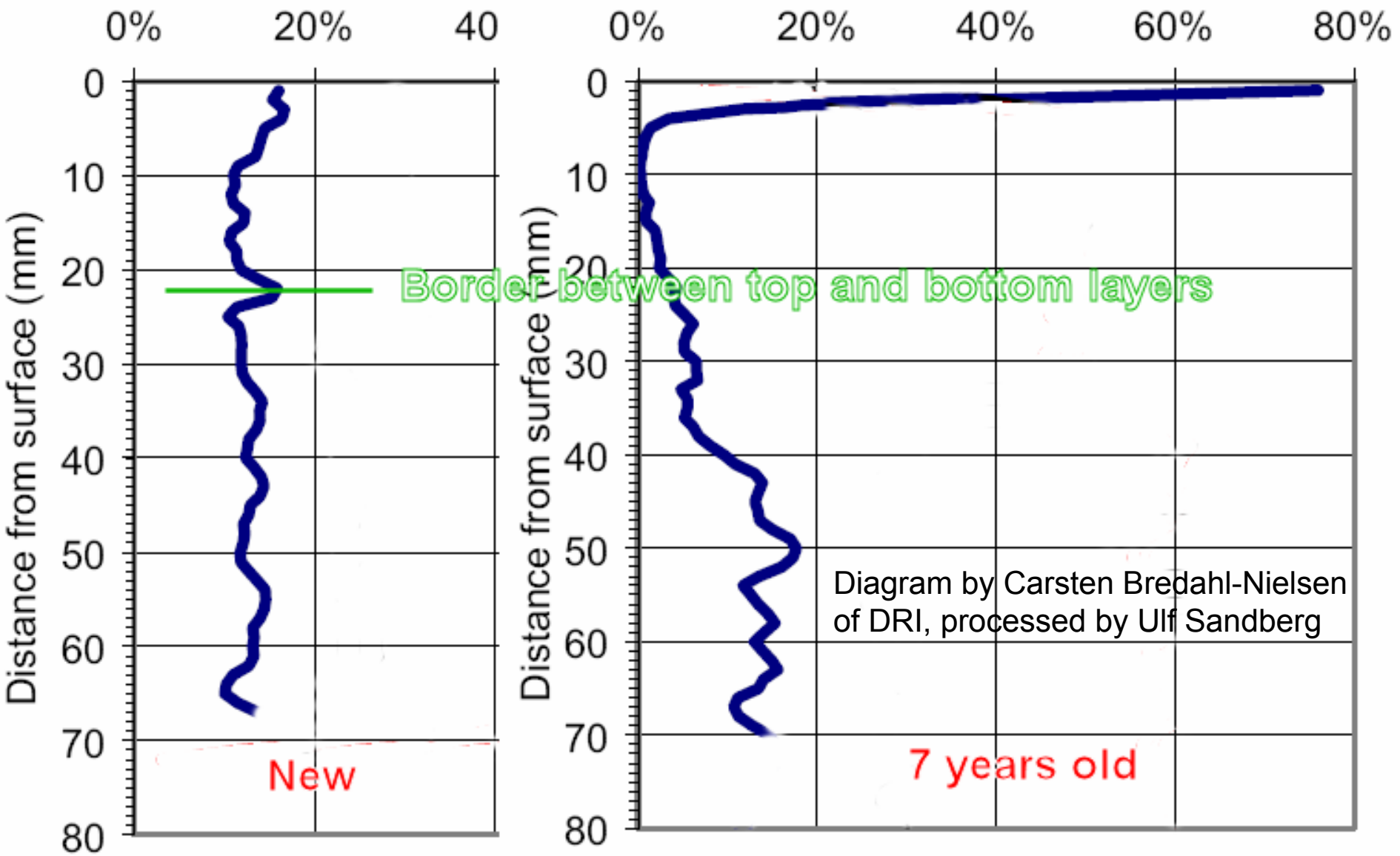
Samples from Denmark and Sweden to be fitted in Germany
into curved caskets like above
and then mounted on the inner circumference of the drum

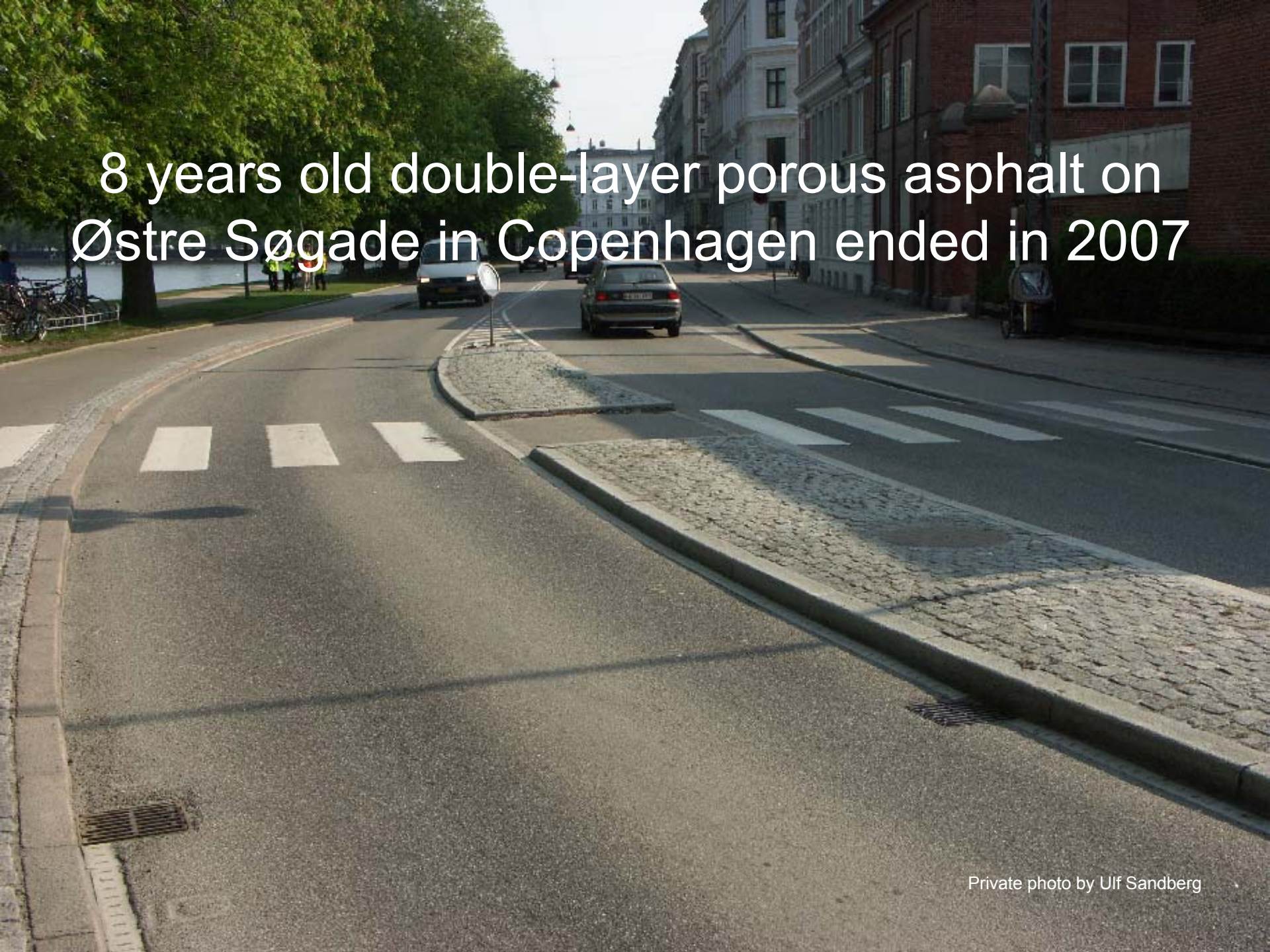

Denmark



Advanced CT scanning of clogged samples of porous asphalt at the Danish Road Institute

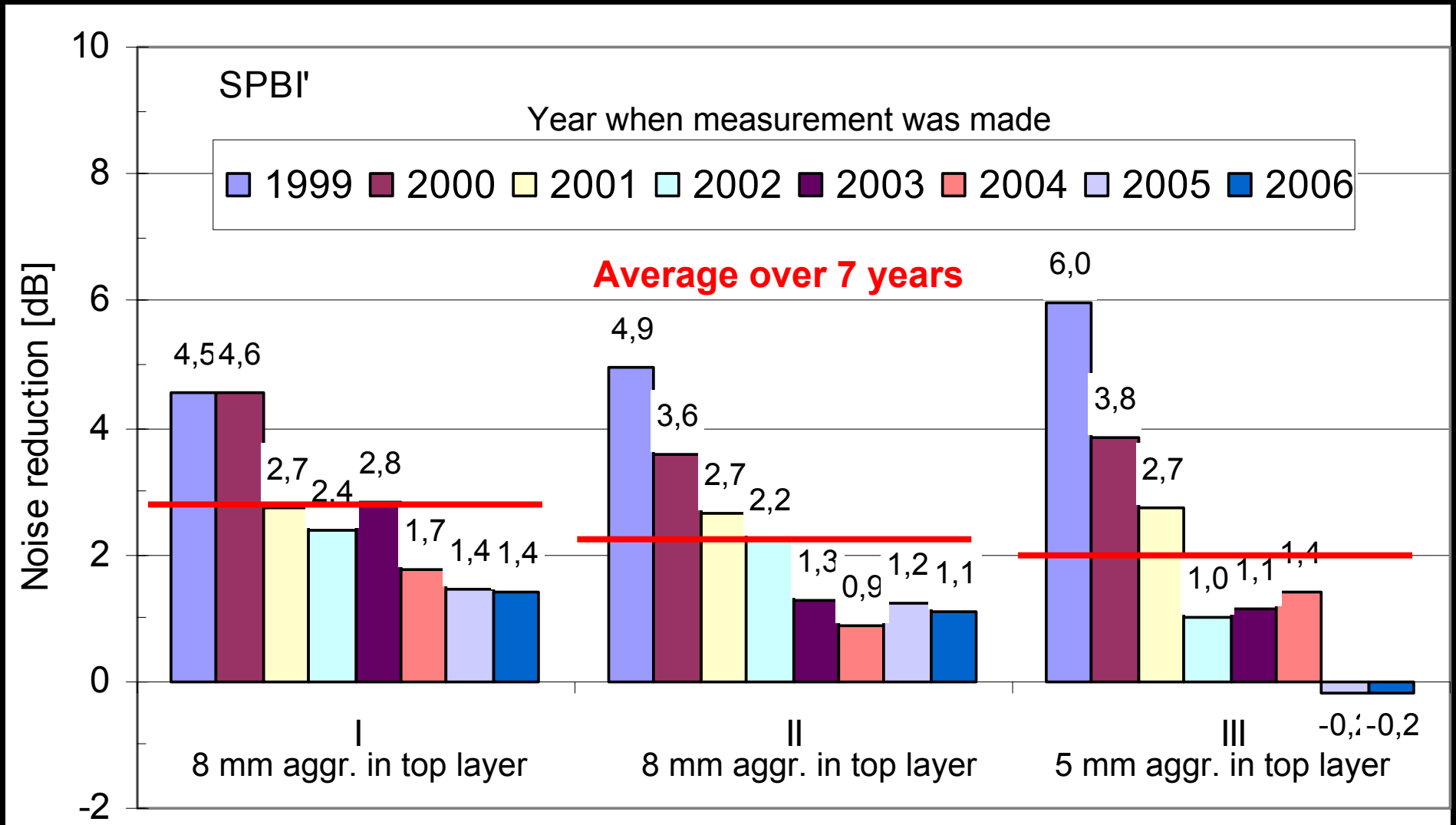
Measurements of air voids content of 70 mm thick pavement sample of double-layer porous asphalt as a function of distance from the top. Sample of new pavement (left) vs 7 years old one (right)




8 years old double-layer porous asphalt on
Østre Søgade in Copenhagen ended in 2007
Private photo by Ulf Sandberg

Results of the experiment in central Copenhagen with double-layer porous asphalt
Note: 50 km/h, mixed traffic !

[J Kragh, Danish Road Institute, yesterday]




Kerbside drainage should have been better


Private photo by Ulf Sandberg
Initial noise reduction 4 dB(A)
(corresponds to 6 dB(A) with Dutch reference surface)
Ravelling so far only from gas station exit
2 years old double-layer porous asphalt (70 mm thick, 8 mm max. aggr.) on Lyngbyvej in Copenhagen (60 km/h)

Another double-layer porous asphalt laid also over light-controlled intersection in Copenhagen
No apparent ravelling yet

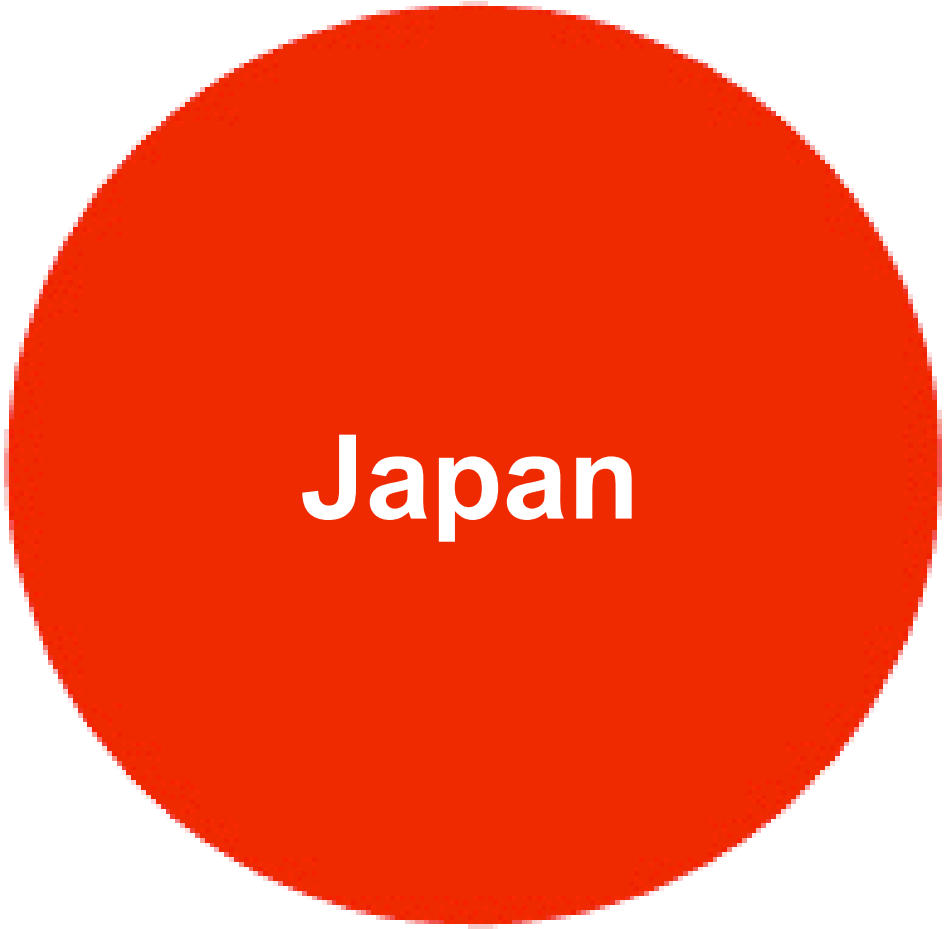
Thin layers

Test road with 4 thin layer pavements
Near Copenhagen international airport
(60 km/h)

Noise reductions:

Initially: 1-3 dB(A) (1 dB higher comp. to Dutch ref surface)

After 1-2 years: 1 dB(A) less


Japan

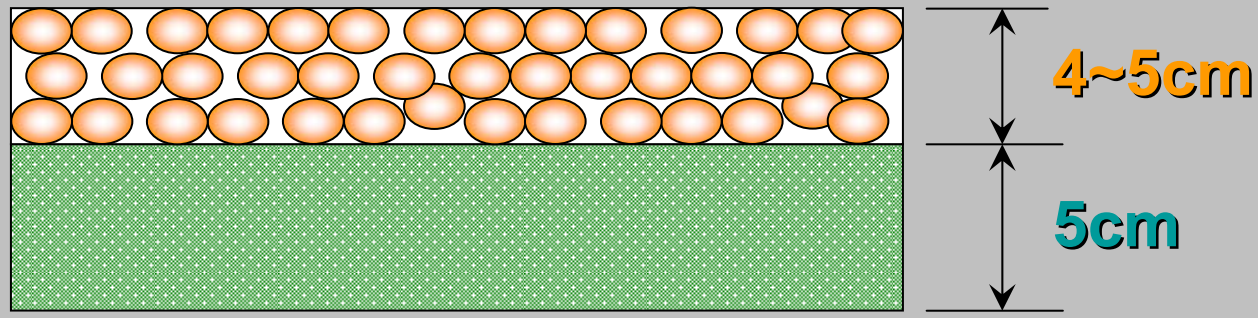
Noise Reducing Pavement used widely in Japan

Surface layer ; Porous Asphalt Mixture

Binder layer ; Dense-graded Asphalt Mixture / Coarse-graded Asphalt Mixture

Properties of Porous Asphalt Mixture

- Maximum Particle Size: 5 ~ 13mm
- Air Voids: 17 ~ 23%
- High Viscosity Modified Asphalt

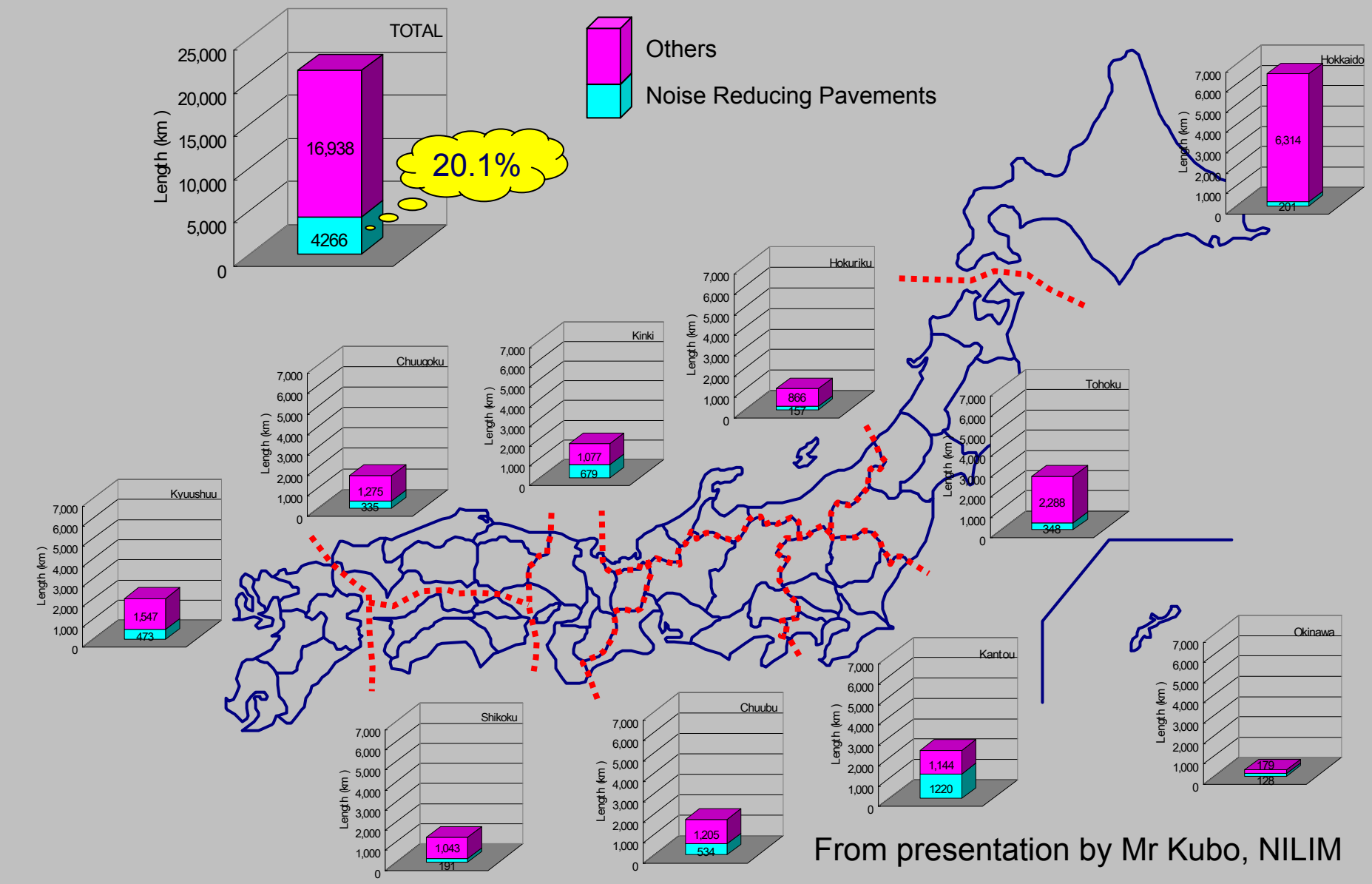


From presentation by Mr Kubo, NILIM

Constructed Length of Noise Reducing Pavements

National Roads [Managed by MLIT]

2005.4.1



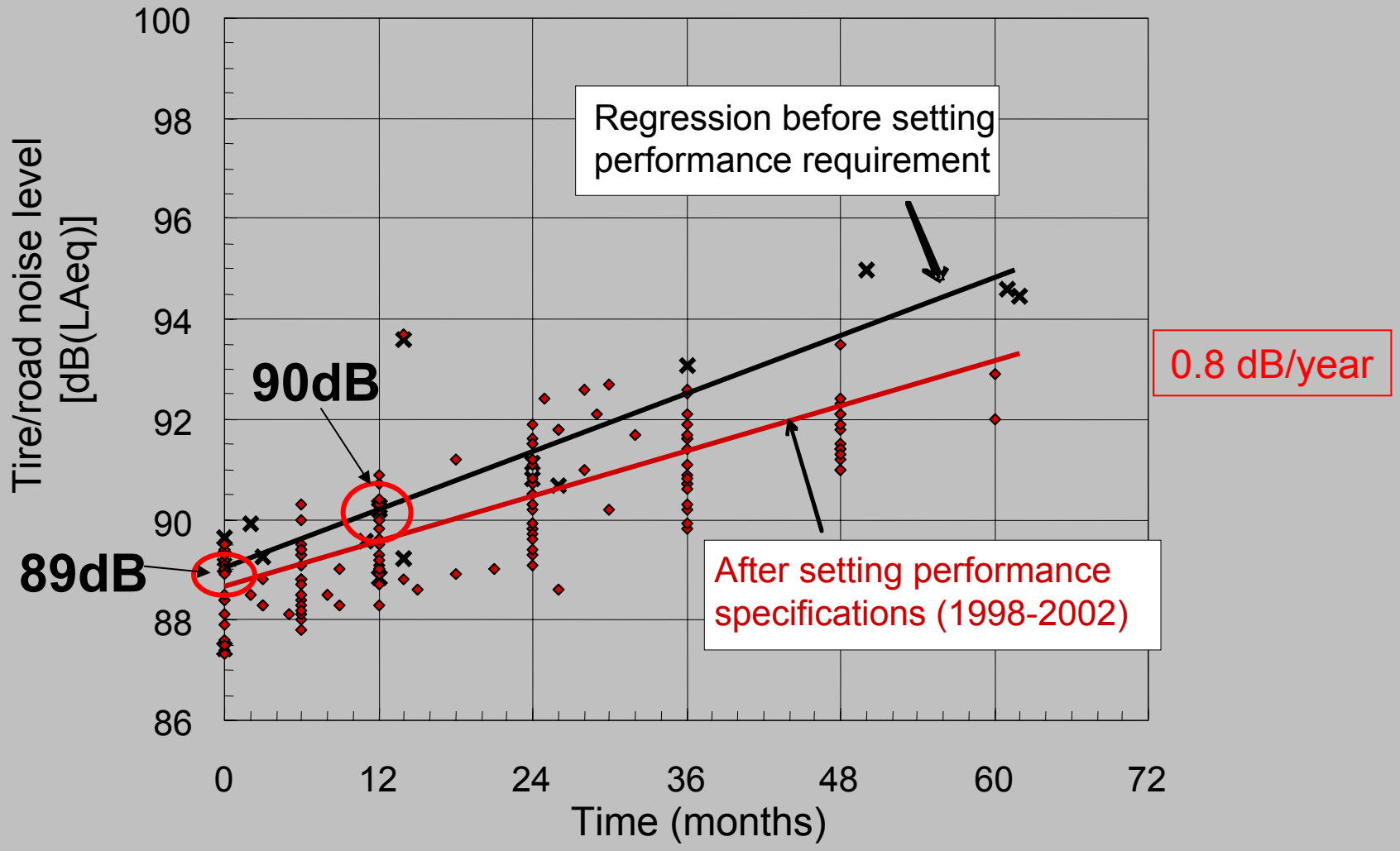
From presentation by Mr Kubo, NILIM

Porous asphalt laid over central area in Tsukuba, Japan

Quite high volume of mixed traffic, accelerating and turning

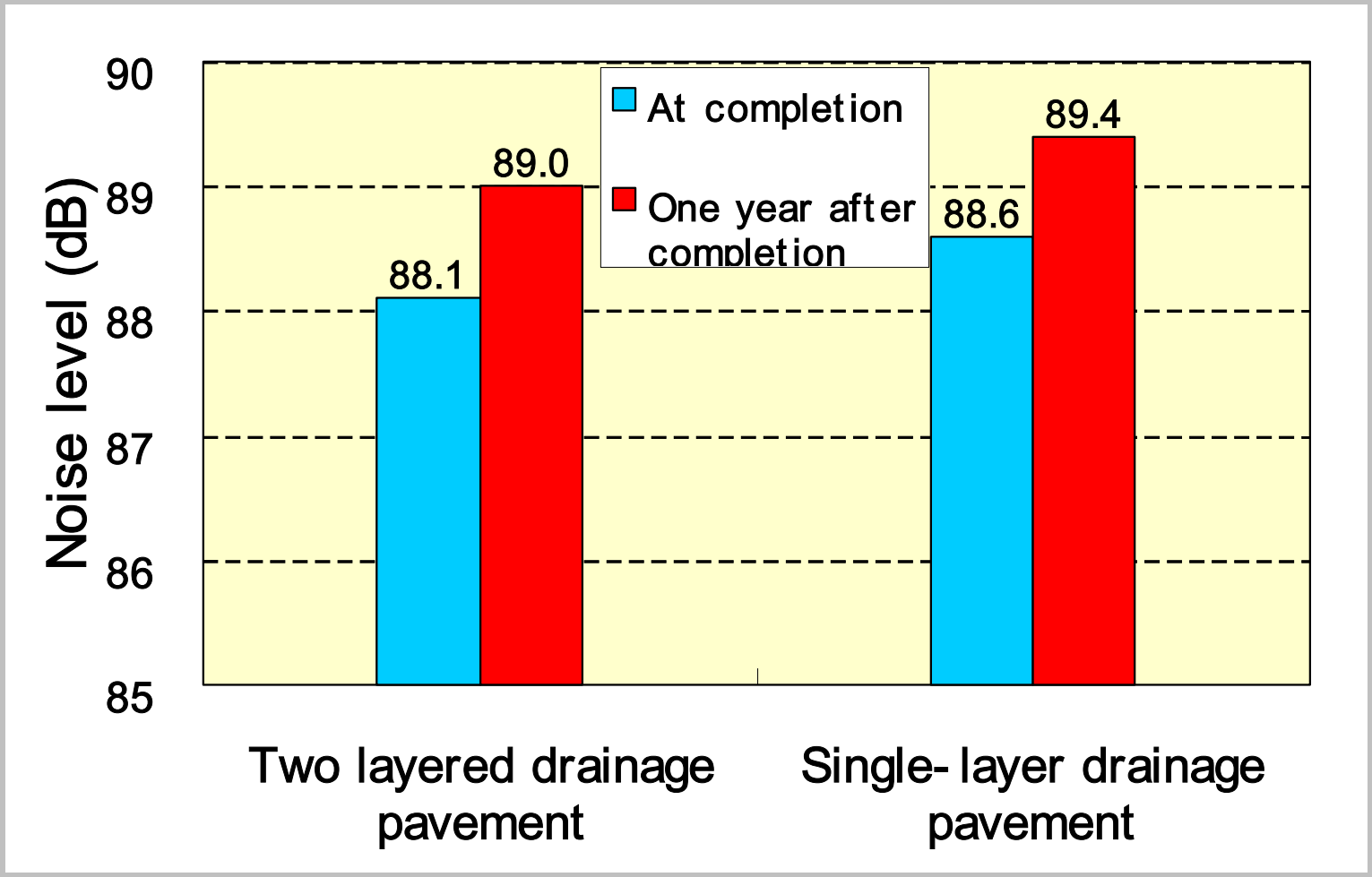
Regression of tire/road noise performance

From presentation by Mr Kubo, NILIM



Noise level for each kind of drainage pavement

From presentation by Mr Kubo, NILIM



Wider application, for example in urban streets

Hibiya dori Avenue in central Tokyo

Abatement of the heat island effect by porous asphalt retaining water

Epoxy cover to increase strength and improve water retainment

Conventional porous asphalt (basic material)

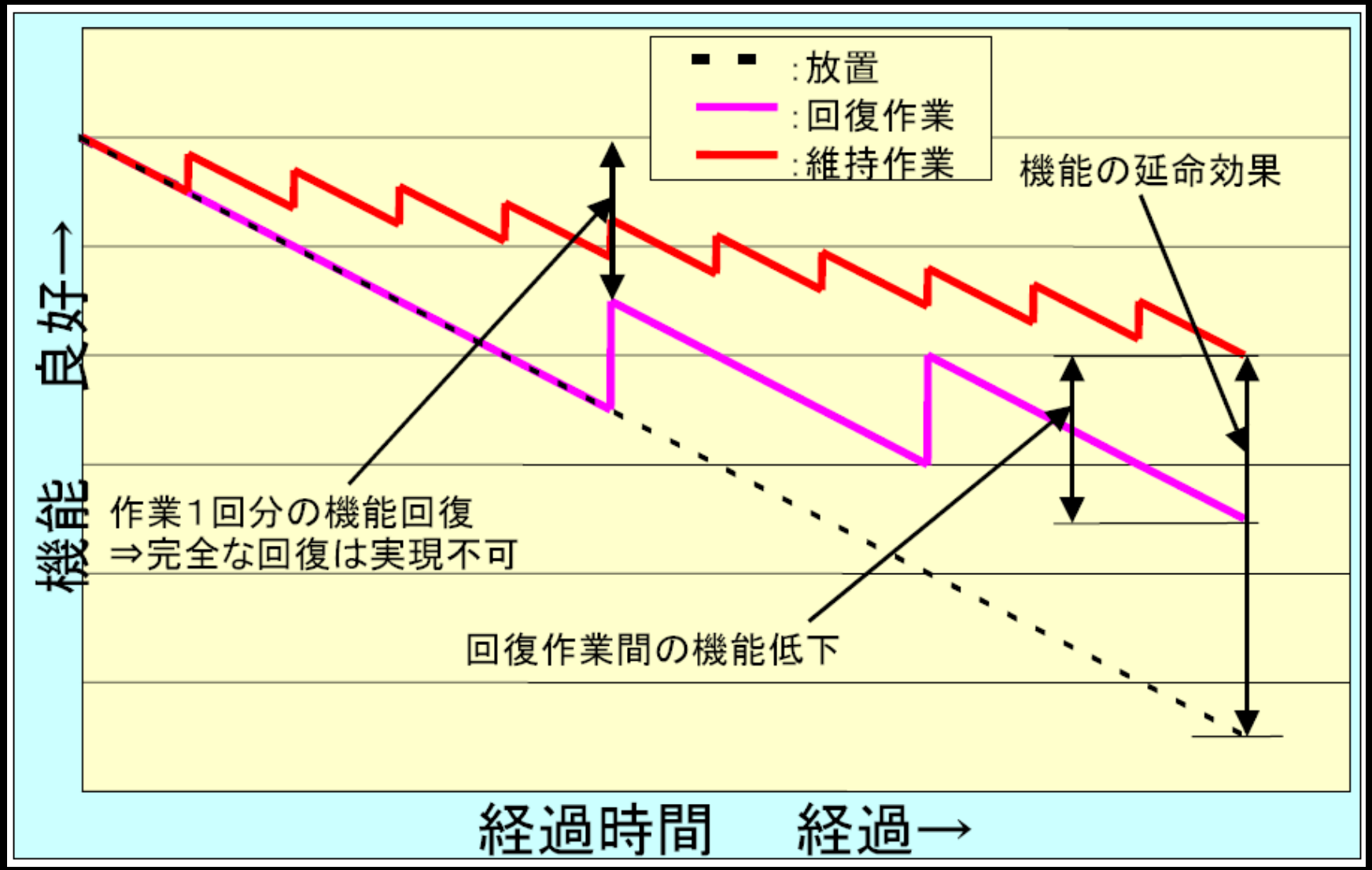
Filling the pores with water absorbing and retaining material


Trial on street in Tokyo
with water-retaining
material in the bottom
of porous asphalt

Trial on street in Tokyo with epoxy-covered porous asphalt

Cleaning of clogged porous asphalt

Advantage of doing maintenance work once per month instead of recovery 3-4 times per year



Water permeability [l/s]

Time [months]

Cleaning of clogged porous asphalt

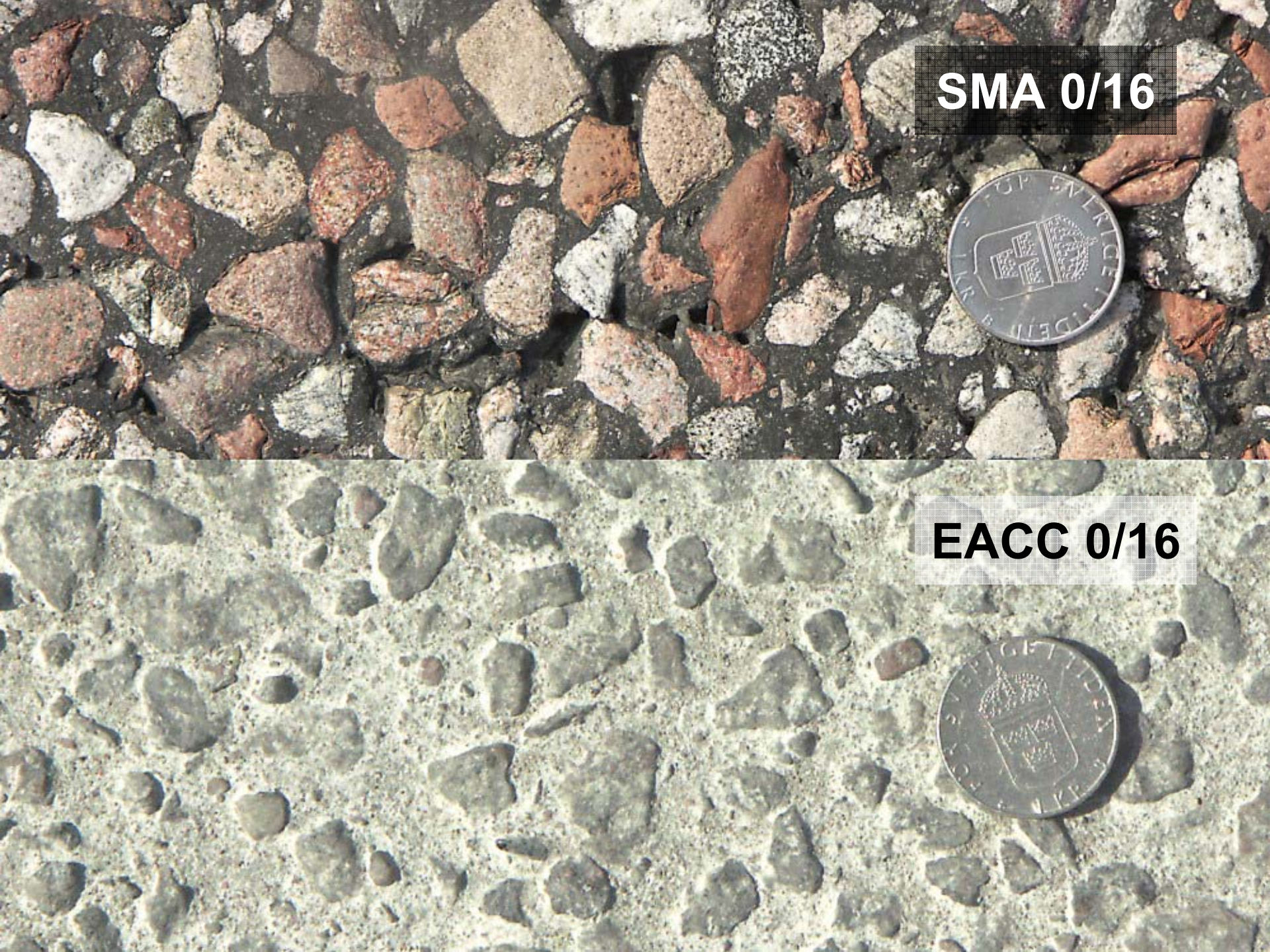
New machine relying entirely on blowing high-pressurized air

Machine developed by Romantec

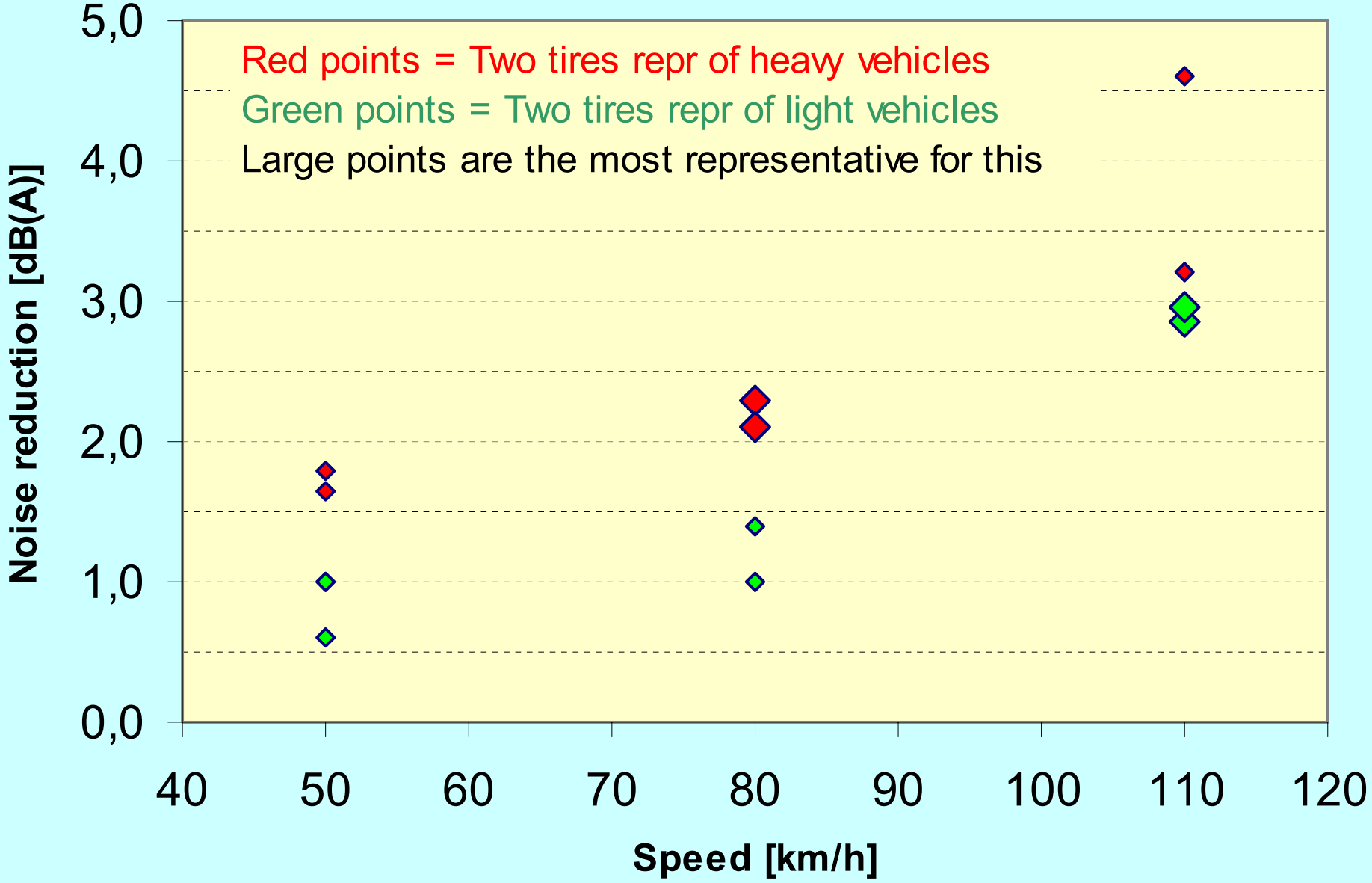
Romantec machine in operation, 10-20 km/h
Most effective: cleaning once per month

Improved poroelastic road surface laid on road with high traffic volume – View after half a year

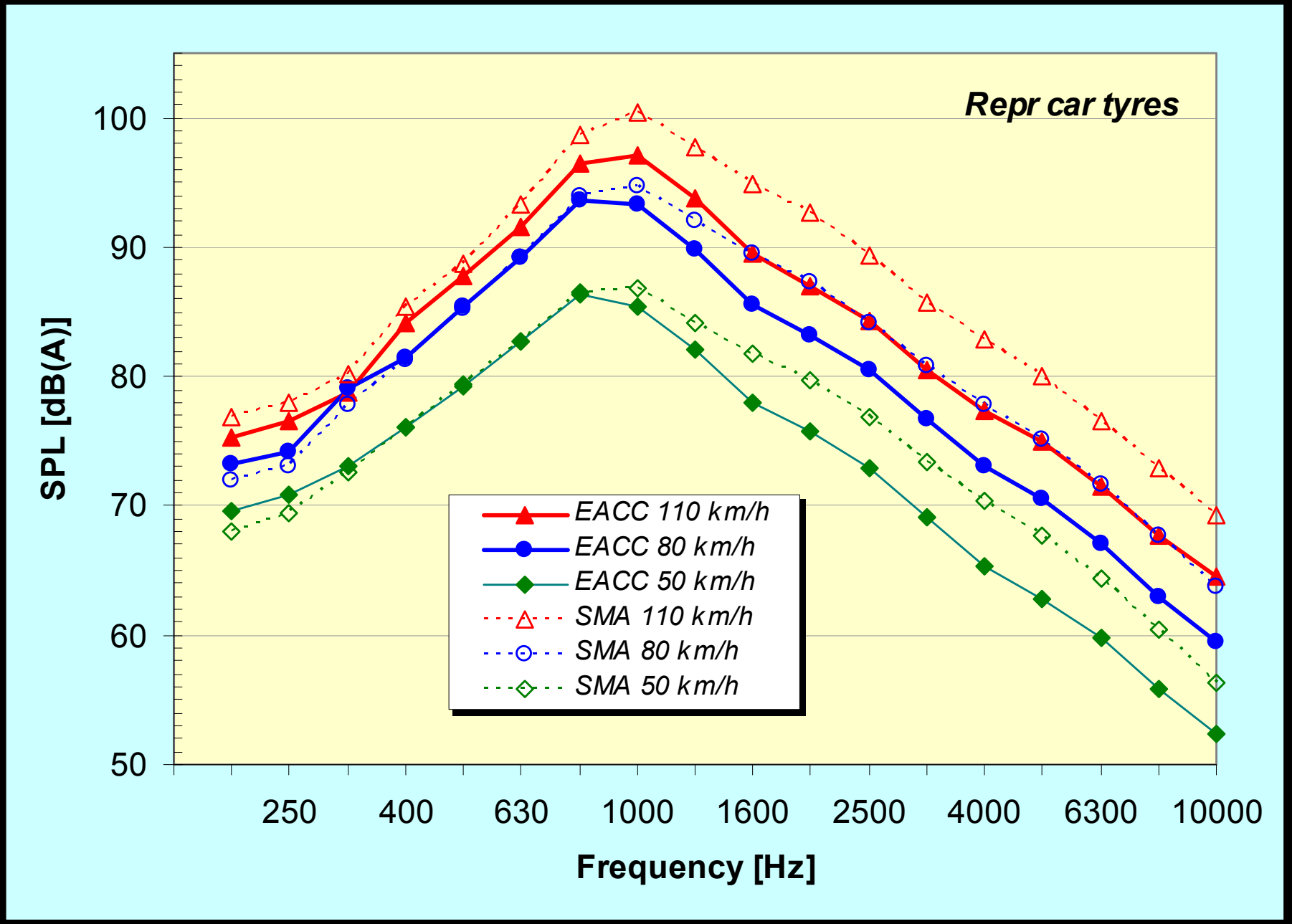
Sweden


SMA 0/16
EACC 0/16

Sound level diff. between SMA 16 and EACC 16



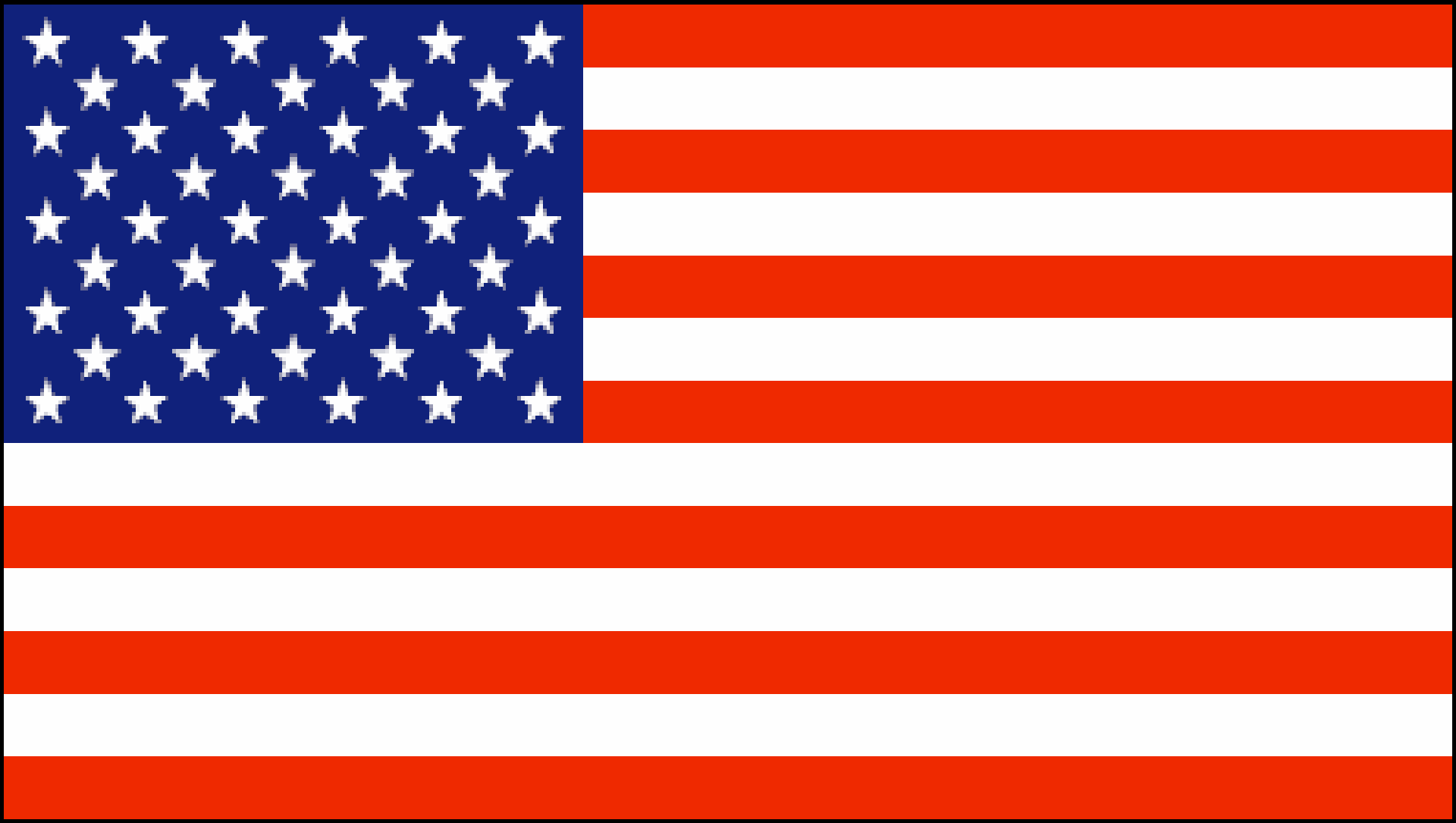
Comparison of spectra of SMA 0/16 and EACC 0/16



Samples of asphalt rubber being prepared by VTI for testing in Germany

47 mm thick

United States of America
California and Arizona




Studies at Route 66 (Iron Hog Saloon), CA
…. but that is another story
The end
Budweiser
KANSAS
US
66
ILLINOIS
MISSOURI
OKLAHOMA
TEXAS
PANHEAD
MAIN STREET US