

High-Performance Asphalt Pavement – Insights from Formula 1 Tracks for Airports

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Hart Consult International GmbH

managing partner & pavement expert for race tracks and proving grounds



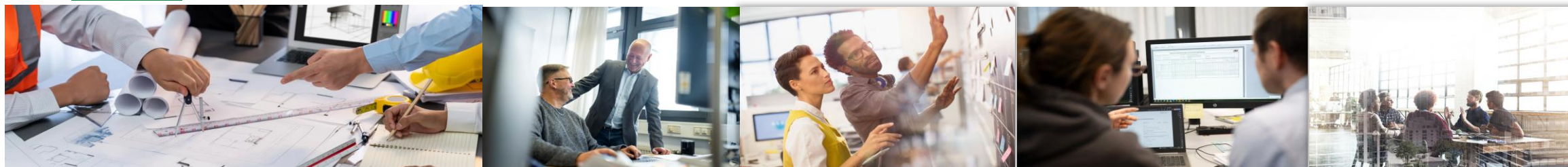
HART CONSULT
INTERNATIONAL GMBH

our company for international relationships and engineering services for racetrack projects, proving grounds, airports and other asphalt projects



IBQ
INGENIEURE

our company for national relationships and engineering services for asphalt projects (preparation tender documents/ award process, site management, invoice verification)



IBQ
INSTITUT

our company for material testing and development of new material mixes, training and supervision for laboratory and on-site testing and quality management

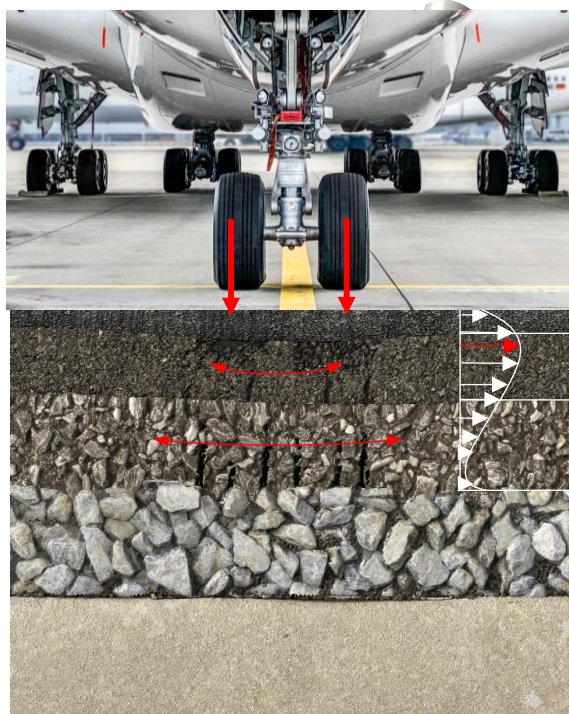




360° full support from the initial concept to the final roll pass

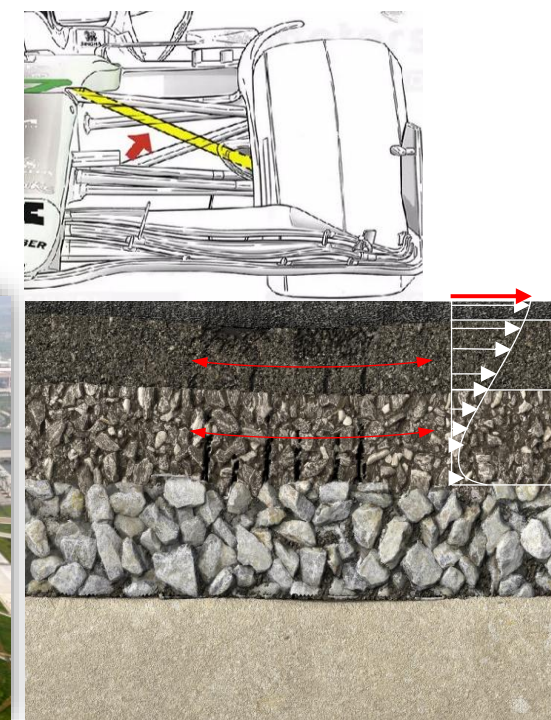


Runway

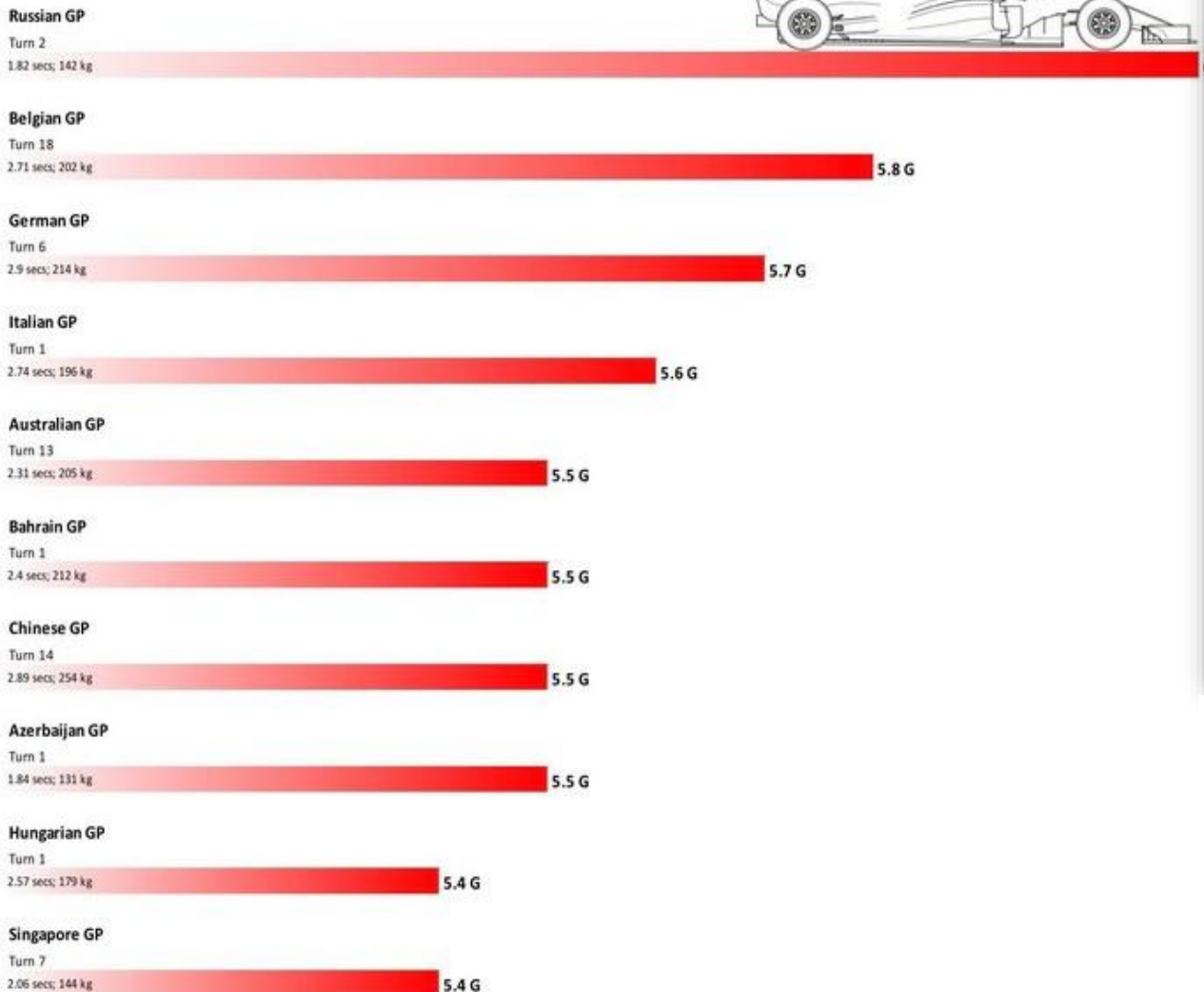


Design: straight lines, flat
Slope: transverse or longitudinal slope: $\leq 1.5\%$
Tolerances: evenness max. 3 mm/ 3m
texture (MTD) $\geq 1,0$ mm
grip $\geq 0,72$ new / $\geq 0,40$
Deviations: limited possible
Lifetime: ???

Race Track



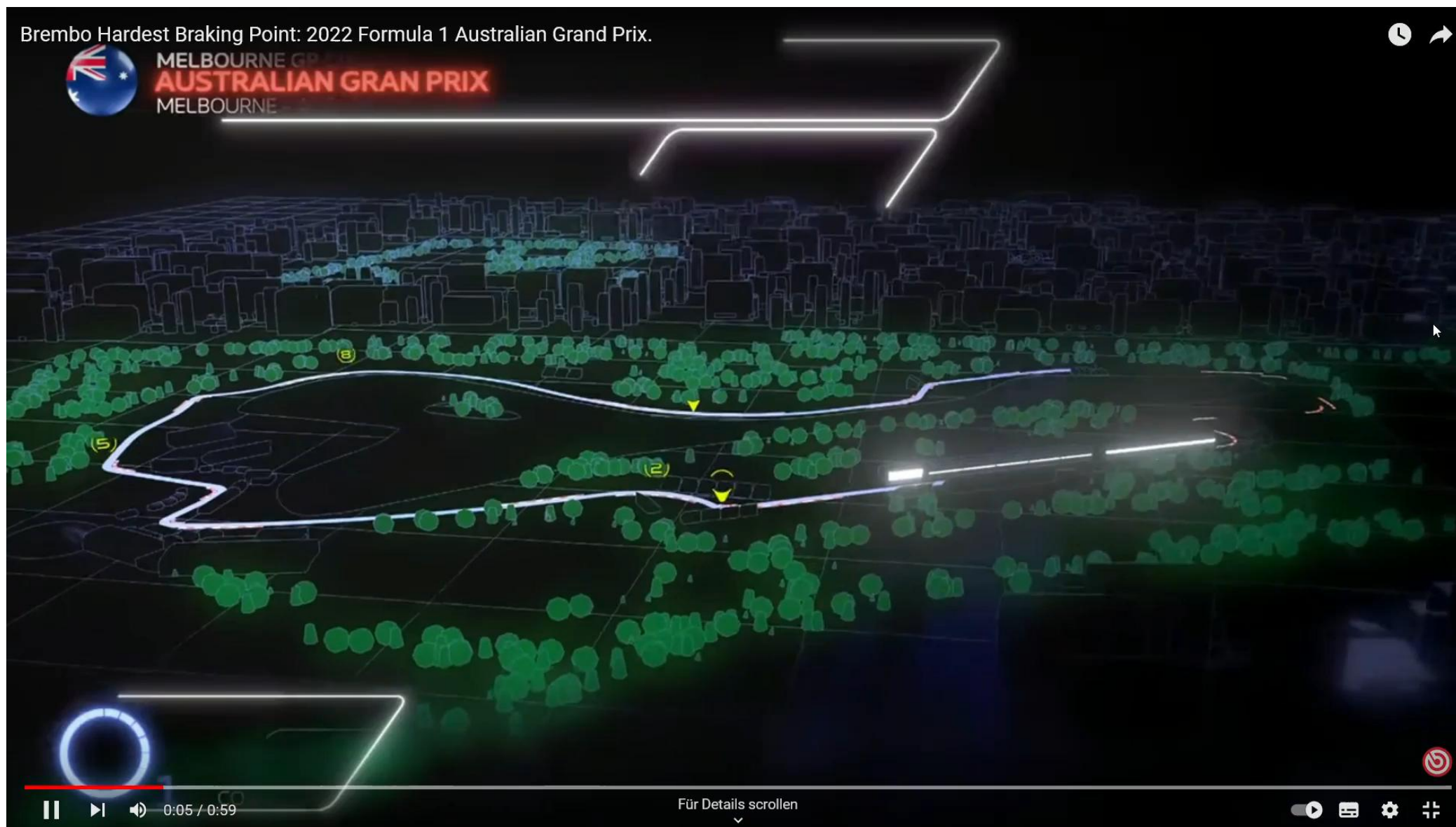
Design: very curvy, steep inclines
Slope: up to 24 % (Madrid), 20 % (Spa)
Tolerances: evenness max. 2 mm/ 3m
texture (MTD) $\geq 1,0$ mm
grip $\geq 0,9$ new / ($\leq 0,5$ to resurface)
Deviations: impossible!
Lifetime: normally 12 – 15 years, possible 20 years



Surface pressure of car tires: approx. $0.4 \text{ N/mm}^2 = 0.04 \text{ kg/mm}^2$
Width of car tires: approx. 200 mm
Total: approx. 80 N/mm = **8.0 kg/mm**

Surface pressure of F1 tires: approx. $1.5 \text{ N/mm}^2 = 0.15 \text{ kg/mm}^2$
Width of car tires: approx. 450 mm
Total: approx. 675 N/mm = **67.5 kg/mm**

2019 Braking Forces Infographic via Brembo





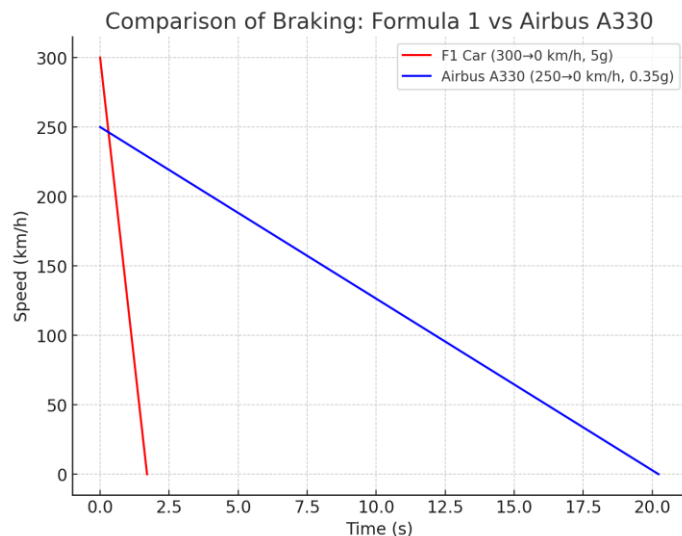
Basics about race tracks and proving grounds



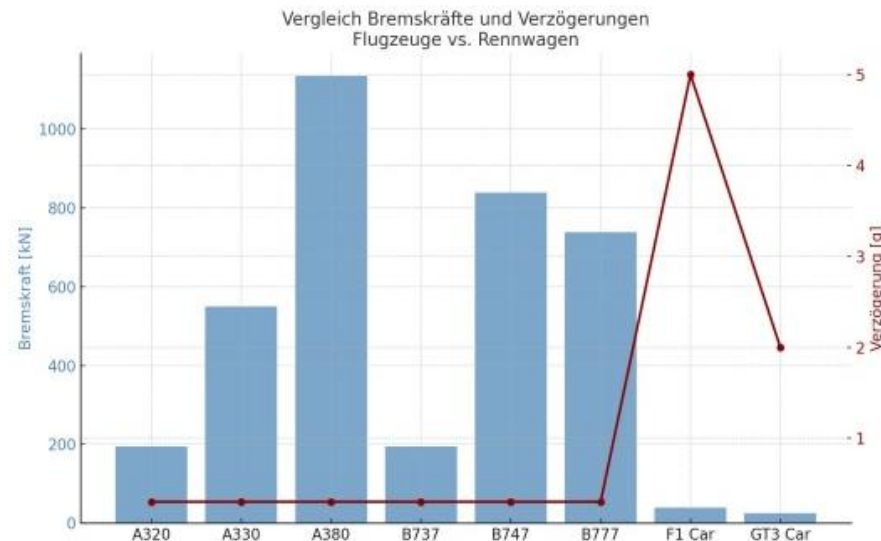
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Source: ChatGPT



Source: Dr. Carsten Karcher EAPA



Surface Pressure of A330

Normal force per tyre: $F_N = 141 \text{ kN} = 141,000 \text{ N}$

Coefficient of friction: $\mu \approx 0.55$ (aircraft tyres on concrete)

Tyre surface area: $A = 0.2 \text{ m}^2 = 200,000 \text{ mm}^2$

Maximum thrust per tyre: $F_{\max} = \mu \cdot F_N = 0.55 \cdot 141,000 \approx 77,550 \text{ N}$

Ground pressure per mm^2 : $\sigma = F_{\max} / A = 77,550 / 200,000 \approx 0.3878 \text{ N/mm}^2 \approx 0.04 \text{ kg/mm}^2$

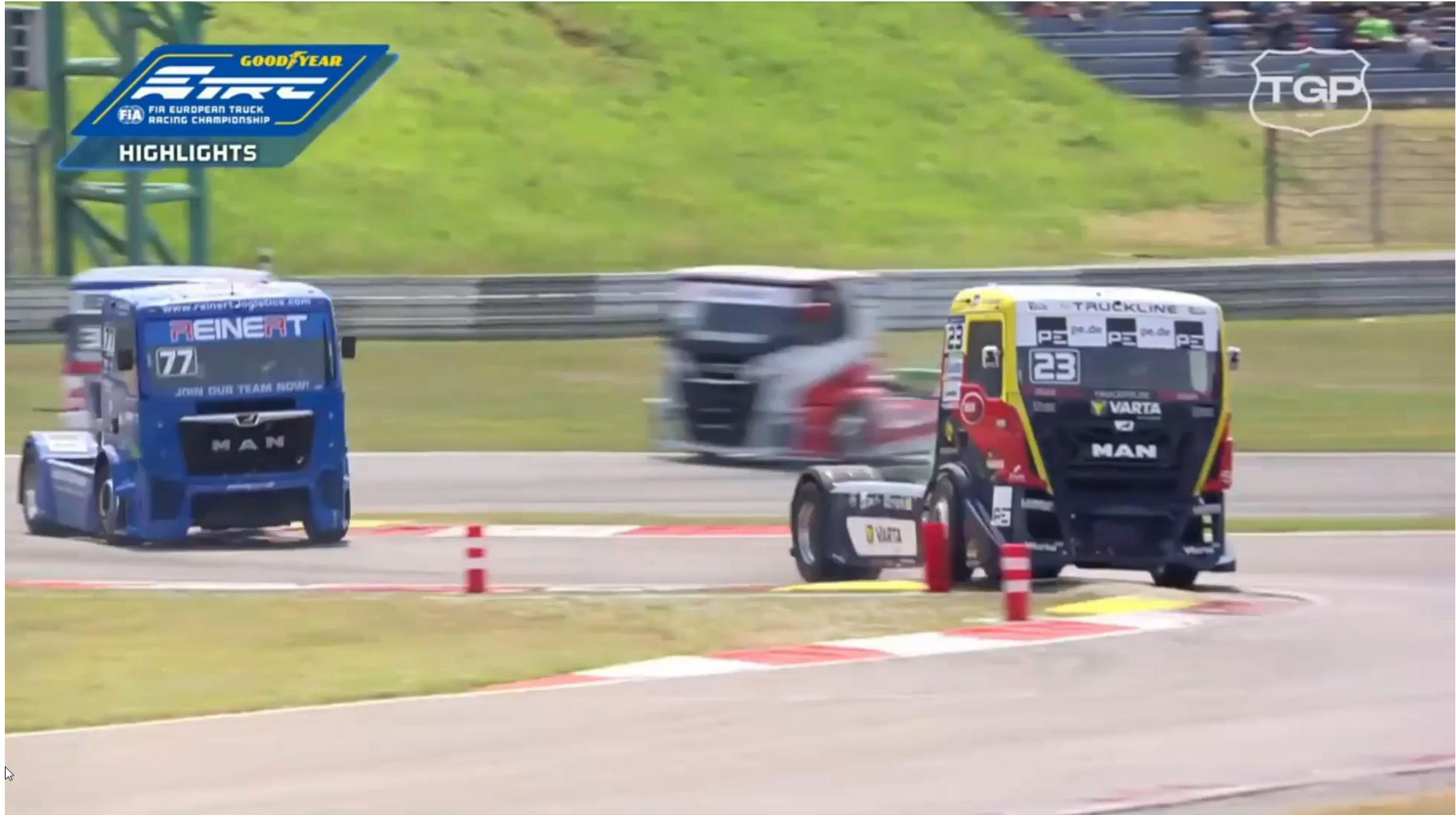
Width of A330 tires: approx. 510 mm

(→ Source ChatGPT → happy if you could share your experiences to confirm this)

Mario, come on, it's easy when you only have to worry about light racing cars...



Of course, but we're also trained to take care of the big boys...



proving grounds for heavy duty testing

ton(axle)	5t	6t	7t	8t	9t	10t	11t	12t	13t	14t	15t	16t
---	19%	11%	3%	3%	5%	20%	18,50%	0%	20%	0%	0%	0,50%
day	5	3	1	1	1	5	4	0	5	0	0	0
year	68	40	11	11	18	72	67	0	72	0	0	2

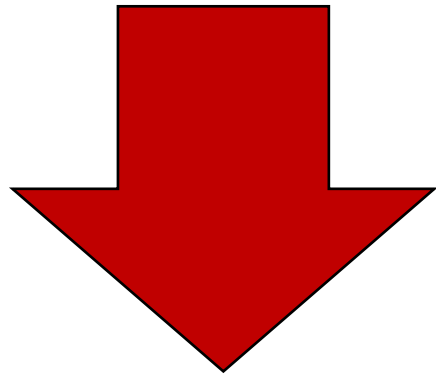
Speed	80-60	80-40	80-20	80-0	60-0
---	20%	5%	5%	10%	60%

350 full braking scenarios every day (250 days/ year)



Basic questions from race tracks and proving grounds for urban roads and highways

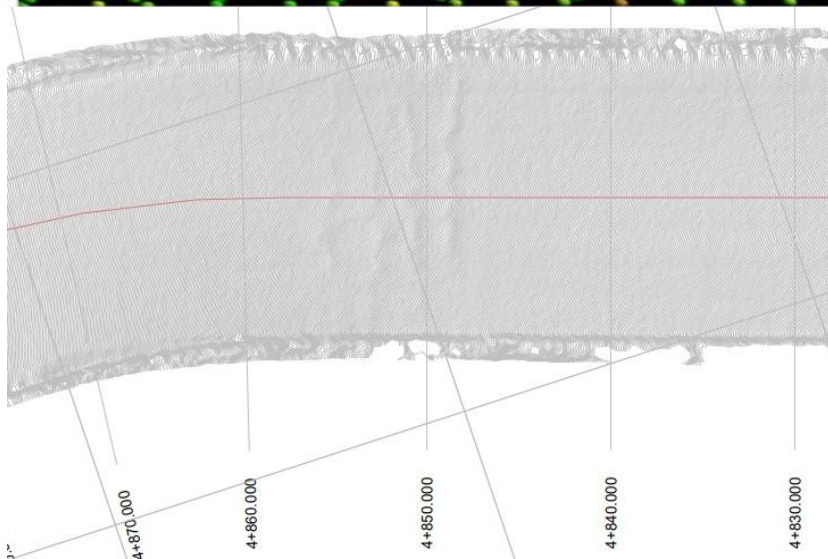
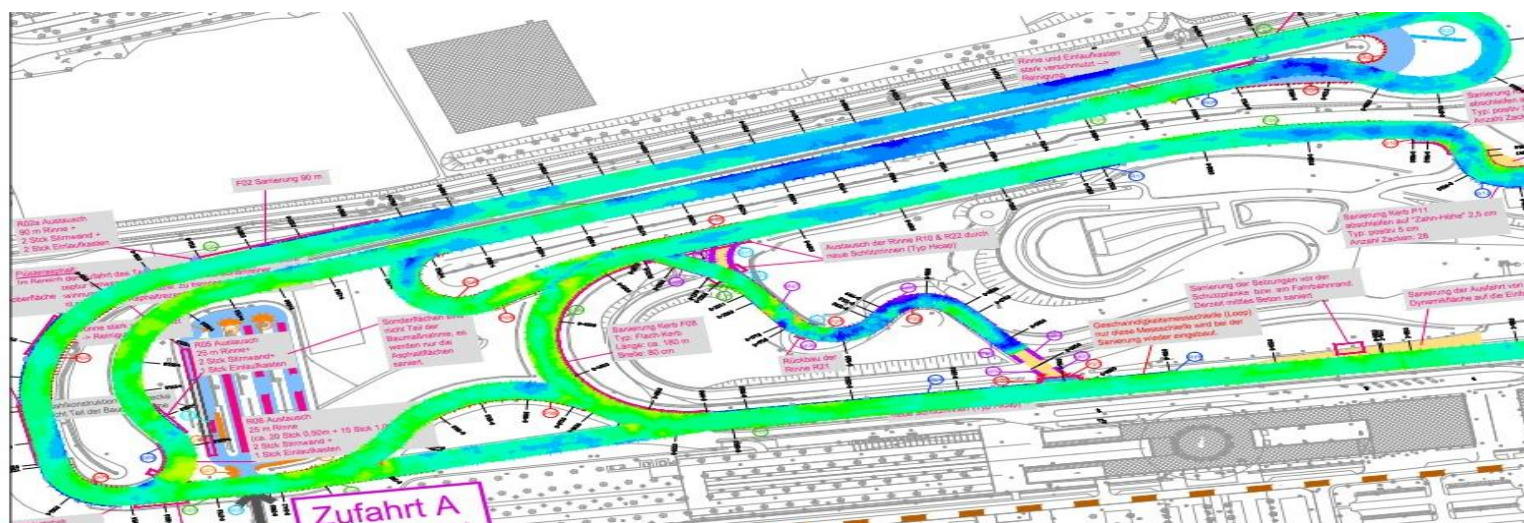
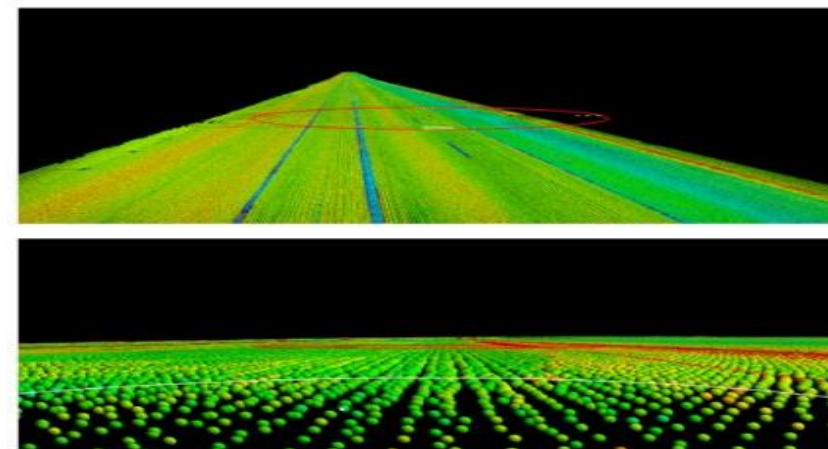
- How can you absorb the very high forces?
- How can you maintain grip and evenness over the long term?
- How can we take into account the different car and truck classes so that the track and proving ground can be used for a long time (> 15 years without wearing course damage)?



high quality in every single step



Milling - Analysis of the existing situation using a 3-D scan and development of an optimised 3-D milling model as a .dgm file for milling depth and optimised slopes



Only selected raw materials are suitable for such high demands:

1. Aggregates – only very few rock sources known to us worldwide that completely fulfill the high requirements
2. Fillers – very high demands on chemical reactivity
3. Bitumen – only very few crude oil sources known to us worldwide that completely fulfill the high requirements



Fig. 5. Compatible system with 4% SBS [5].

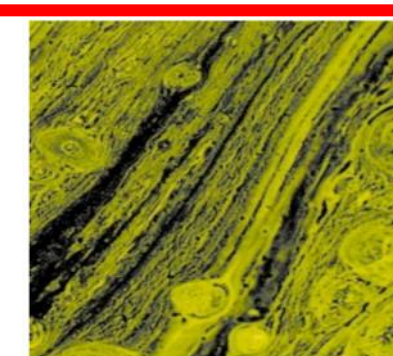
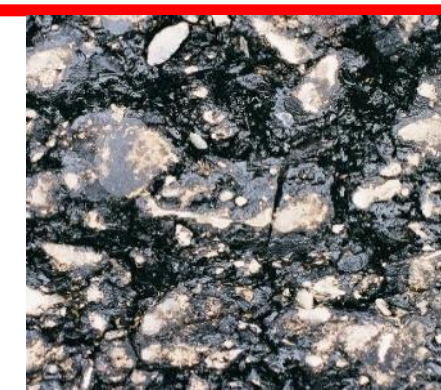
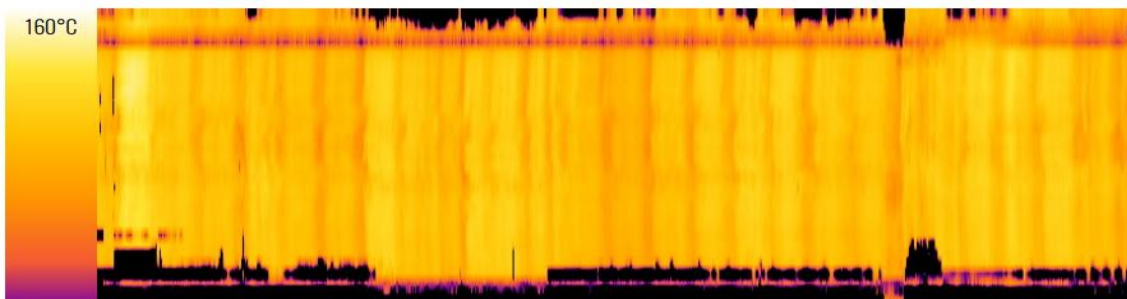


Fig. 6. Incompatible system with 4% SBS [5].

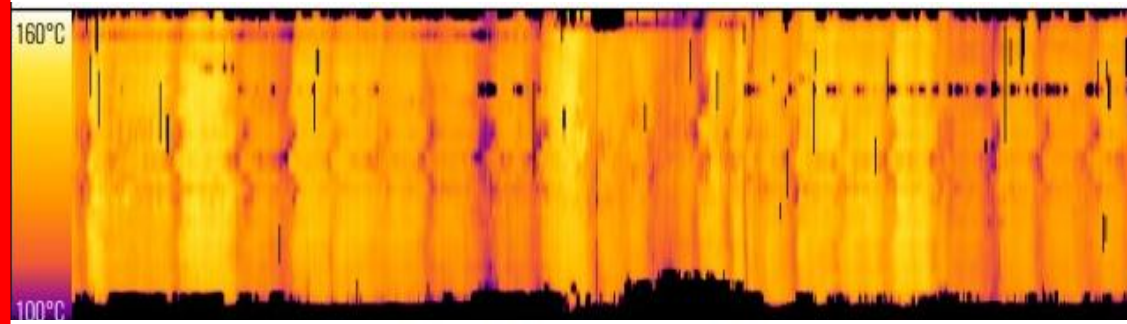
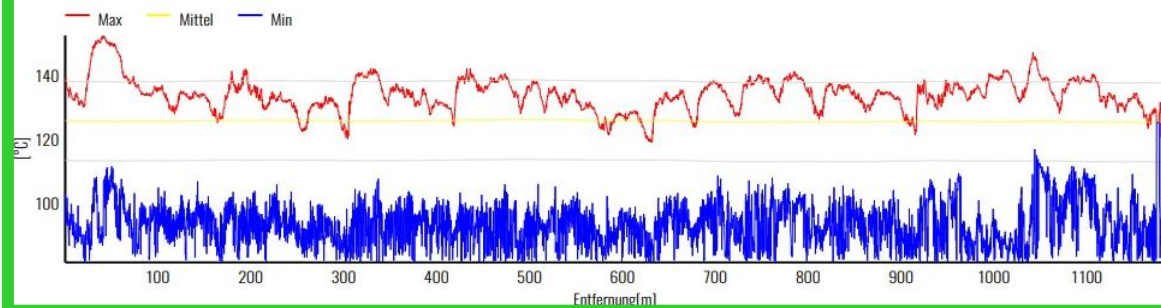
Asphalt production is only possible at suitable mixing plants and under suitable production conditions:



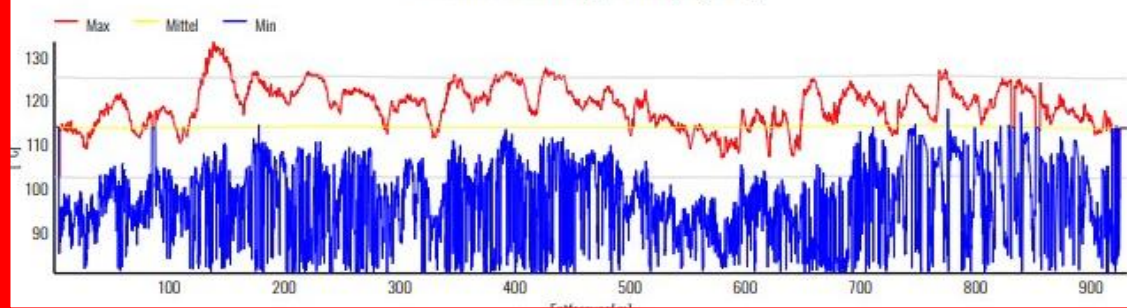
Transport –With thermal insulation and good discharging technology, the most homogeneous temperature distribution is achieved.



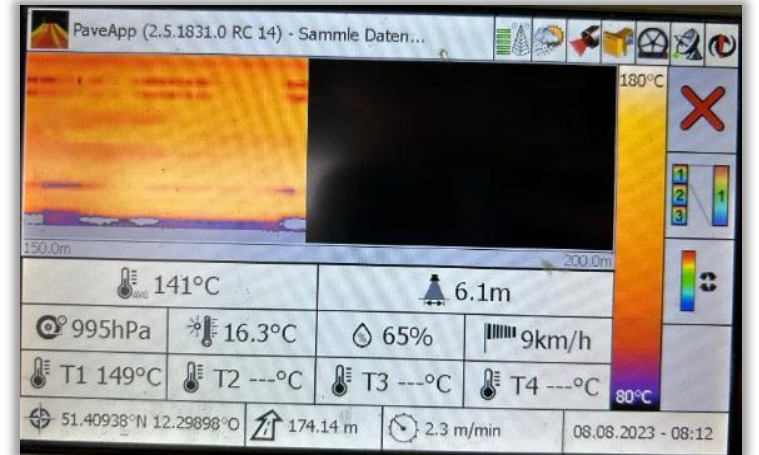
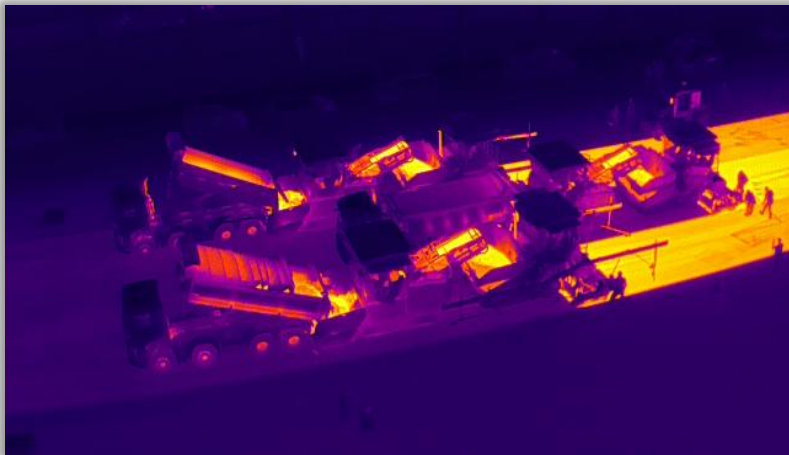
Thermale Homogenität (0,5%)



Thermale Homogenität (25,8%)

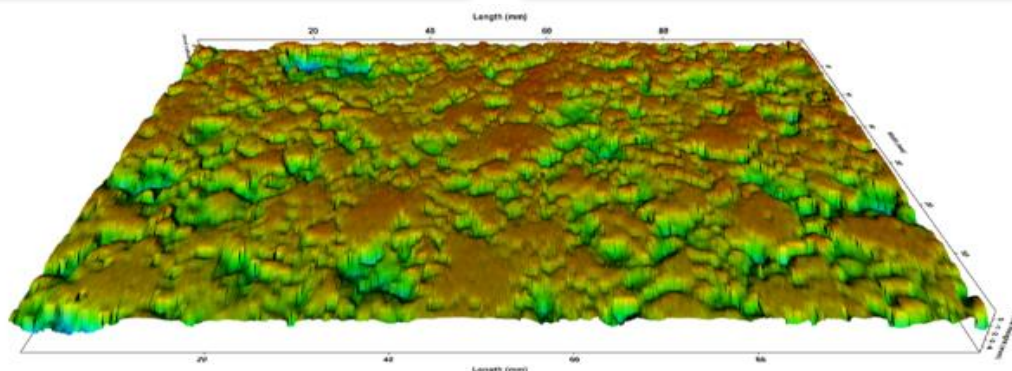
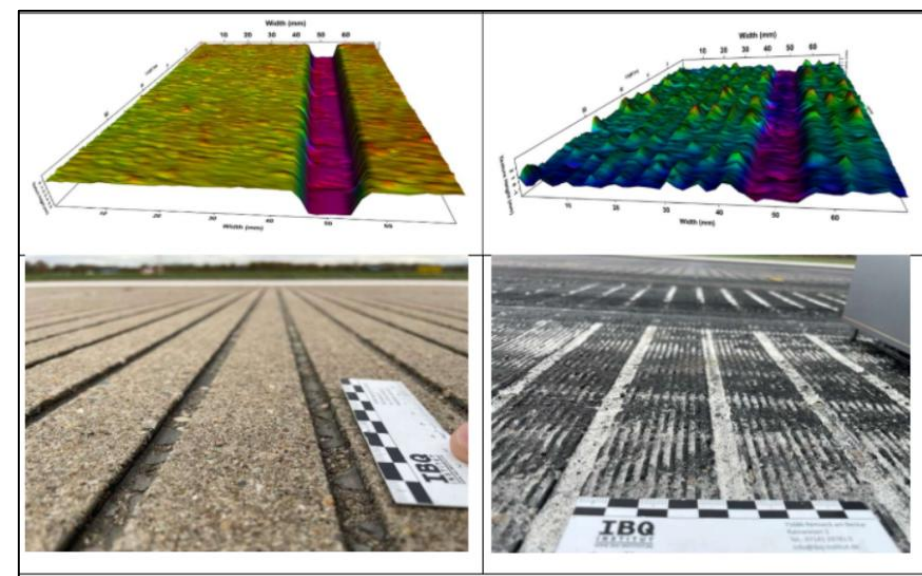


Technical assistance during paving for operators and site managers

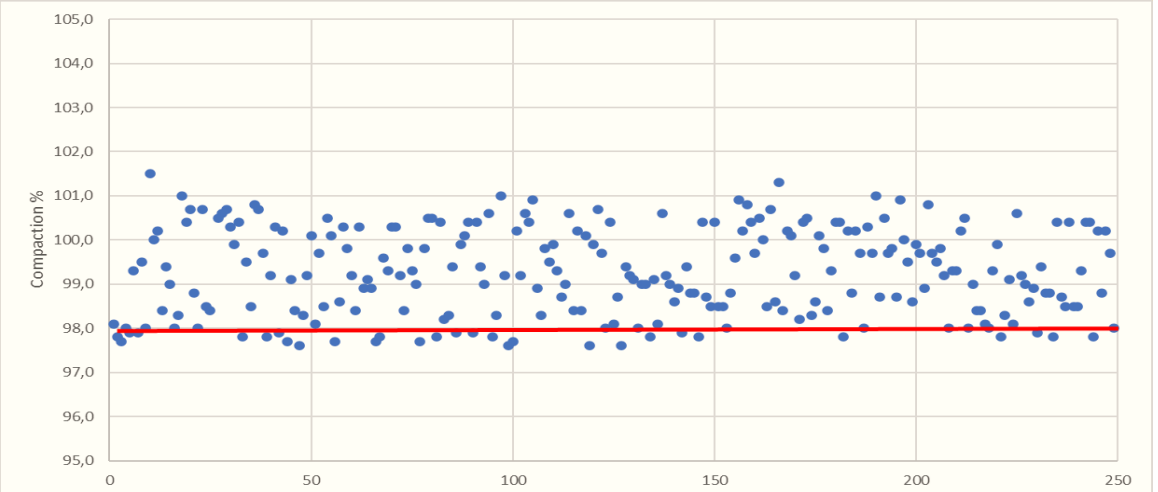
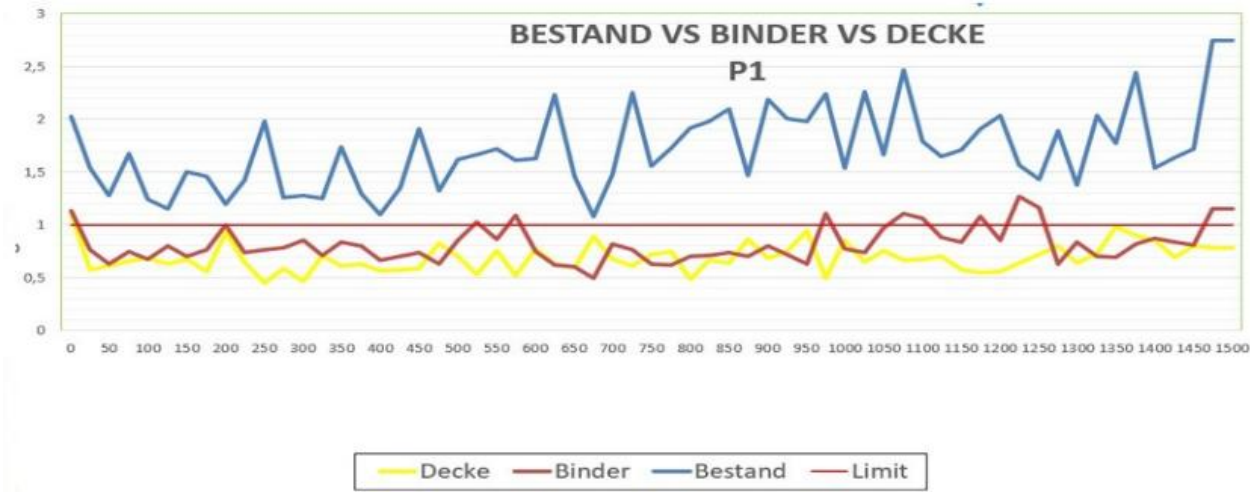
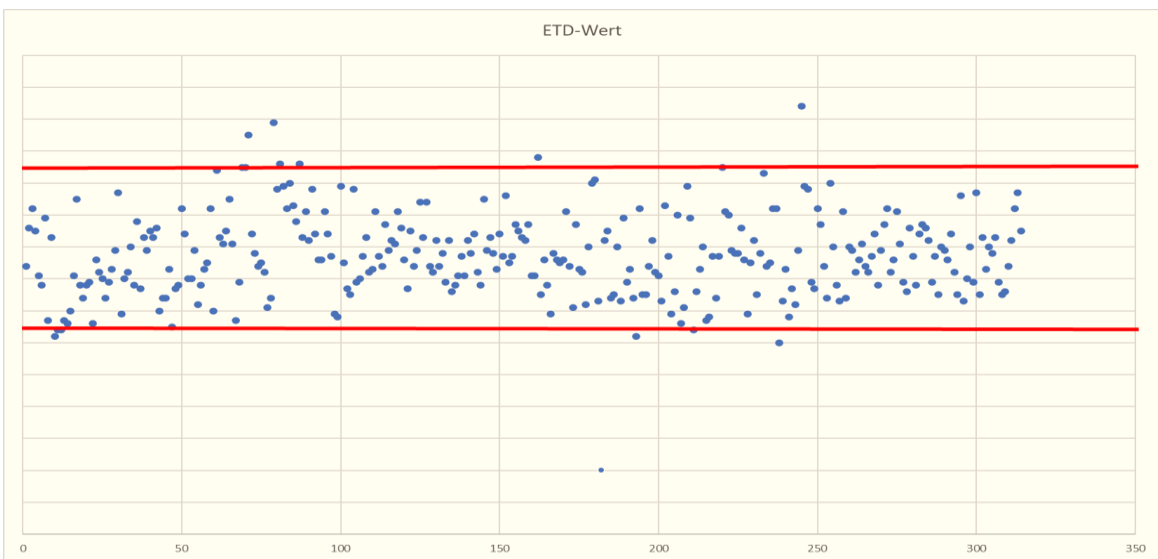
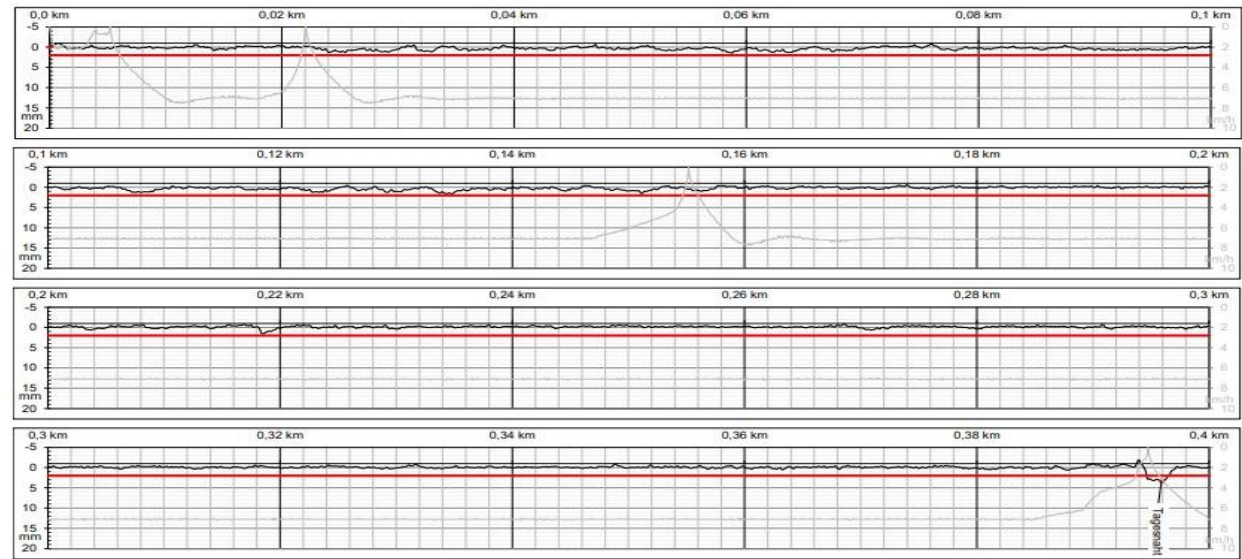


solutions and state of the art technology for race tracks and proving grounds

None destructive testing methods while paving



Paving - with the perfect settings and processes for the desired asphalt result



Is it possible to apply knowledge gained from race tracks and proving grounds to

Airports



Yes !!!!

because we use

- standard construction equipment
- normal operators
- natural materials

but we

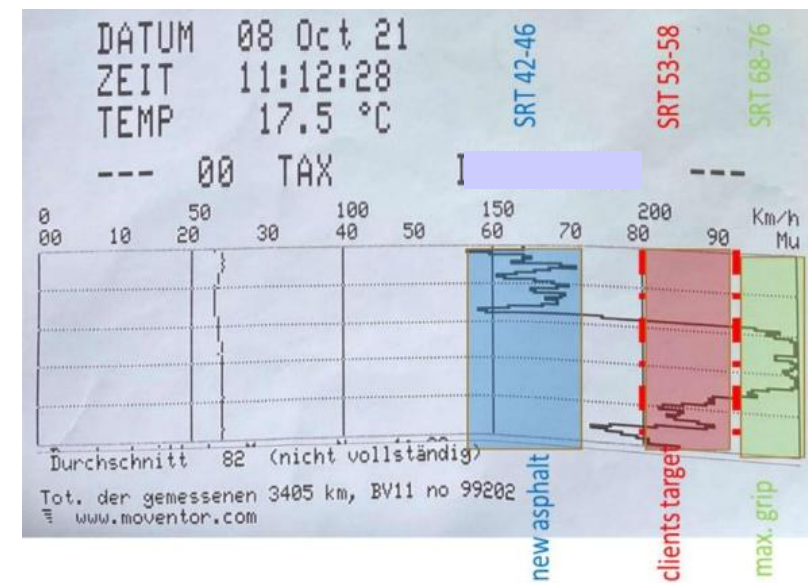
- customised specifications
- customised bitumen and raw materials
- optimised asphalt paving processes
- lead every single construction step with specialists
- we also take maintenance work into account in our asphalt concepts.

It doesn't matter whether it's a race track or a runway –
treat your asphalt with care so that it can be used for a long time.

Solution – special asphalt mixture for water blasting maintenance with only very minor texture changes



Solution - Water blasting with only very minor texture changes – initial grip



fresh paved

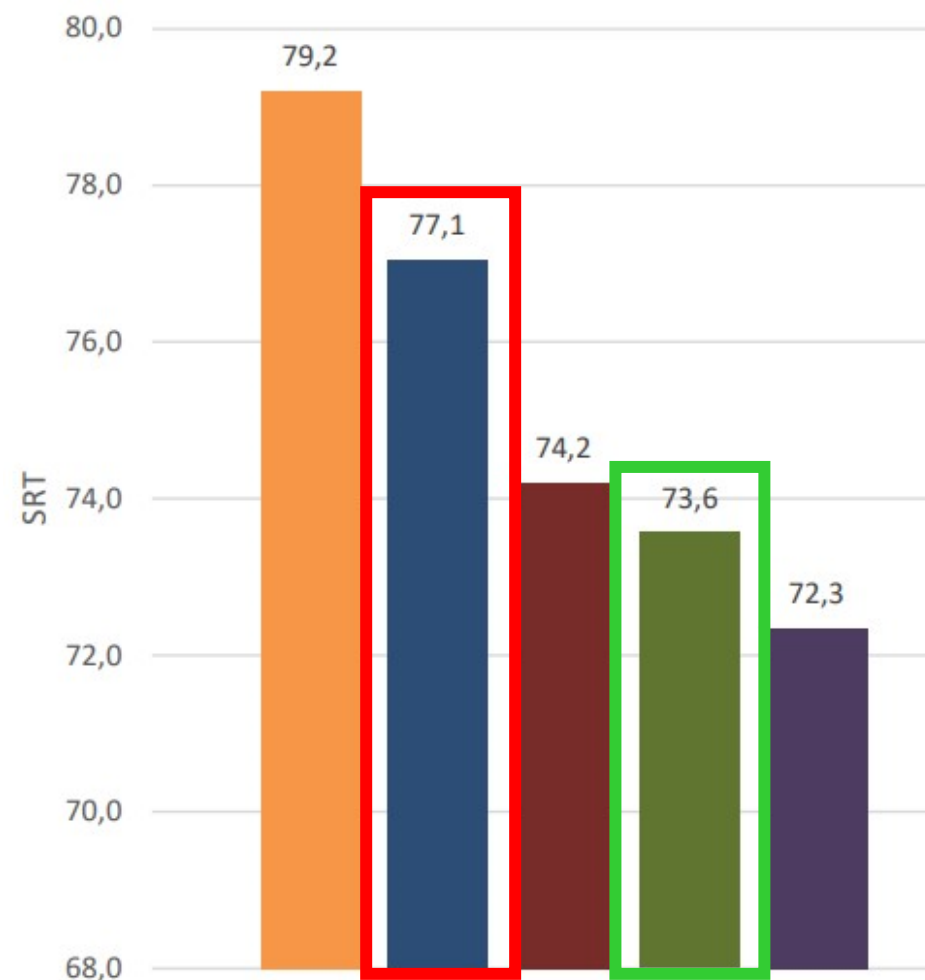
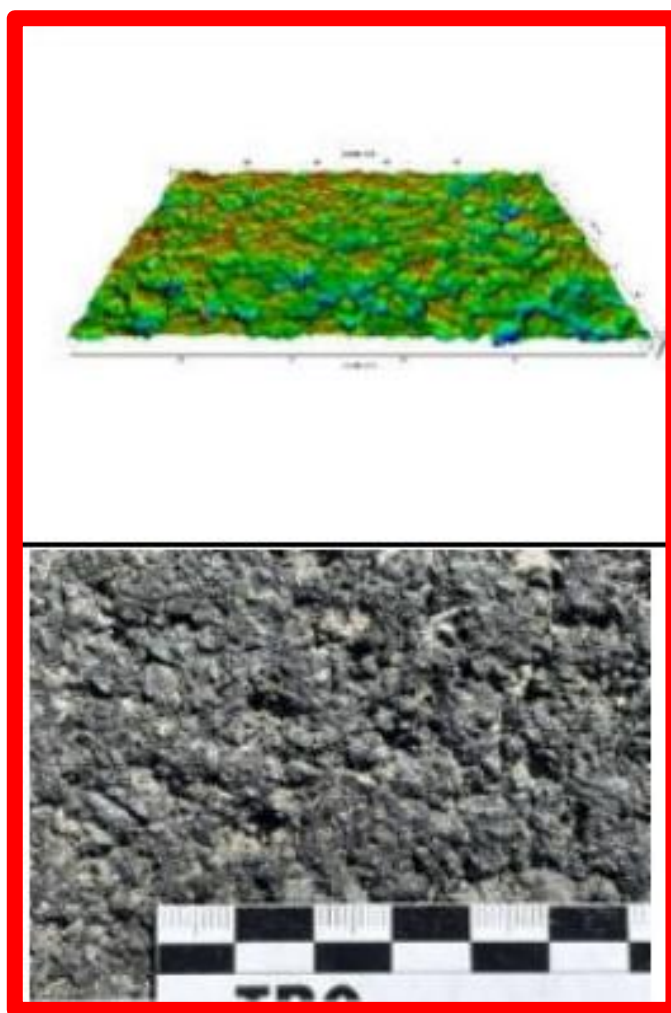
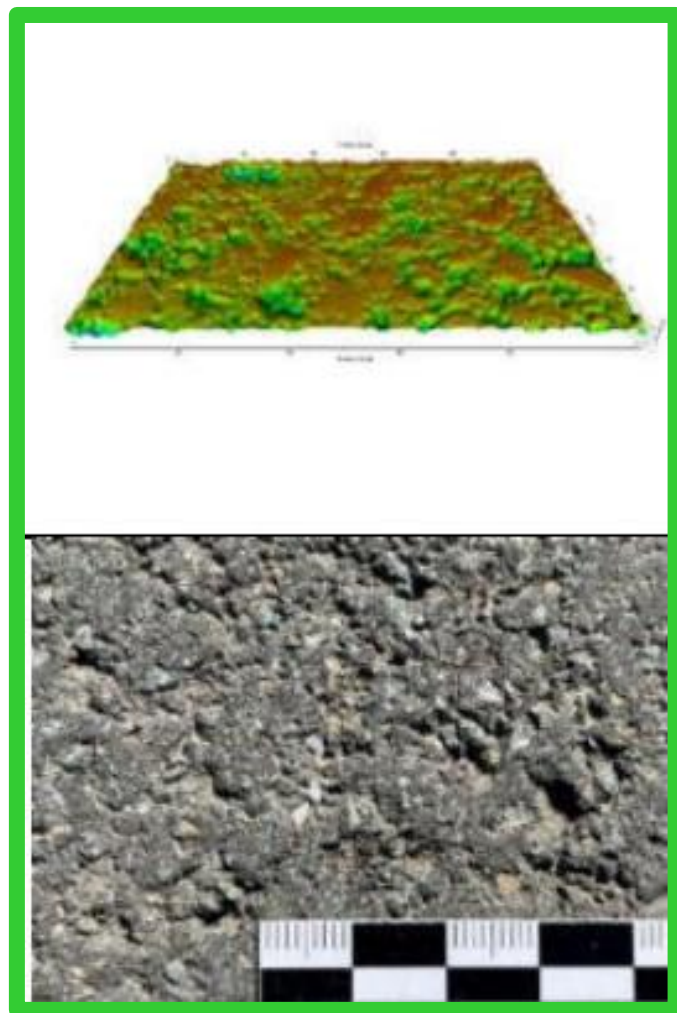


light blasting

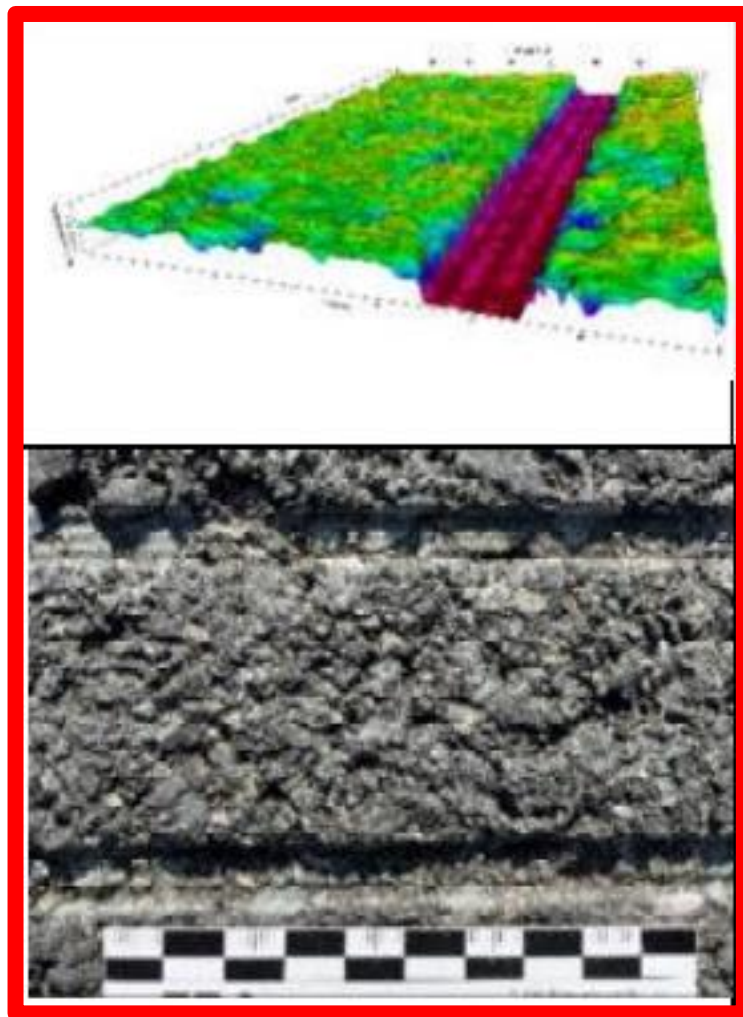
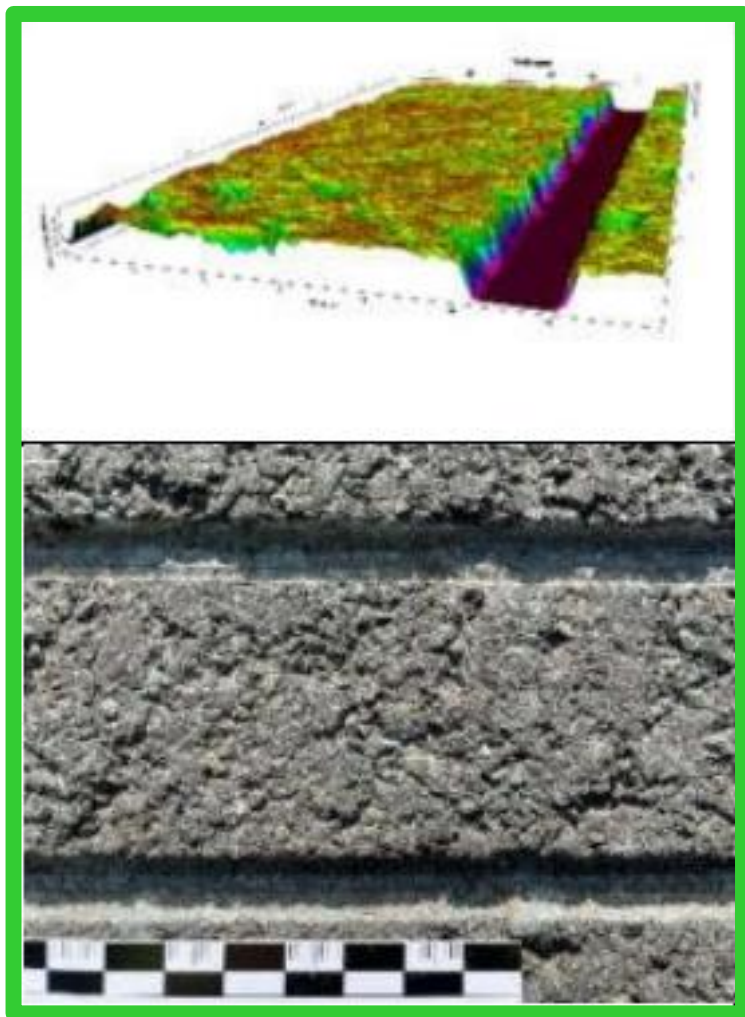


strong blasting

Solution - Water blasting with only very minor texture changes – rubber removal



Solution - Water blasting with only very minor texture changes – rubber removal



Why are you allowing your asphalt to be destroyed and paying for it?



In summary, it can be said that knowledge of the perfect asphalt production, paving and maintenance for race tracks and proving grounds can also be applied to runways and airports.

It is expected that this will enable construction sites to be carried out more efficiently and extend the service life, which can save a lot of money in the long term.

Thank You For Your Attention

And if you would like to talk about sustainable and economical asphalt concepts, you can find me at

GATE booth B5-1360, B5-1158

- **Contact information**

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