# Reducing Pavement life-cycle costs and increasing sustainability

Josef Fliegl, Fliegl Bau- und Kommunaltechnik

# Content

**Requirements + regulations (theory)**

**Requirements + Regulations in practice**

**Asphalt temperature from mixer to installation**
research by the Technical University of Vienna

**Segregation – Problems in practice**
Segregation – Problems in practice

**Thermography systems, the current state of the art**

**Preventing accidents -** safety first on construction site

**Costs / benefits**

**Environmental Protection**
save energy, $CO^2$ - lowering the production temperature

**Summary**

# Requirements and regulations
## Theory

- The mix in the paver bucket should

  a. regard to the temerature
  b. regard to the grain structure (grading curve) be evenly distributed

➢ The basic prerequisite for long-lived asphalt surfaces !

# Requirements and regulations from practical applications

## PROBLEMS IN ASPHALT ROAD CONSTRUCTION

**With conventional transport technology**

**Even when transporting mix materials with conventional thermall insulated (dumper) vehicles, one of the main problems in asphalt road construction has not been solved –**

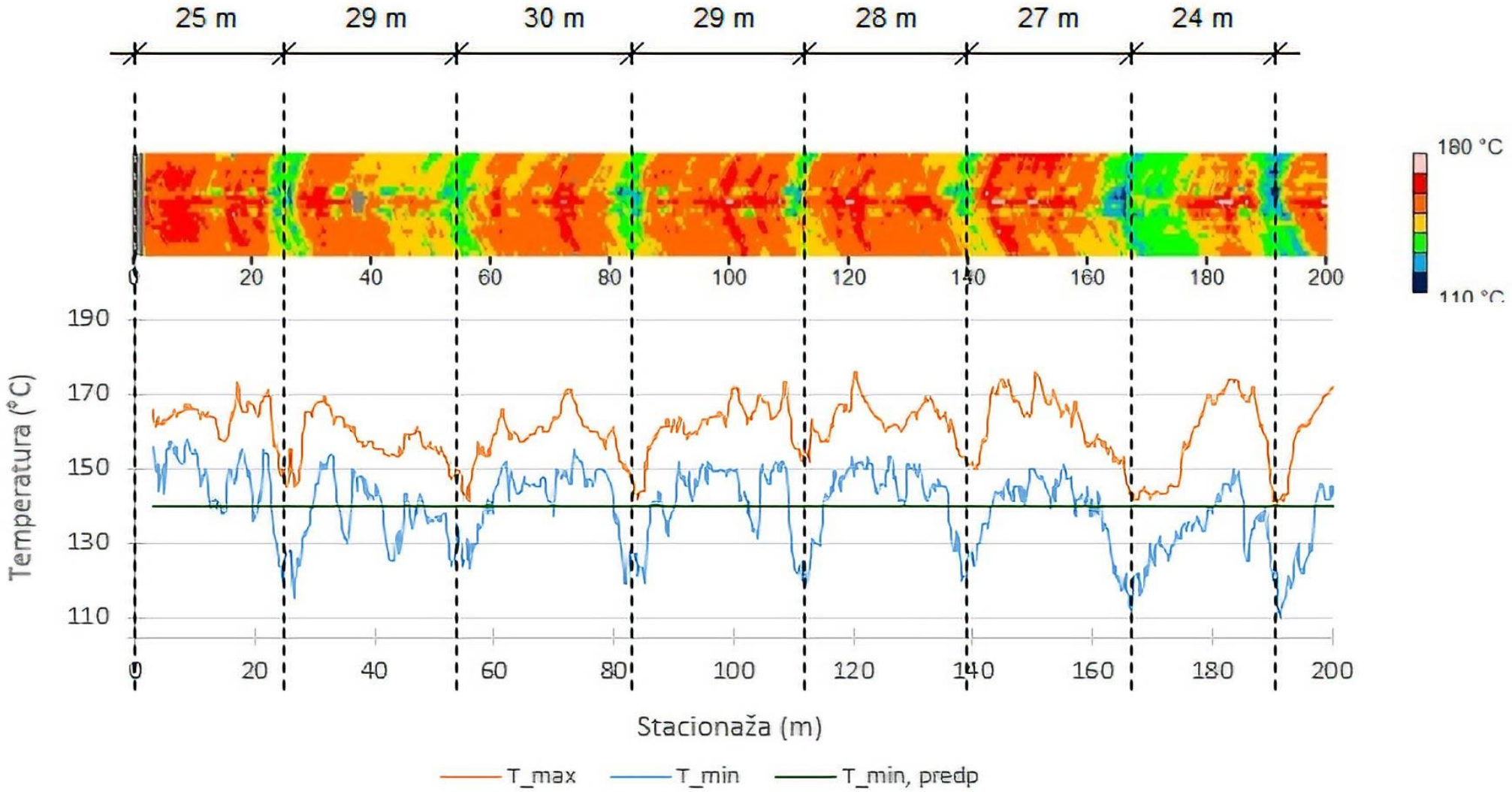
**SEGREGATION**

# MECHANICAL AND GRANULAR SEGREGATION

**Homogeneous mix ?**

**Consequences: Early damage, e.g. loss of material, grain break out, frost damage, rutting, crocodile cracks…**

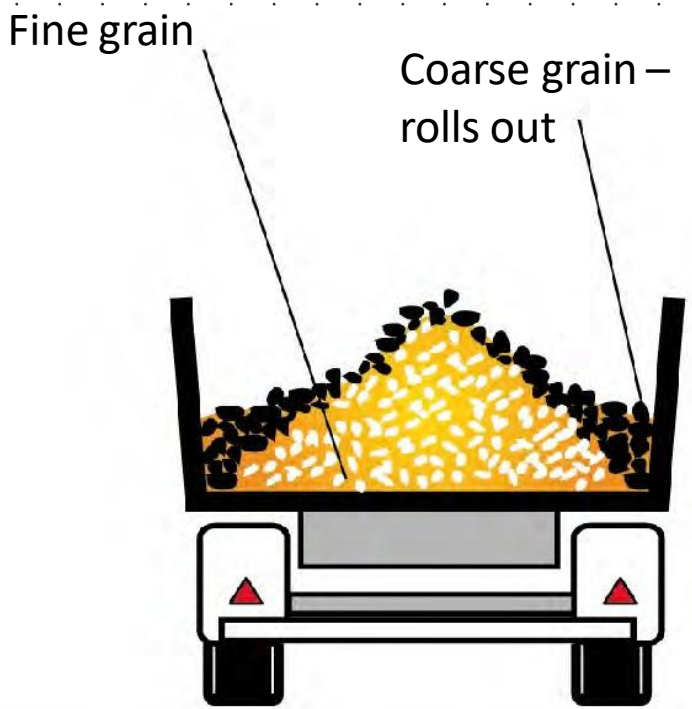
# Temperature evaluation with Thermoscan




**Quellenverweis**

Rok Rošer Master Thesis TU Ljubljana UDC: 625.7:691 (043.3)
Temperature Segregation in Asphalt Mixture Placement

# Cause of granular segregation coarse grains roll outward – coarse grains come out at the start

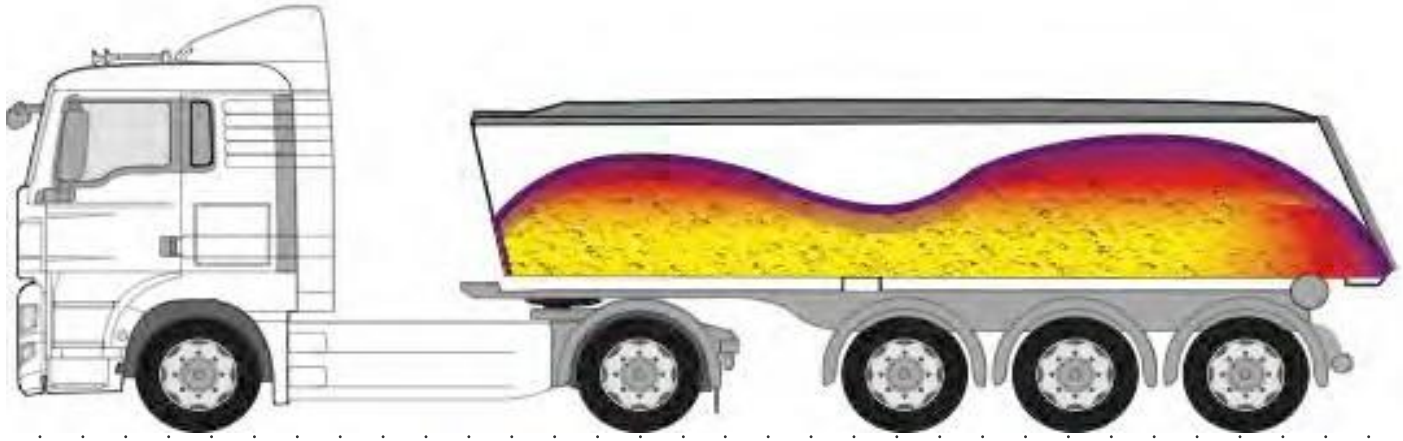



**Clusters of coarse grain usually occur at intervals**


$$\frac{\text{Tonnage per truck load}}{\text{Installation depth (m) x installation thickness (m) x 2.5 to/m}^3} = \text{Distance (m) from clusters (coarse grain and cold spots)}$$

# THERMAL SEGREGATION

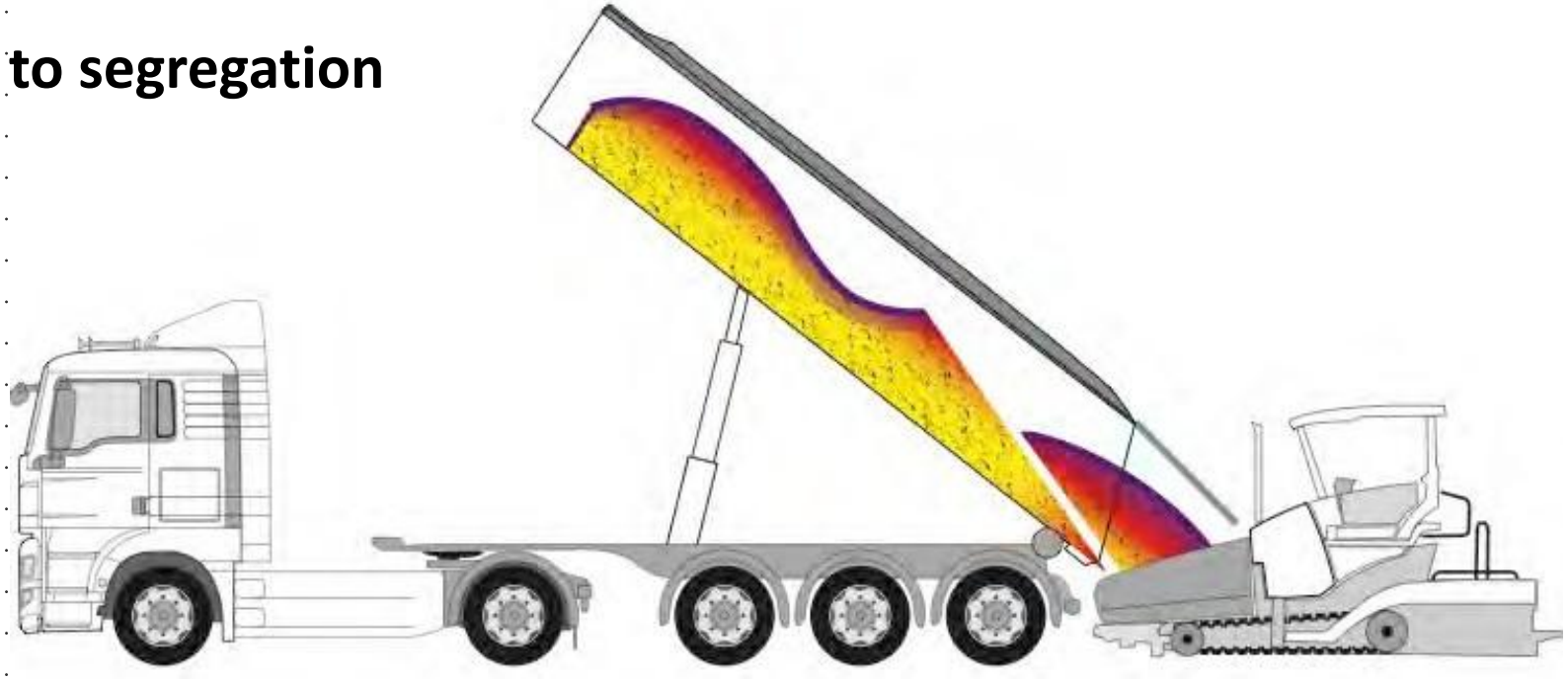
**The cold layer is clearly visible**



# THERMAL SEGREGATION

**The first 5-6 tones of asphalt getting into the paver or feeder are cold -**

**This leads to segregation**



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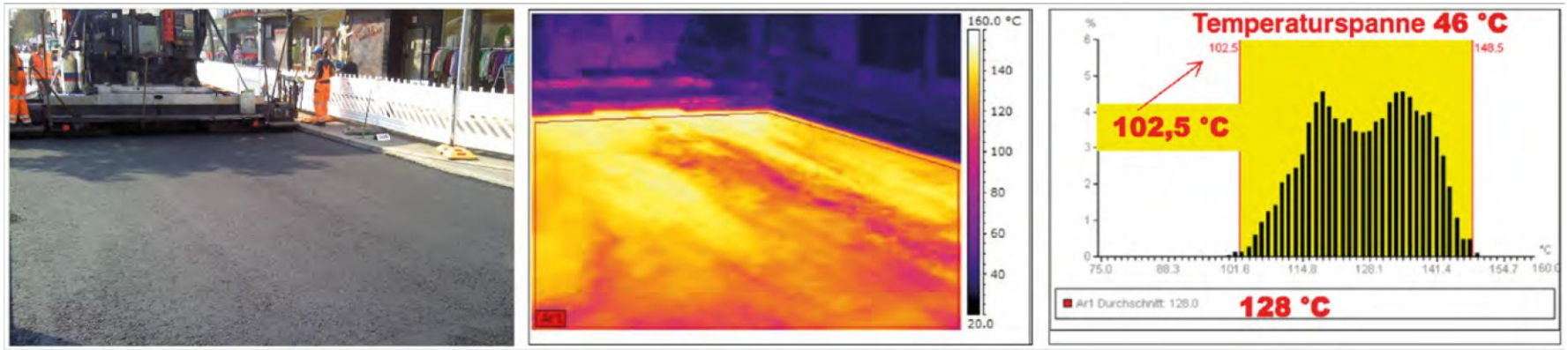
# THERMAL SEGREGATION

## Thermal segregation during asphalt transport

**Sometimes significant temperature differences on dumper vehicles before the first roller pass**




**The use of thermally insulated vehicles doesn't solve the problem of segregation.**

# „Impact of temperature segregation on the service life of roads“

| Relationship between surface temperature differences, level of segregation and additional building costs (after Stroup-Gardiner und Brown, 2000) | | |
|---|---|---|
| **Asphalt surface temperature differences** | **Degree of segregation** | **Additional costs (%) of the original building costs** |
| <10 °C | | |
| 10 – 16 °C | Low segregation | 8 – 13 % |
| 17 – 21 °C | Moderate segregation | 22 – 30 % |
| > 21 °C | High segregation | 37 – 46 % |

**Numerous studies on newly constructed and repaired roads show that temperature segregation quickly leads to road damage.**

**In numerical terms, the follow-up costs due to temperature segregation can amount to nearly half of the original construction costs, as damage becomes apparent only a few years after installation.**

**With significant temperature segregation, the service life can be reduced by up to seven years, approximately half of the expected lifespan (see table).**

Quelle: Segregation in Hot-Mix Asphalt Pavements; Report 441
M. Stroup-Gardiner; E.R. Brown; National Center for Asphalt Technology

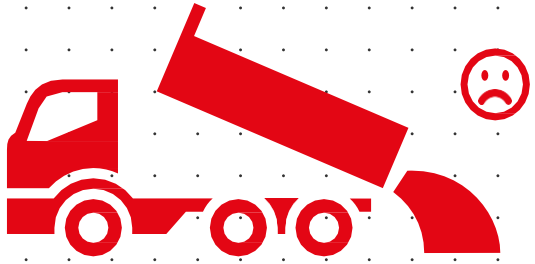
NCHRP Peportage

# Requirements and regulations from practical applications

CIVIL ENGINEERING

**Transportation of concrete?**

**How would you handle transportation?**



With dumper?

➡ Considerable segregation

**Material quality or cost as main priority ?**

# Requirements and regulations from practical applications

CIVIL ENGINEERING

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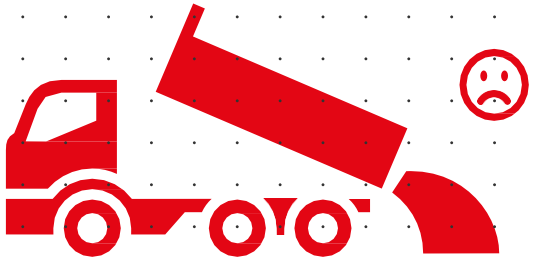


With dumper?

➡ Considerable segregation

**Construction cost as main priority ?**

with concrete mixer!

➡ Continuous mixing

**Material quality as main priority ?**

# Requirements and regulations from practical applications


**‘Quality has priority!!!’**

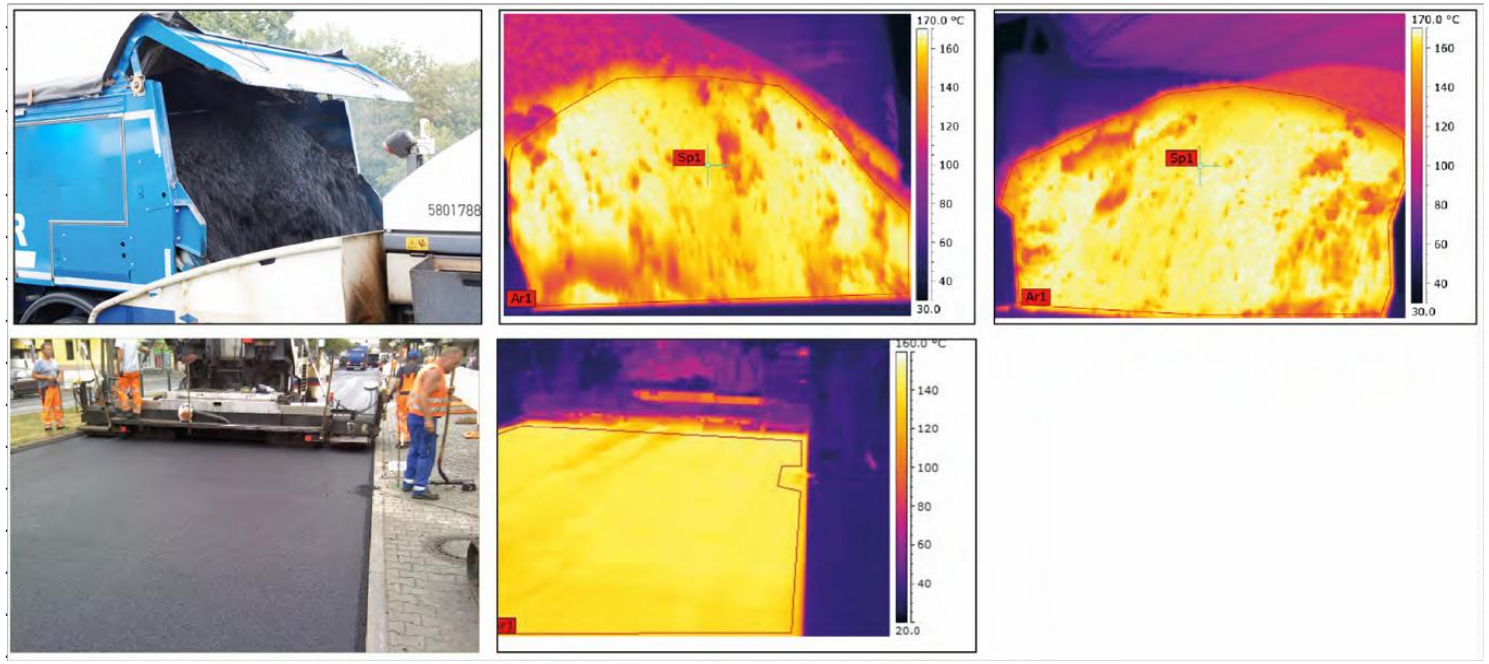
# Requirements and regulations from practical applications

**Continuous mixing throughout the unloading process**
(of temperature as well as bitumen and binder-agent proportions)

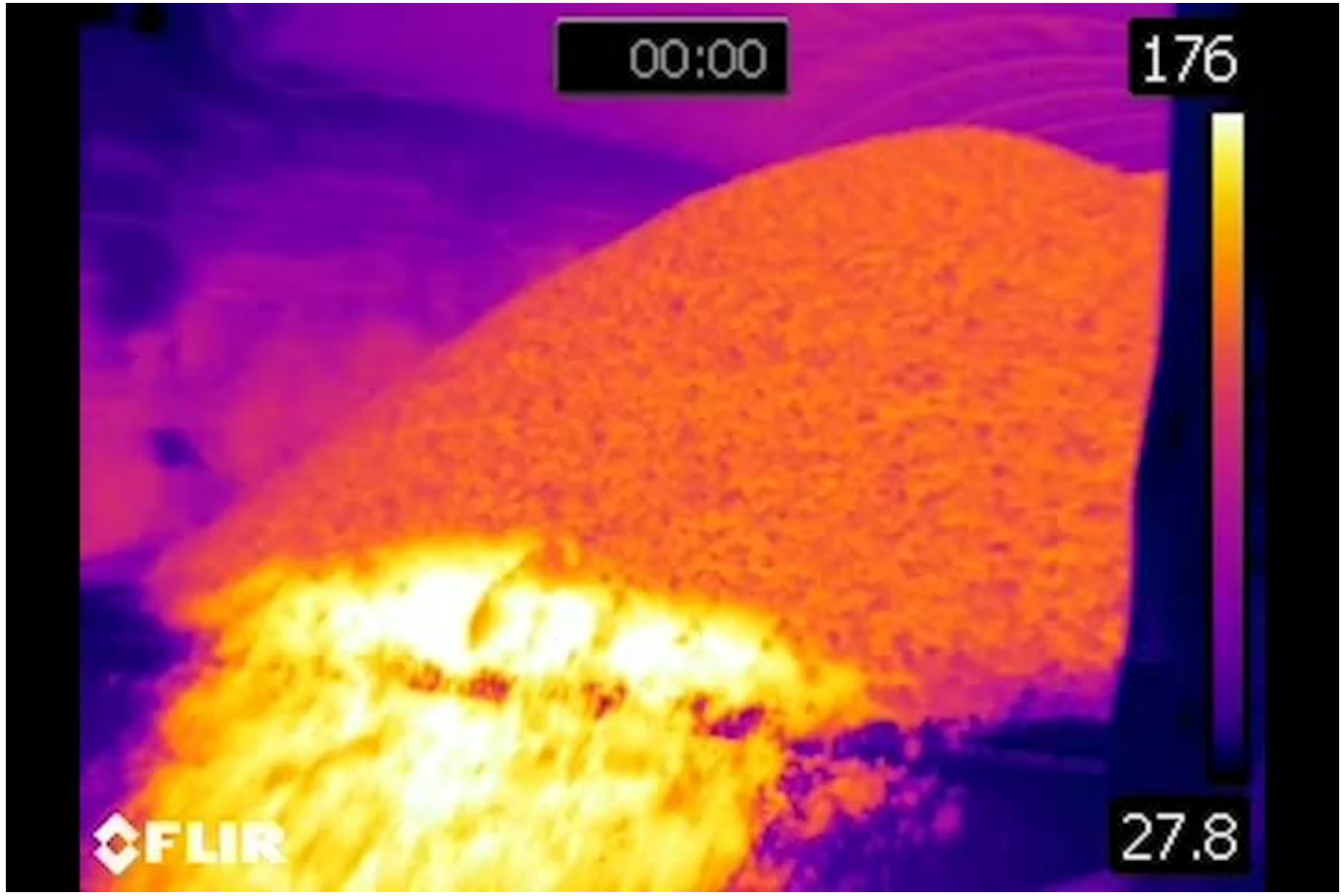
- even distribution of grain sizes (in accordance with grading curve)
- truckbodies clean and completely emptied – also without "Near-East" separator (diesel)

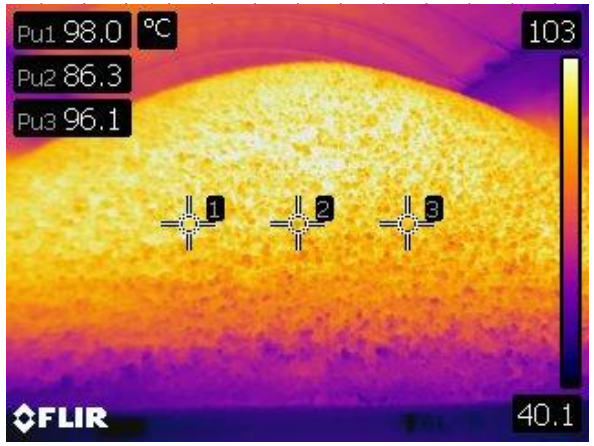
# Requirements and regulations from practical applications

## Continuous mixing



# Construction site report by road authorithy: MUNICH



# Clean and completely emptied with the push-off technology

**Even with difficult mixes, such as OPA, PMA, LOA, DSHV, rubber or polymer-modified bitumen**

**Result WITHOUT separating agent in the body**

# Results from a number of studies (PRACTICE)

- TU Darmstadt
- TU Vienna
- TU Brunswick
- BA Berlin
- BPS Austria
- KLB Cologne
- RUB Ruhr University
- Installation of noise-reducing layers  OPA – Porous Asphalt

LOA 5 D

PMA – porous mastic asphalt

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Forschungsbereich Straßenwesen

# Asphalt temperature from mixing plant to installation

**Temperature measurements taken during construction and asphalt technology studies**

**Project number D230 0615 4003 / 15406**



Fliegl BAUKOM

# 2.1 Construction project / task

**MA 28 installed a new road surface along a section of approx. 465 metres in 1140 Vienna**

**The following structure was realised:**

- **3 cm AC11 surface, PmB 45/80-65, A2, G1**
- **8 cm AC22 binder agent, PmB 25/55-65, H1, G4**
- **9 cm AC32 base, 50/70, T1, G4**
- **20 cm non-bonded top base layer, U1, 0/63**

**The difference between two types of delivery, one with conventional dumpers (KK truck) and one with push-off trailers (TA truck)**

# Construction fields

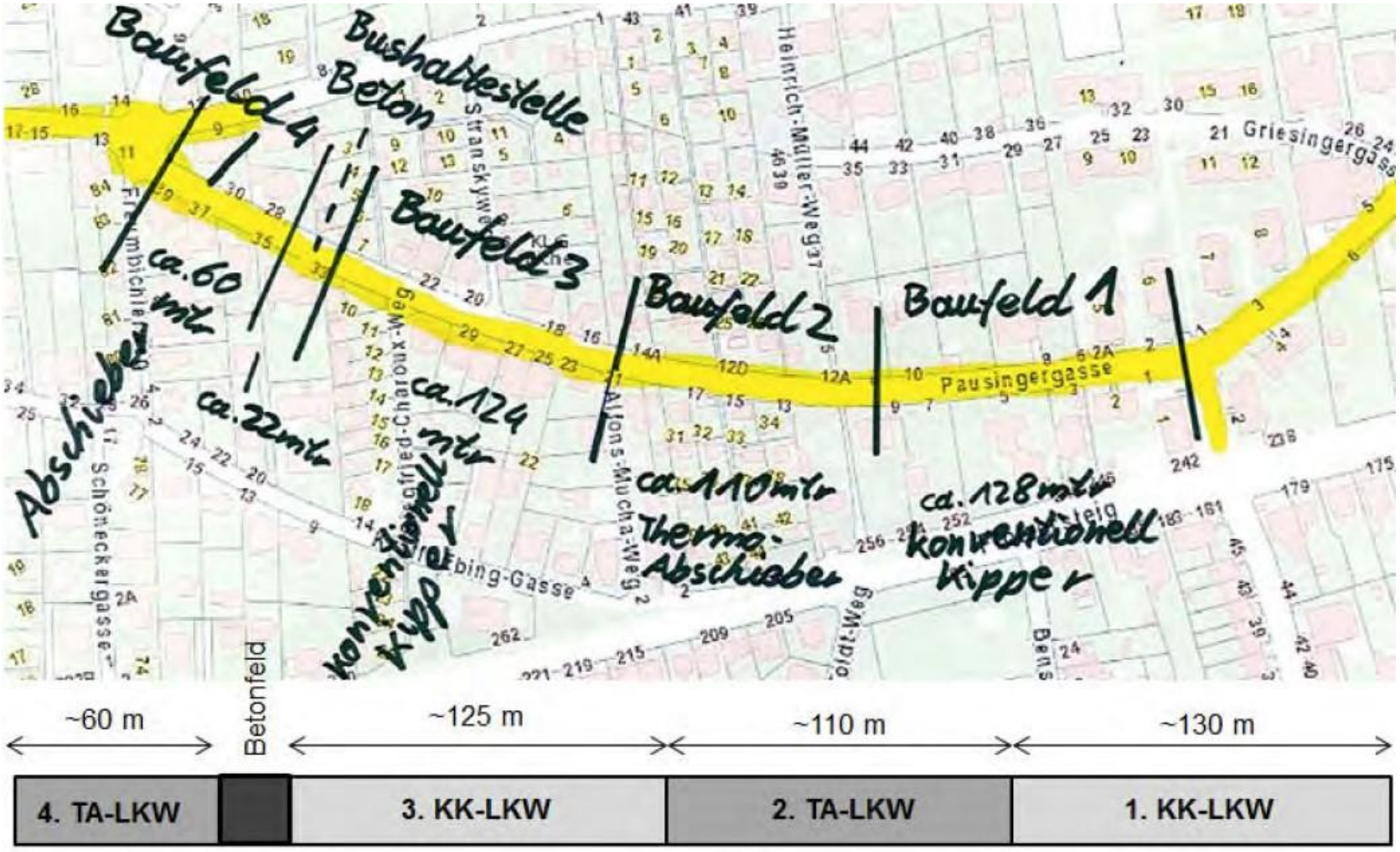


Fig. 1: Layout of the four construction plots

# 3.2.4 Difference in the asphalt surface temperature with KK and TA after installation

The three asphalt layers (base, binding, surface layers) revealed sometimes large differences in the surface temperature between KK and TA trucks.

**Fig. 9 below shows as an example**

**the average surface temperatures for each 5-m section across the entire length of Construction Fields 1 and 2**

**for the two versions of delivery**

**KK truck (Dumper)**

**TA truck (Push-off-Truck)**

# Average asphalt temperature per 5-m section

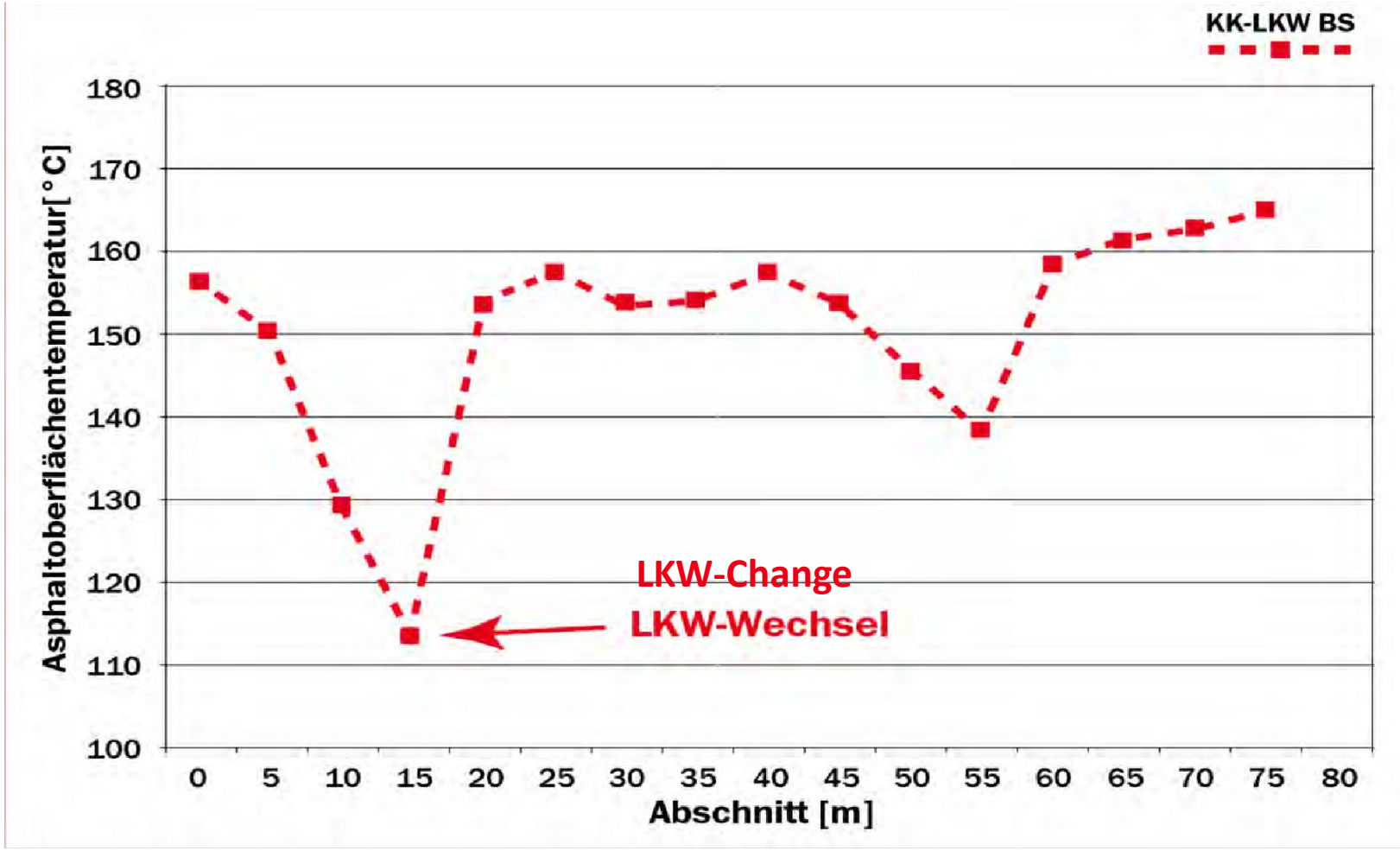


Fig. 9.1. Progression of the **average asphalt surface temperature** after installation for all layers (thermal image)

# Average asphalt temperature per 5-m section

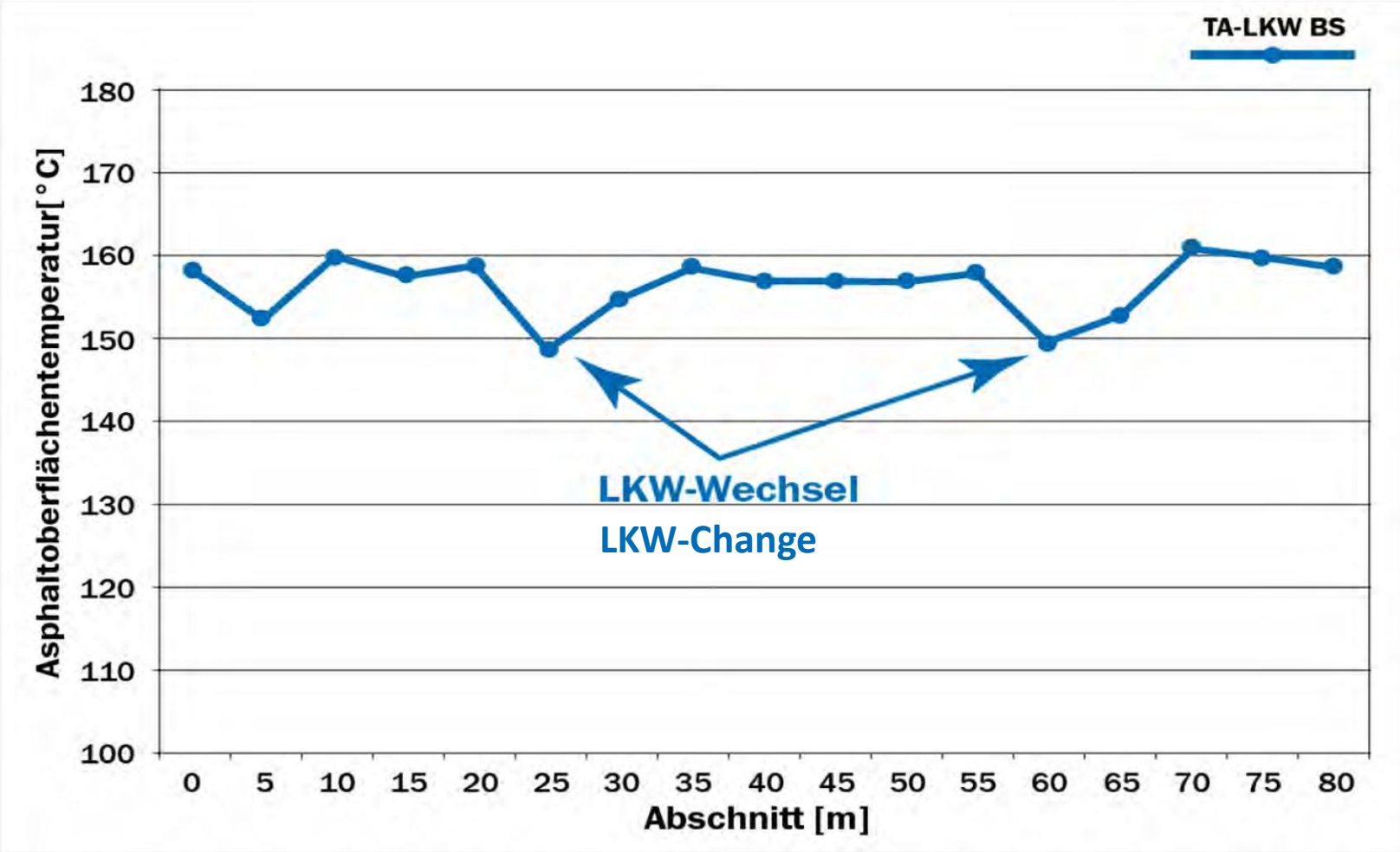


Fig. 9.1 Progression of the **average asphalt surface temperature** after installation for all layers (thermal image)

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Vienna University of Technology

# 5. SUMMARY AND INTERPRETATION

- **The risk of cold nests occurring was reduced significantly when vehicles with push-off technology were used and a more homogeneous temperature distribution was achieved with the bit-by-bit transfer of mix to the paver.**

- **Using transport vehicles with push-off technology in urban areas also reduces the risk of damage to overhead lines during unloading; they can also be used more easily in tunnels, under bridges in avenues than dumpers can.**

# Temperature progression during asphalt installation

## Berlin, B96 Residenzstraße

**Installation with thermal bodies**

Sunshine, approx. 25 – 35°C

Binder layer:
Mix transport with thermally insulated dumper bodies

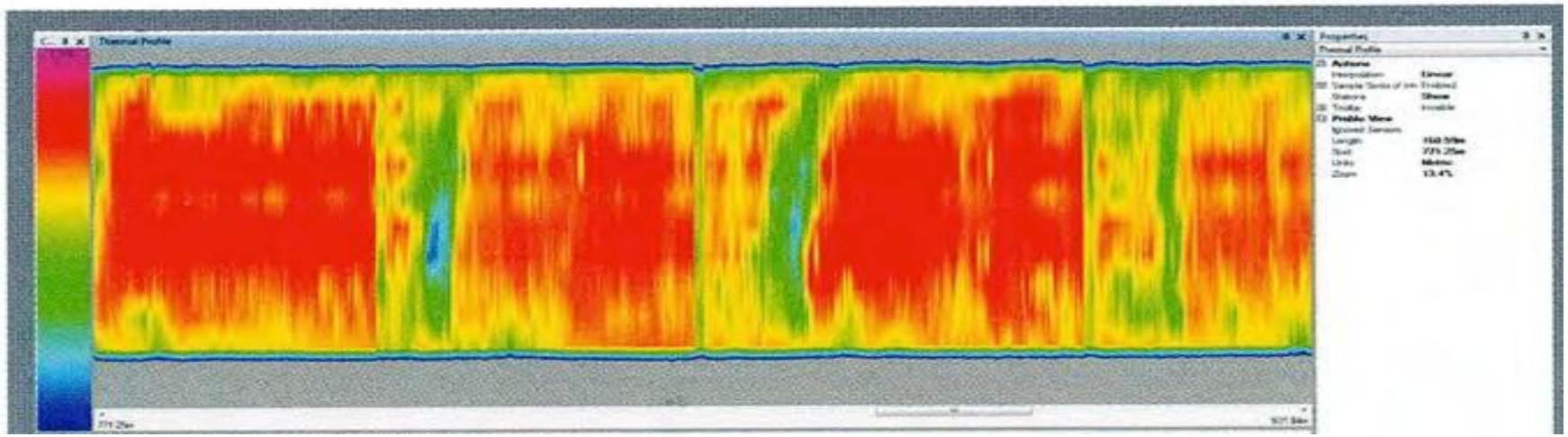
Surface layer:
Mix transport in thermally insulated push-off vehicles

# Thermal imaging systems that have proved themselves in practice e.g. Vögle Road Scan

**High-precision infrared camera with 100% measuring cover**

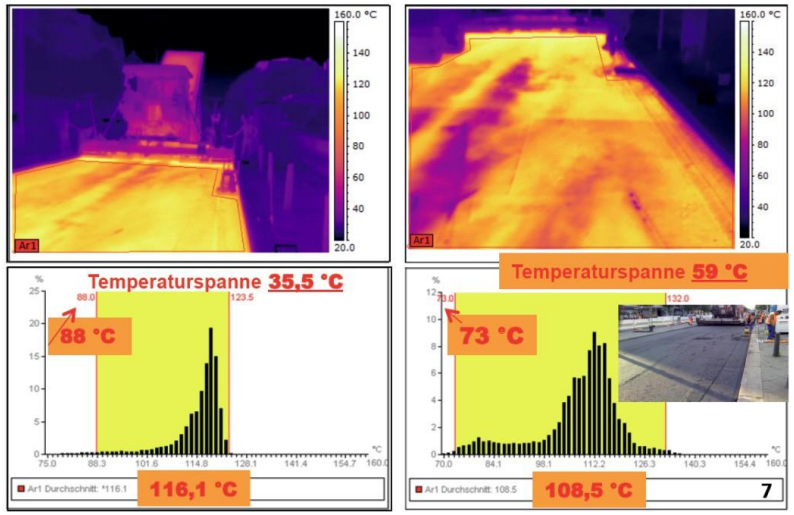
# Thermal imaging systems that have proved themselves in practice e.g. Moba Pave – IR Scan

"Truck changes are often the cause of temperature differences in the mix and may be quickly identified as a clear cold point."



# Temperature progression with thermal bodies – dumpers

**Berlin, B96-Residenzstraße_Einbau mit Thermomulden-Teil 1**
**Witterung: Sonnenschein, windstill, ca. 25 -28 °C**
**Einbau von Binderschicht von ca. 8.30 Uhr bis 9.15 Uhr**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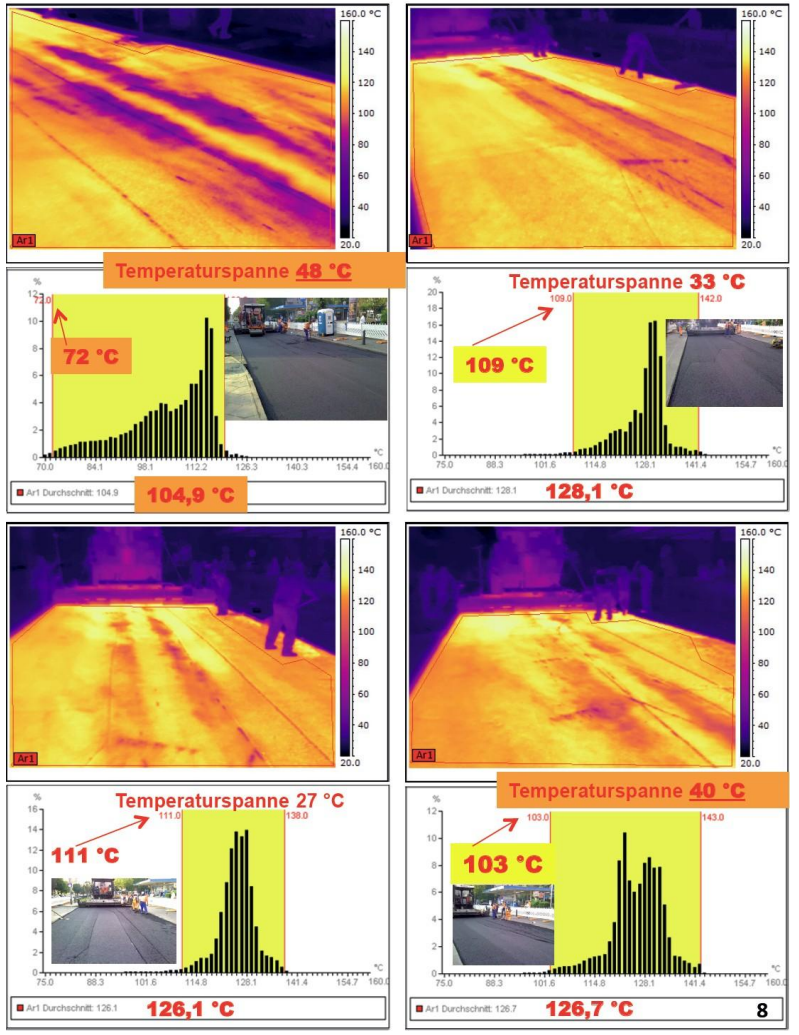
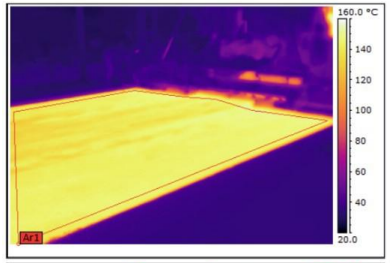
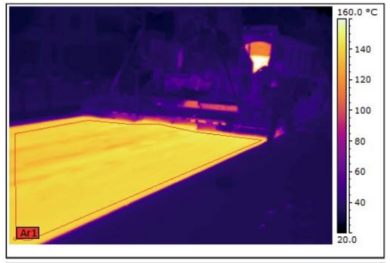
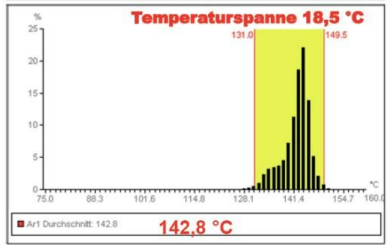


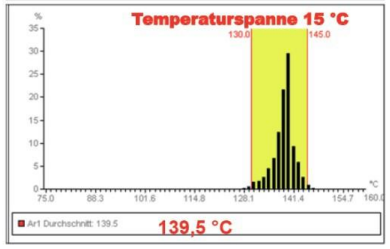
# Temperature progression with thermal bodies – dumpers

**Berlin, B96-Residenzstraße_Einbau mit Abschiebefzg.-Teil1**
**Einbau von Deckschicht als Dünnschichtbelag (2,5cm.)**
**Witterung: Bewölkt, windig, Gewitterneigung, ca. 28 -30 °C**
**15.August, Einbau ca. von 18.00 bis 19.00 Uhr**








**Berlin, B96-Residenzstraße_Einbau mit Abschiebefzg.-Teil1**
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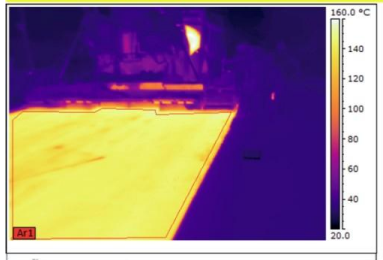
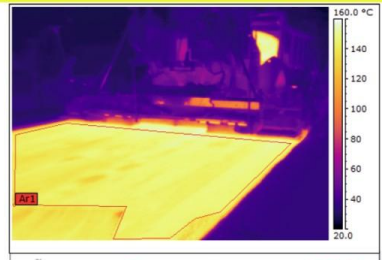
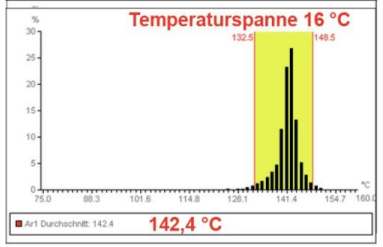
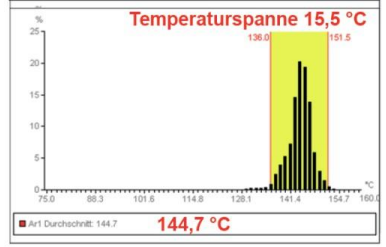
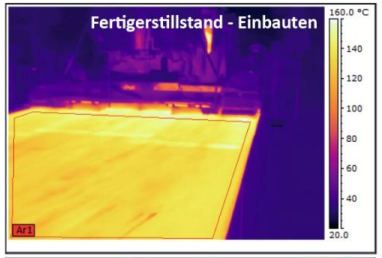
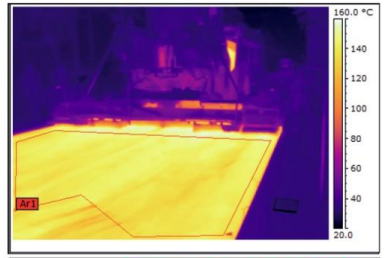


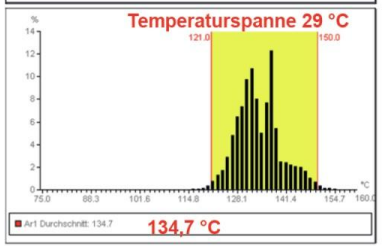


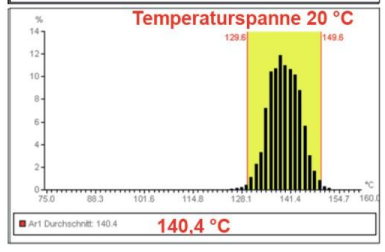




# Costs / benefits for thermal bodies with push-off technology?

- **No residual quantities in the bodies that have to be disposed of (without separating agent in the body) even with PA, PmB, Split-mastic**
- **No excavator required at the cleaning yard to scrape out the bodies**
- **Safety**


# Health and safety

**Horizontal Discharge technology offers:**

- **maximum tilt stability**
- **No risk of collision with overhead obstacles**

15 Einsatzkräfte der Feuerwehr Knittelfeld waren nach Eigenangaben im Einsatz

Die Feuerwehr konnte erst nach Stromabschaltung durch das Energieversorgungsunternehmen mit der Bergung beginnen. Der 47-jährige Fahrer erlitt schwere Verletzungen, sei aber laut Polizei nicht in Lebensgefahr – er wurde mit dem Rettungshubschrauber in das LKH Graz geflogen. Die S36 musste während der Rettungsarbeiten in Fahrtrichtung Klagenfurt komplett gesperrt werden.

red, steiermark.ORF.at/Agenturen

# Costs / benefits for thermal bodies with push-off  technology?

- **Use push-off technology to avoid  stop and go**
- **Continuous asphalt installation with push-off technology**

  **Process reability for all asphalt pavents**

# Costs / benefits for thermal bodies with push-off  technology?

- **Asphalt installation while airport operation continue without restrictions from air-traffic control's radar ( 5 meter limitation )**

- **Not necessary to shut down flight operations for the rehabilitation  of aprons**

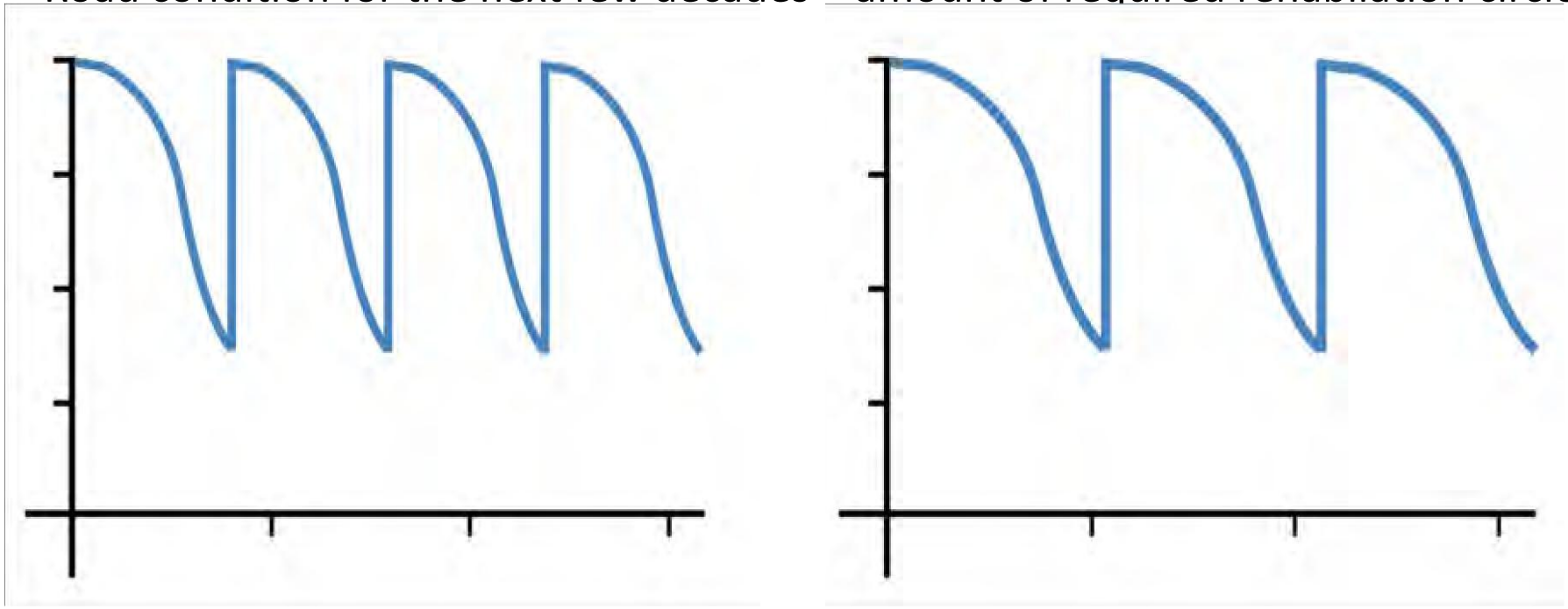

# Asphalt installation of the runway at airport Belgrad with 270.000 tonnes



Trucks with push-off technology are used to guarantee the quality

# Costs / benefits for thermal bodies with push-off technology?

- **Particularly when budgets for road maintenance and construction are limited, it`s more important in tenders are being requested - so roads last as long as possible !!!**
- Road condition for the next few decades – amount of required rehabilation circles



**Improved homogeneity during installation allows longer life of the asphalt pavements**

**-> thereby improved overall $CO_2$ balance over the period of use**

# Environmental Protection through low CO2 emissions during asphalt production

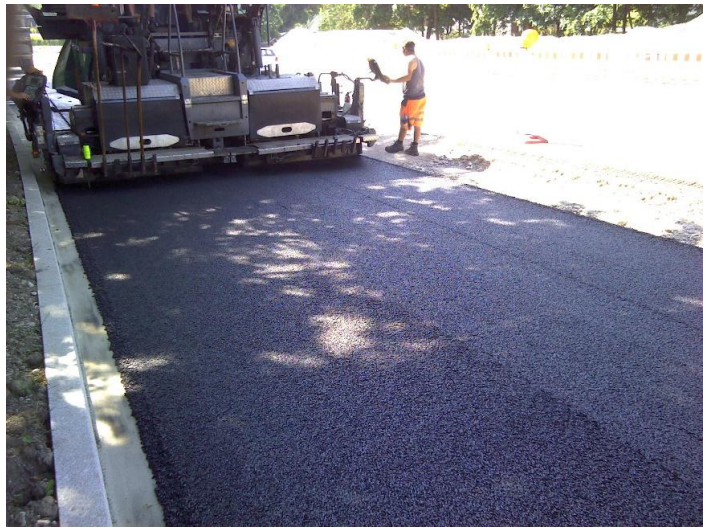
**Continuous mixing of the asphalt during the transfer into the paver / feeder while the same time improving the processability during installation.**

**Thus, the production temperature in the asphalt production can be reduced**

**⇒ reduced energy consumption = less production cost**

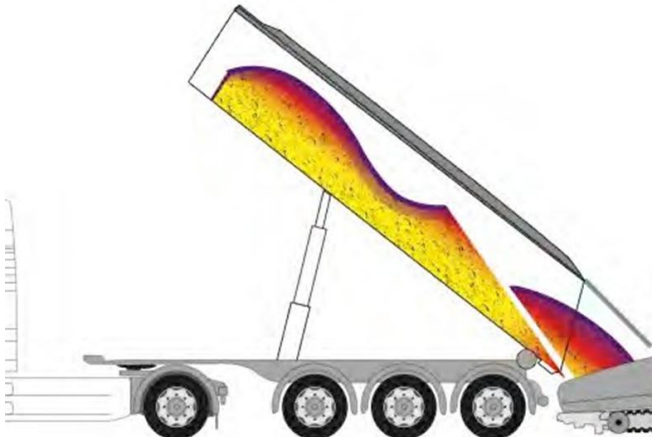
**⇒ reduced $CO_2$ emissions**

# Many road authorities integrate push-off-technology in tender for their road projects: e.g. MUNICH

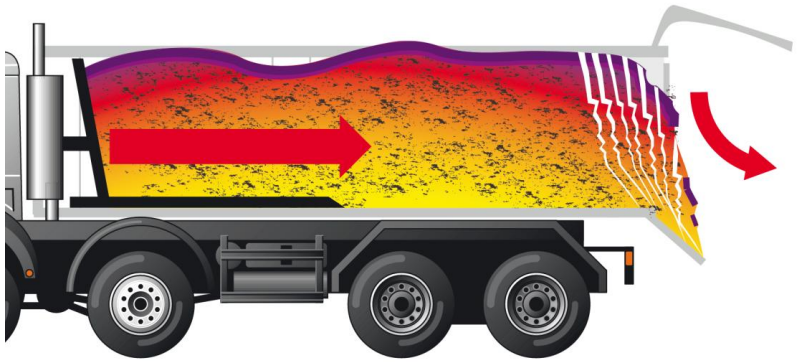




# Summary



- Cheaper sourcing of equipment
- … ?



- Longer pavement lifetime
- Smoother construction process
- No conflict with flight operation
- Increased sustainability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# SAVE THE DATE

## ASPHALT DAYS *Vol. 2*

the second edition live with us!

**Main topics of the Conference:**

- Modern technologies for sustainable and environmentally friendly road construction
- Influence of temperature segregation on road's quality and ways to avoid it
- Difficulties in runway construction for airports
- Challenges in road construction on sloped surfaces, in tunnels, on race and test tracks
- Digital solutions for infrastructure
- Temperature reduced asphalt-decarbonisation
- Live demonstrations

**14-15 of April 2026**

**84453 Mühldorf am Inn, Germany**

**Further Information coming soon!**

Conference Speakers and Partner:

Fliegl

newton trailers

asphalt

Technische Universität Dresden

InfraTest

JRS Fibers for Life.

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# Thank You

## For Your Attention

### Contact information

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### Presentation