MAINTAINING OPERATIONAL EFFICIENCY WHEN RESURFACING THE RUNWAY AT BILLUND AIRPORT WITH A NEW OVERLAY IN THREE DAYS

by

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Job to be done

- Renewal of the overlay of the asphalt surfacing
- Last renewal was in 1992, and before that in 1981
- One runway of 3.100 * 45 meter
- Primarily used by C class planes, however, D and E, too
- 60,000 operations a year

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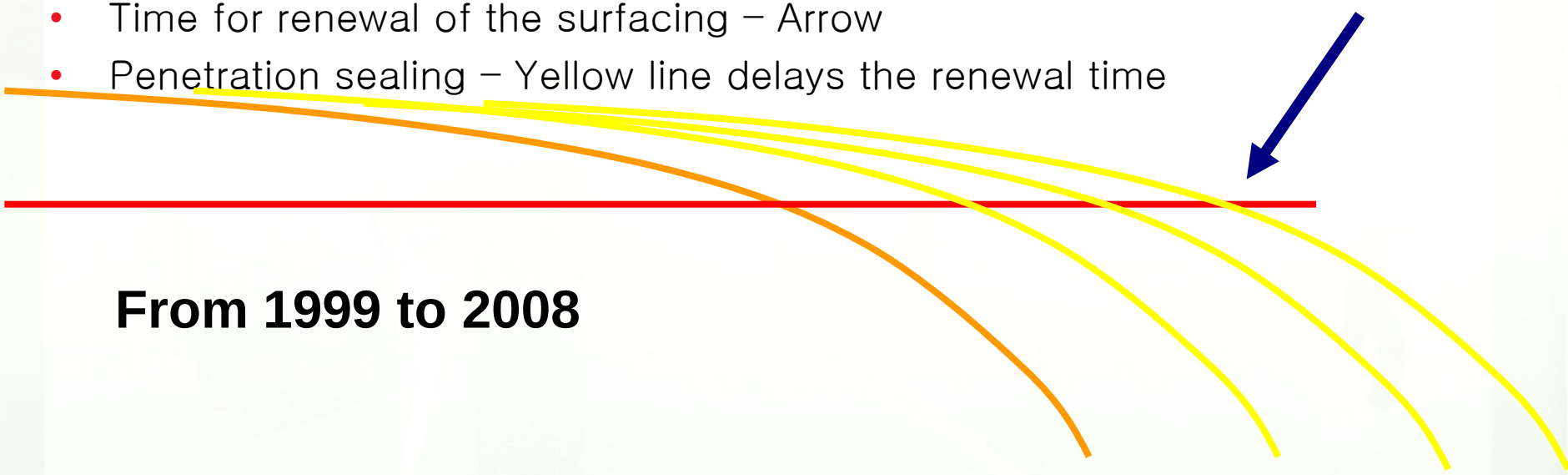
Life cycle

- The surfacing condition over time – Orange line
- Accepted quality level – Red line
- Time for renewal of the surfacing – Arrow
- Penetration sealing – Yellow line delays the renewal time



From 1999 to 2008

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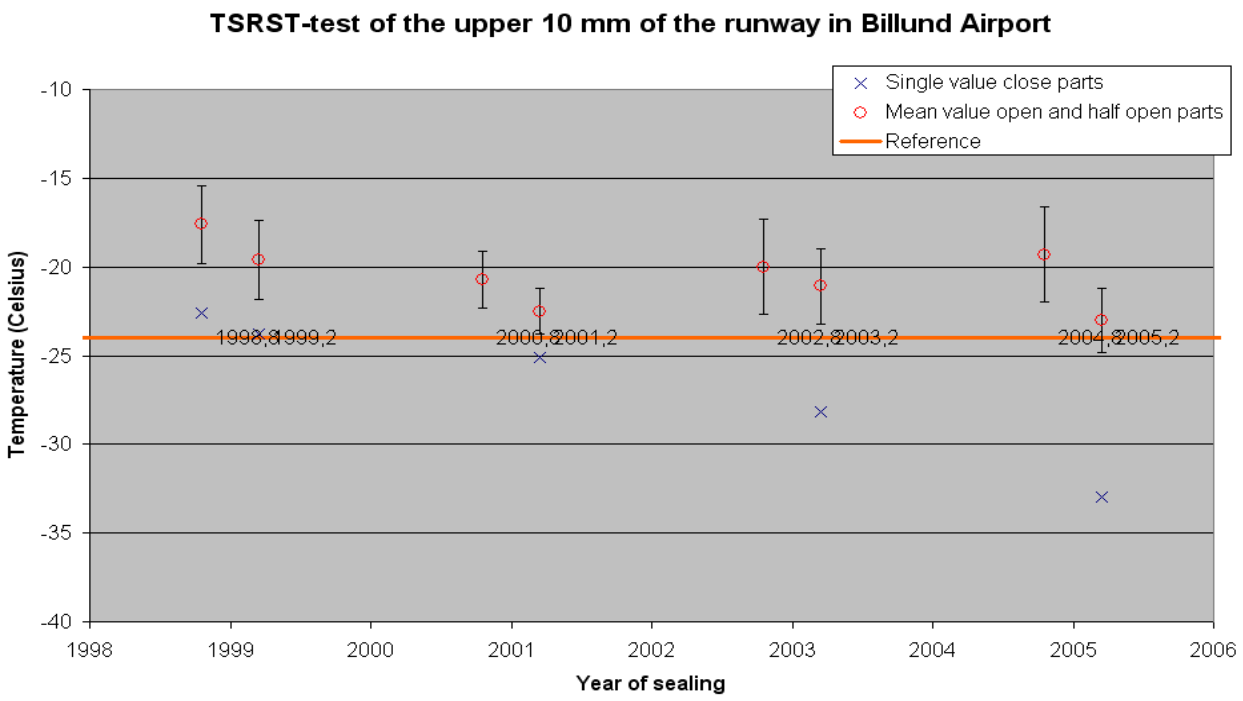

TSRST test

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Tendering strategy

- Public tender
  - Tender documents
  - Fixed price incl. risks
  - No flexibility
  - Limitations in alternative solutions

- Direct negotiation
  - Open books
  - Minimizing risks
  - Flexible performance and schedule
  - Open dialogue on solutions

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The initial requirements for the wearing course were:

- **Wearing course thickness: 33 mm (-0/+2 mm)**
- **Service life greater than 15 years**
- **Warranty period 5 years**
- **High resistance to rutting**
- **High resistance to ageing**
- **Friction coefficient greater than 0.6**
- **Roughness 3 m straightedge less than 3 mm**
- **Roughness 45 m straightedge less than 35 mm**
- **Texture depth (sand patch) between 0.5 and 1.1 mm**
- **FOD: no loose particles greater than 3 mm**

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Partnering principles

- Unit prices agreed
- Minimization of the risks
- Handling of conflicts including a pre-agreed escalation procedure
- Dialogue about potential solutions

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Organization:

Dispute Resolution Board

- Unsolved conflicts
- Appointment of Mediator

Steering committee

- Economy
- Overall schedule
- Contractual relationship
- Partnering principles
- Coordination with the air traffic

Operating committee

- Methods of fabrication
- Detailed specification of product and materials
- Risk analyses
- Distribution of tasks
- Detailed schedule

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Time for planning

- The planning started 2 years prior to the execution
- Orientation of airlines 7 months prior to that, remember the final coordination
- Reminder to the airlines a few days before the execution, where the runway was closed to air traffic 3 nights of 7 hours
- The centre part was carried out in 2 nights of 7 hours

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Open calculation

- Profit known
- Unit prices agreed
- Earmark a risk fund of 135,000 EUR
  - The risk fund paid unforeseen expenses and contingencies. The remainder was divided between the client and the contractor

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Total costs

- 2,3 mill. EUR
  - 2,0 mill. Asphalt work
  - 120,000 Consultants
  - 160,000 Additional work

- 3,100 * 45 m^2 = 139,500 m^2

- 16,3 EUR/m^2

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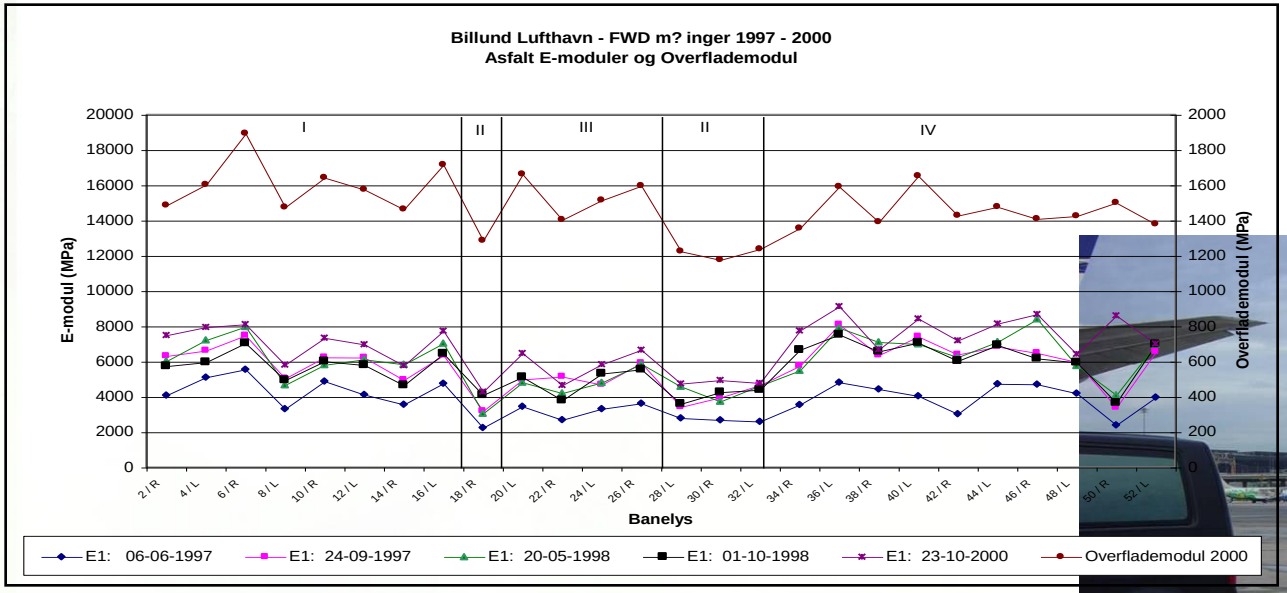
- Assessment of bearing capacity (FWD 1997-2000)



Surface E-modulus, E_0, year 2000 and Asphalt layer E-moduli, E_1 (25 ºC), as a function of RWY chainage (light no.).

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- Asphalt layer thicknesses incl. reconstruction (blue) and new wearing course (green):

Eksisterende bærelag

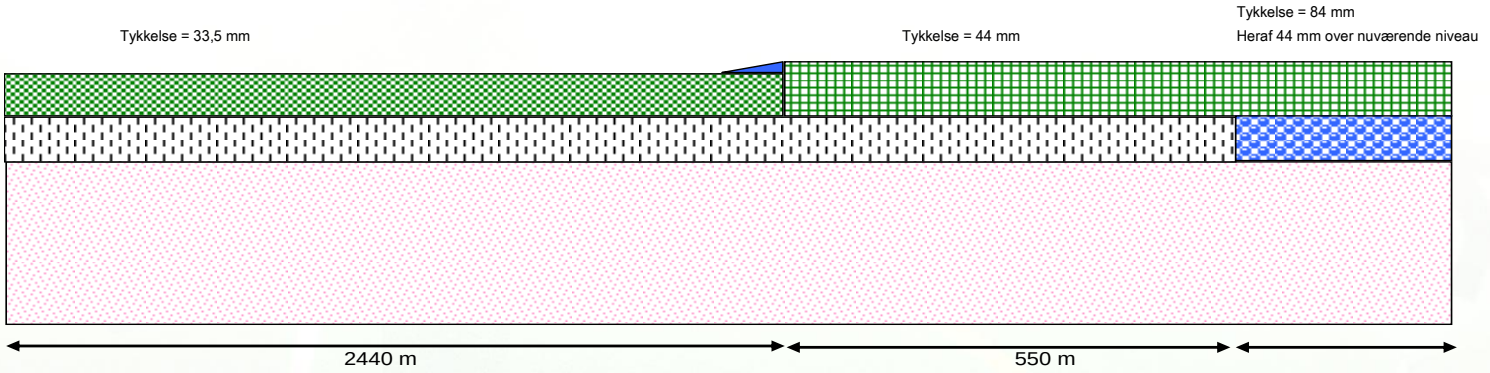
Eksisterende slidlag = ca 4 cm skærvemastik

Udskiftning af slidlag = ABB 40 mm ≈ 90 kg/m²

Slidlag = SMA 80 kg/m² ≈ 33,5 mm

Slid-/forstærkningslag = SMA 44 mm ≈ 105,2 kg/m²

Kilestrækning i SMA - Udligning ca. 11 mm - 1% fald = Længe på kilestrækning er minimum 1,1 m



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Asphalt Wearing Course

As wearing course was chosen:

- **Asphalt type:** SMA
- **Particle size:** 0-11 mm
- **Aggregate type:** Durasplit (Norway)
- **Los Angeles Value:** < 12%
- **Binder content:** 6.7% + 0.3%
- **Binder type:** Styrelf PMB 65A
- **Polymer type/content:** SBR n 3% (Vulcanized)
- **Elastic recovery:** > 50%

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- Action plan – Operation committee:
  - Definition of risks and risk handling
  - Planning of initial work
  - Planning of night work
  - Planning of repair work
  - Planning of the main work
  - Preparation of the manual
  - Preparation of the quality control
  - Concideration regarding flow of materials, roller capacity etc.
  - FOD – procedure for clean pavements
  - Risk Assessment

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- Objectives

Objectives	Action plan	Results and measurements	Responsible	Follow-up	Deadline
Quality and functionality					
Agreement about quality	Special specification and quality control	Agreement between partners	Steering committee		October 15, 2007
Uniform surface structure	Test sections	Visual inspection	Steering committee		January 10, 2008
Highest quality for the price	Focus by operation committee	Feedback of optimization	Operation committee		May 1, 2008
Handling of deviation resulting in minimum damage	Deviations treated without delay by partners	Daily evaluation of possible deviations	Project management		
Avoid accidents	Plan for health and security included orientation of all persons involved	No accidents	Steering committee		May 1, 2008
Economy					
Common responsibility of the economy	Procedures for economical decisions	Registration	Steering committee		January 10, 2008
Milestones	Time and ressource planning	Registration	Operation committee		On-going
Collaboration and conflict management					
Execute good workmanship	Manual incl. Responsible matrix	Registration	Steering committee Operation committee		Manual, January 10, 2008
No unsolved conflicts	Conflicts solved by the involved partners	Feedback	All		
All involved people shall act in partnering spirit	Information meeting and teambuilding for key persons	Registration	Steering committee Operation committee		Before start
Development					
Create positive reputation for the project and all involved	Joint plan for handling visitors and the press	Udarbejdet plan	Steering committee		March 10, 2008

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- Planning of paving operations

UDLÆGNINGSDAG FØRSTE NAT — Start lampe 43,25 — Tonsforbrug pr. m ved 82 kg/m2 3,69 — Slut lampe 27 — Tons lampe 43,25 - 41.3 505,575 tons — Rest tons 3142 tons

Antal biler 60 stk

Udlægningshastighed	4,12 m/minut	14,56311	Udlægningshastighed	4,12 m/minut
Asfaltlagtykkelse	82 kg/m2		Asfaltlagtykkelse	82 kg/m2
Beregningsmæssig udlæggerbredde	4,5 m		Beregningsmæssig udlæggerbr.	4,5 m
Forbrug pr. min for udl. 4,5 m	1,5 tons/min		Forbrug pr. min for udl. 4,5 m	1,5 tons/min
Tons pr. lastbil	30,4		Tons pr. lastbil	30,4
Tømningstid 1.omgang	20,0 minutter		Tømningstid 2.omgang	20,0 minutter
TAST	00:20		TAST	00:20

Tidsforbrug pr. omgang	02:00 timer ved afhentning i Kolding eller Roust	Tidsforbrug pr. omgang	02:00 timer ved afhentning i Kolding eller Roust
Tidsforbrug fra Trige/Odense til BLL	01:45	Tid fra Trige/Odense til BLL	01:45 timer
Tidsforbrug fra Kolding/Roust til BLL	01:00		
Returtid fra udl. til udl (Kolding,Roust)	01:40		
Start udlægning	23:30	Afstand mellem udlæggere	00:05

Sikkerhed 1. omgang, medfører flg. — Kun de første 60 biler
Tidsforbrug fra Trige/Odense til BLL 02:15
Tidsforbrug fra Kolding/Roust til BLL 01:00

svarer til længde 105 m
Rest længde 852
Samlet strækning 957 m
Svarer til lampe 27,5

Produktion
Kolding 190 tons/time
Roust 130
Trige 250
Odense 170

Ved produktion fra Kolding og Roust:
i % 59,4% Kolding
40,6% Roust

Banebredde 45 m
Kolding 27
Roust 18

Roust 4 alm udlæggere
Kolding 6 alm udlæggere

Jens-Erik 4,5 m — 1 bil
Gert 4,5 m — 1 bil
Jørn 4,5 m — 1 bil
Peter Andersen 9 m — 2 biler
Egon 8 m — 3 biler
Bent 5,5 m
Martin 4,5 m

START 2. OMGANG

	afgang fab.	00:45	fabrik	00:40	fabrik	00:35	fabrik	00:30	fabrik	00:30	fabrik	00:35	fabrik	00:35	fabrik	00:40	fabrik	00:45	fabrik	00:50	fabrik		
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32,6	afgang udl	02:25	4,1	02:20	4,1	02:15	4,1	02:10	4,1	02:10	4,1	02:15	4,1	02:15	4,1	02:20	4,1	02:25	4,1	02:30	4,1		
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31,4	afgang udl	02:45	4,1	02:40	4,1	02:35	4,1	02:30	4,1	02:30	4,1	02:35	4,1	02:35	4,1	02:40	4,1	02:45	4,1	02:50	4,1		
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28,7	afgang udl	03:25	4,1	03:20	4,1	03:15	4,1	03:10	4,1	03:10	4,1	03:15	4,1	03:15	4,1	03:20	4,1	03:25	4,1	03:30	4,1		
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27,3	afgang udl	03:45	4,1	03:40	4,1	03:35	4,1	03:30	4,1	03:30	4,1	03:35	4,1	03:35	4,1	03:40	4,1	03:45	4,1	03:50	4,1		
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3040 973 243
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3344 1155 365
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3648 1338 486

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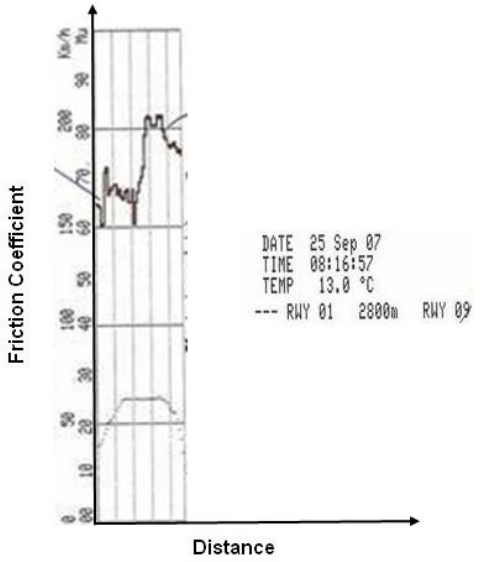
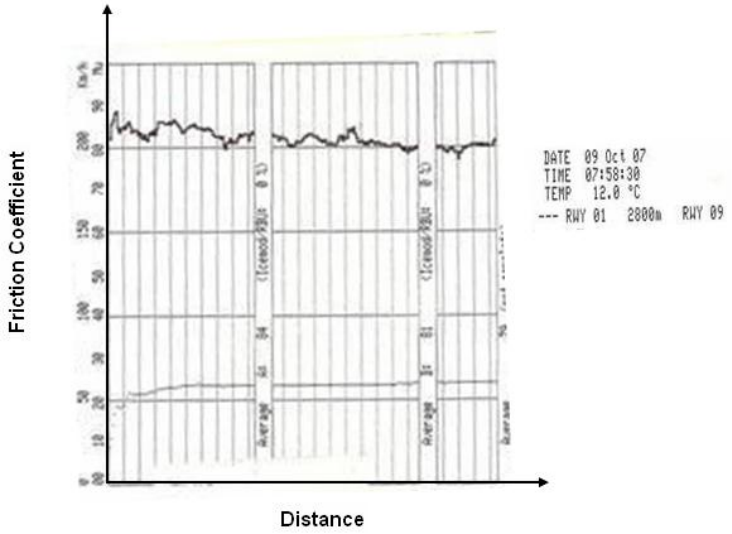
First reference station

Friction coefficient measured in full rain/wet condition



Second reference station

Friction coefficient measured in full rain/wet condition



Skiddometer BV 11

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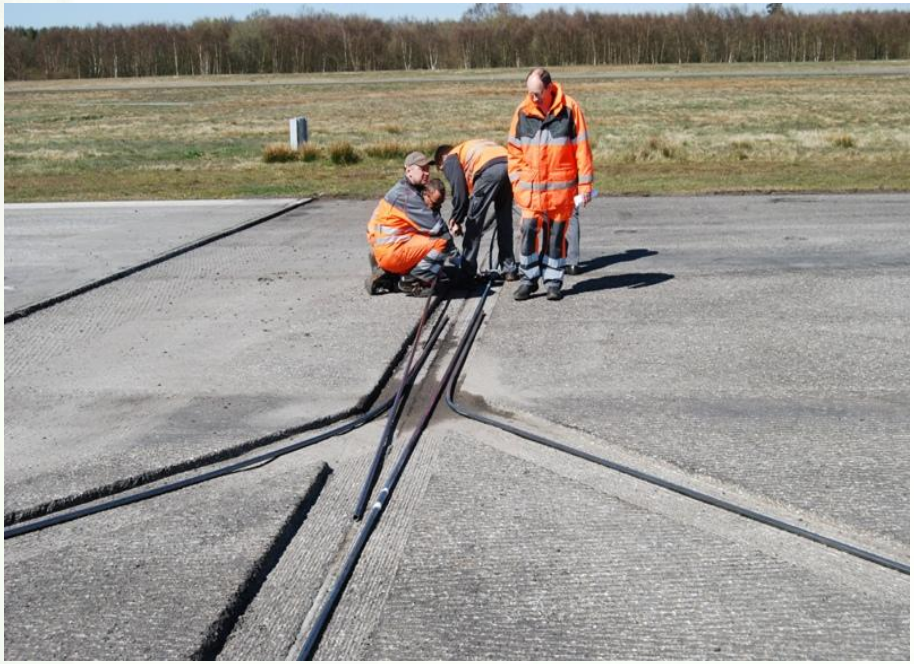

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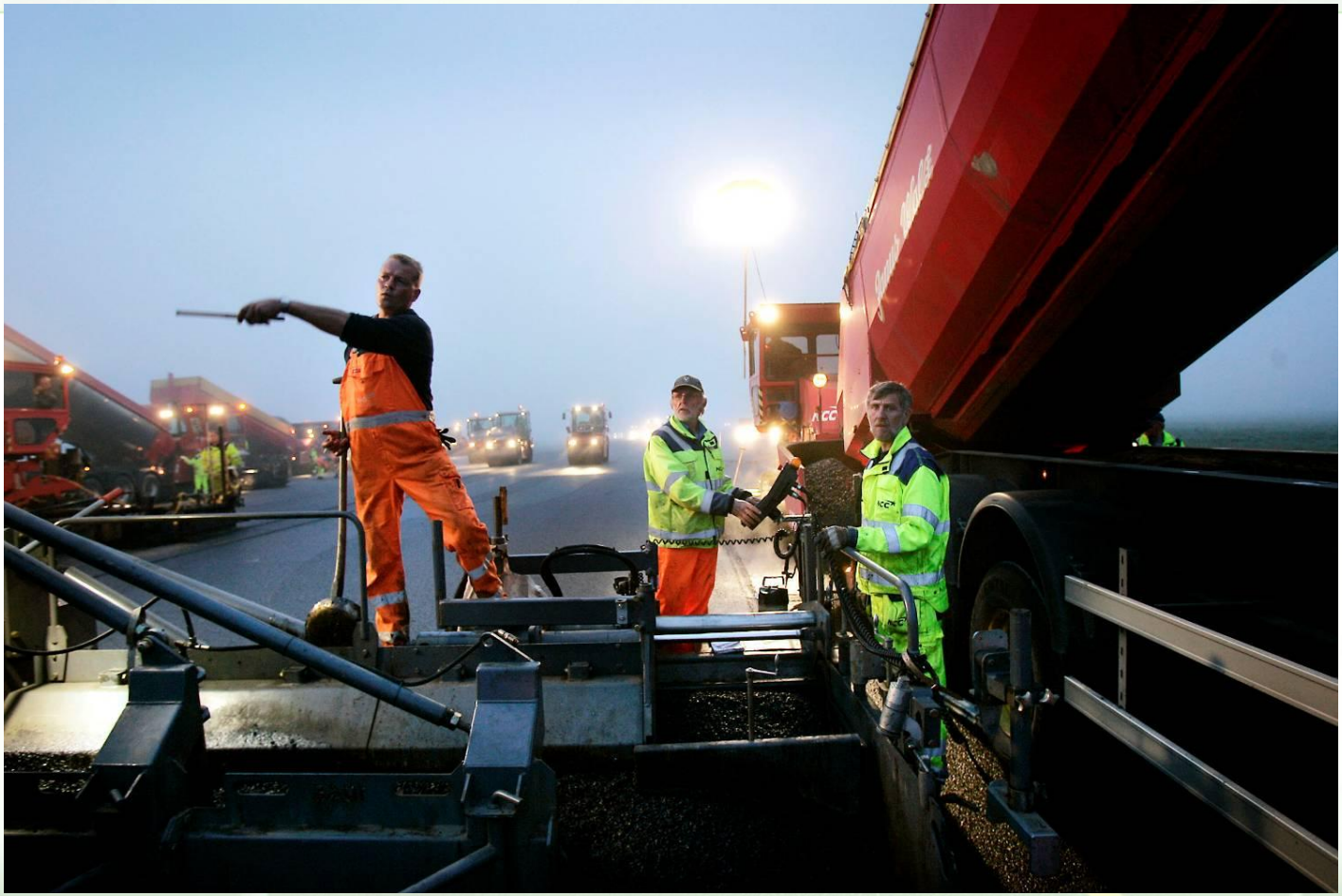

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MAINTAINING OPERATIONAL EFFICIENCY WHEN RESURFACING THE RUNWAY AT BILLUND AIRPORT WITH A NEW OVERLAY IN THREE DAYS

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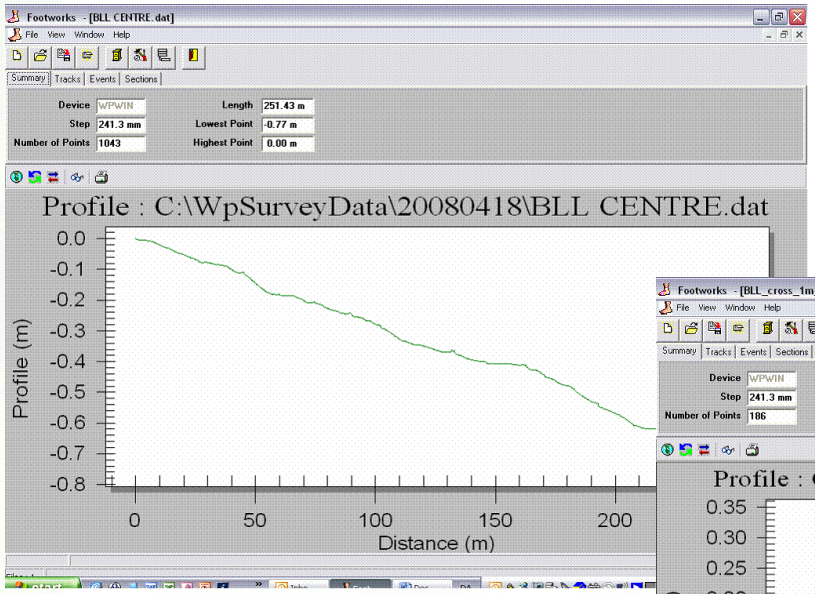

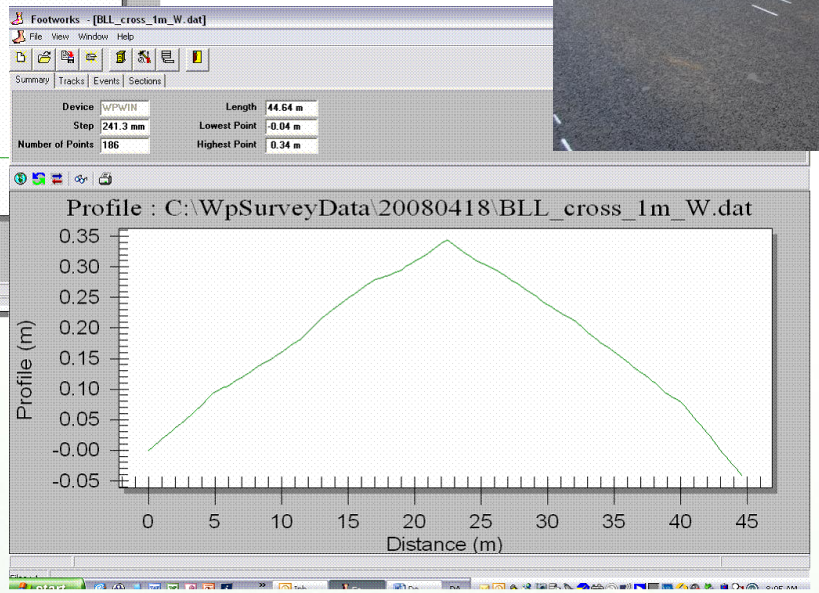

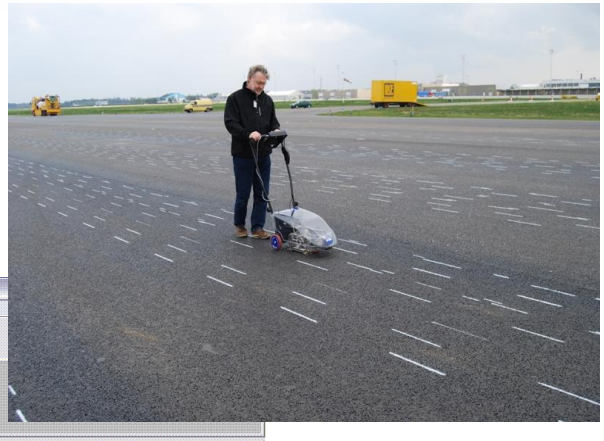

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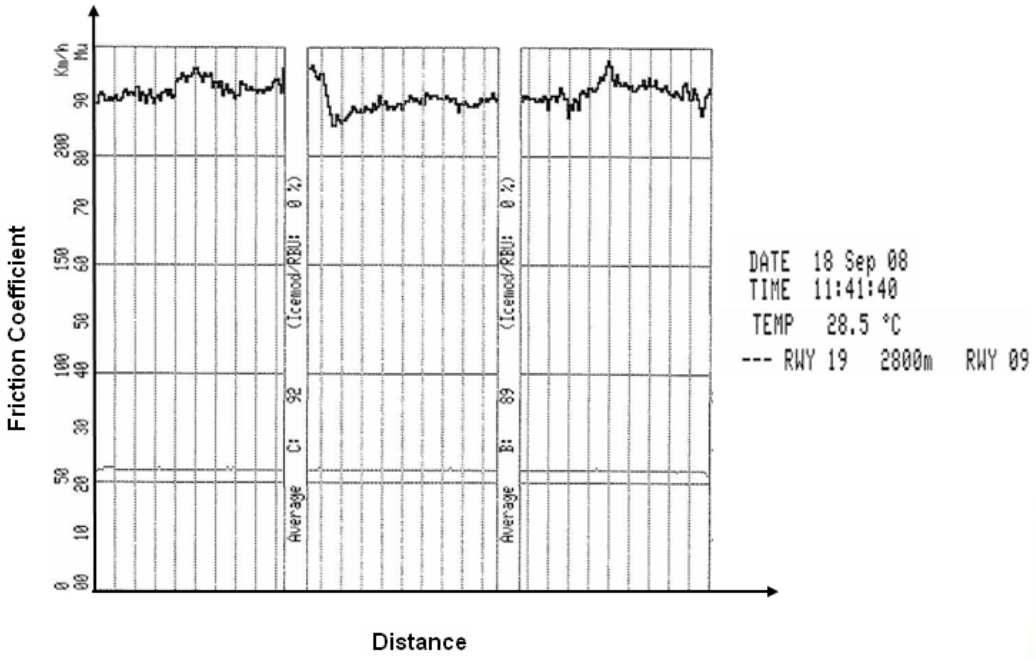
New RWY wearing course

Friction coefficient measured in full rain/wet condition



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Conclusions

- No Surprises
- No Delays
  All works finished on time
- No Extra costs
  Good prices for all partners
- Excellent quality of the works

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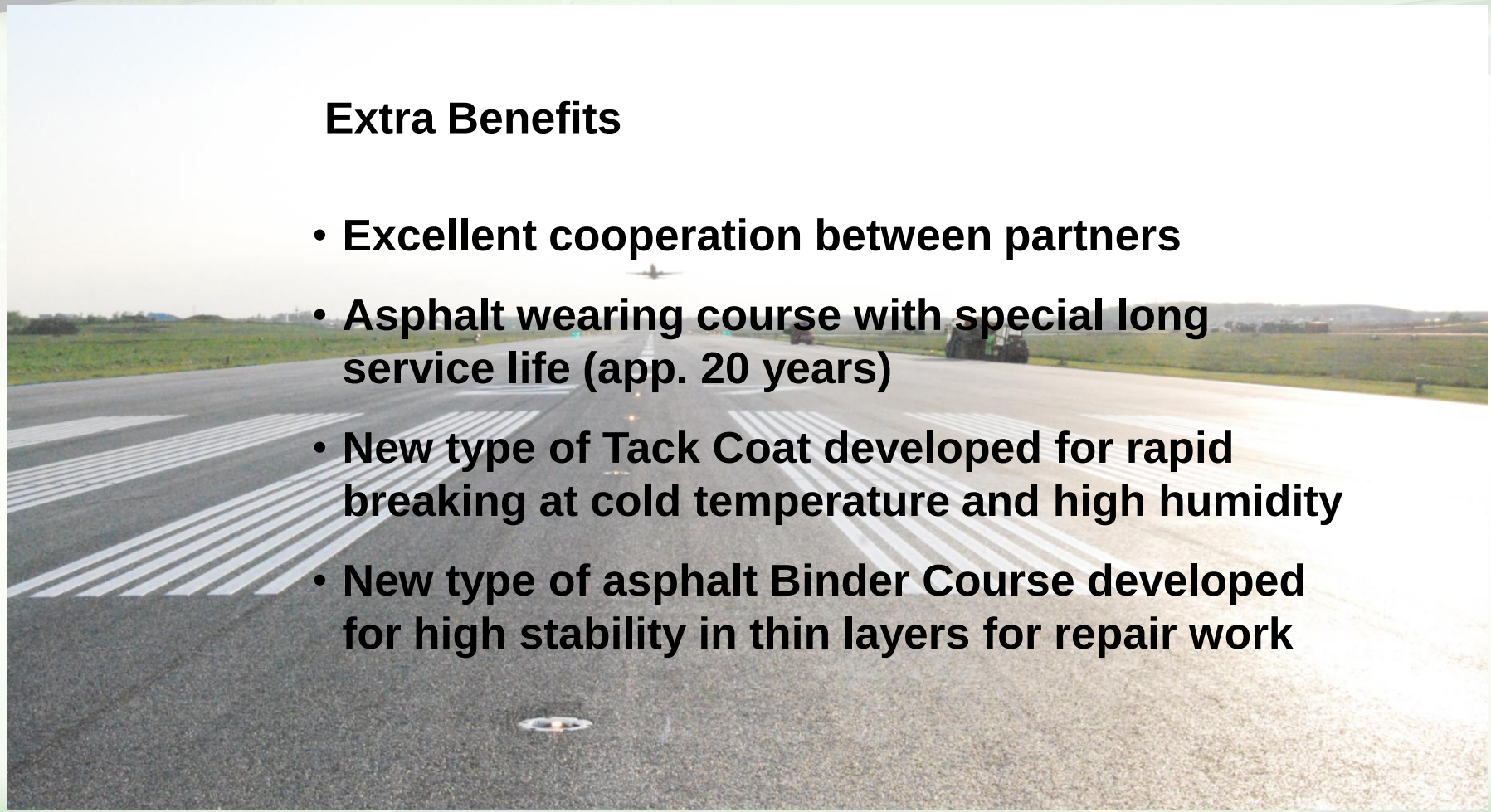

Extra Benefits

- Excellent cooperation between partners
- Asphalt wearing course with special long service life (app. 20 years)
- New type of Tack Coat developed for rapid breaking at cold temperature and high humidity
- New type of asphalt Binder Course developed for high stability in thin layers for repair work

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Other extraordinary Benefits were:

- **Nothing damaged**
- **No one wounded**

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Special thanks to Billund Airport for arranging:

- **No rain during the 3 days**

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An extra benefit of the fine cooperation between the partners are:

- **The partners will follow the development of the properties (ageing etc) of the wearing course trough laboratory testing**

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- Thank you for listening!
- Any questions?

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