

And that's how you benefit from ...



# BANANAS DO IT BETTER!

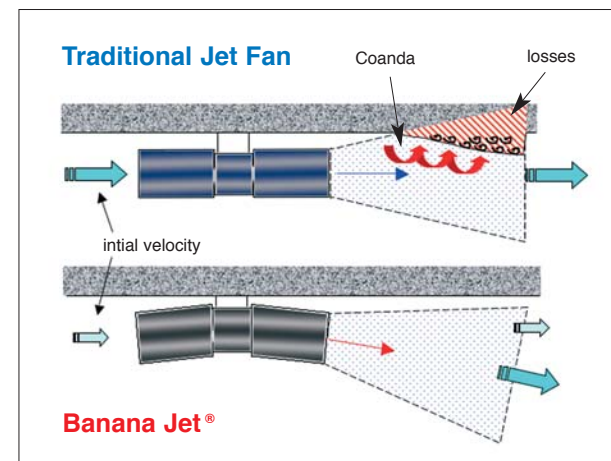
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## As simple as it is effective – simply better:

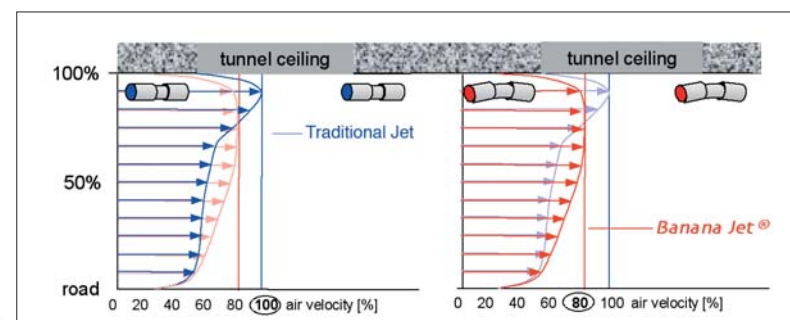
The Banana Jet® achieves a significantly increased air velocity in the tunnel with the same nominal thrust and motor power due to:

- ~ Reduction of the impulse losses at the walls and ceiling
- ~ Reduction of the background velocity (initial velocity) at the air inlet.
- ~ Reduction of the friction losses due to decreased Coanda Effect.

With similar installation height the Banana Jet® transfers the thrust to the tunnel more effectively.



## It's the flow that counts:



The Banana Jet® improves the flow and the air velocity profile in the tunnel by its unique design. It distributes the flow more uniformly by focusing the impulse towards the middle of the tunnel and reduces the losses in critical friction areas.

## Particularly for critical areas:

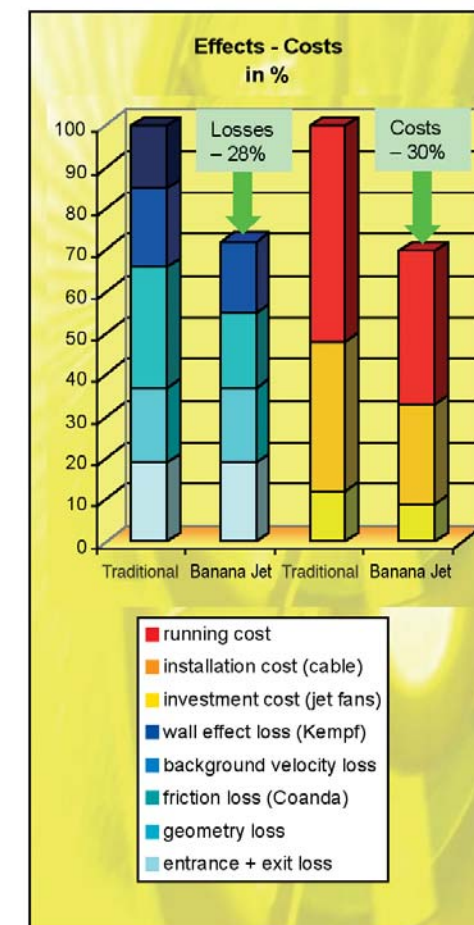
	$\approx 1 - \frac{1}{K}$	$\approx 1 - \left(\frac{1}{K}\right)^2$	$\approx 1 - \left(\frac{1}{K}\right)^3$
Losses acc. to Kempf*	- 5 - 15%	- 10 - 25%	- 15 - 35%
Banana Jet®-Effect**	+ 20 - 30%	+ 25 - 40%	+ 30 - 50%

\* Only impulse losses acc. to Kempf, Schweizer Bauzeitung, Jan. 1968  
\*\* In combination with friction loss and reduced background velocity acc. to a W&S analysis and CFD simulation

The Banana Jet® shows its strengths especially in cases of installation in the corners of the tunnel ceiling or in niches. This is where the Banana Jet's® advantages are most evident.

## More efficiency means more savings !

Savings via a Banana Jet® compared to a traditional jet fan:



Source: Witt & Sohn, analysis: Project Kirchenwald-Tunnel data base: 0.1 kW/hour, 1.000 hours/year, EUR 2.000 installation cost per fan.

## The specific outcome of this is:

1. Reduction of the required number of jet fans and the total energy consumption
2. Reduction of the jet fan size, power and energy consumption while maintaining the same number of fans.

## Benefits:

1. Reduced investment costs by reduced number of fans
2. Reduced installation and cabling costs
3. Reduced maintenance costs
4. Lower sound levels
5. Lower overall power consumption
6. Improved environmental record (e.g. CO<sub>2</sub>)

Higher profits for all parties!



## Reduction in size:

The size of the Banana Jet® can be adjusted to project specific requirements.



# BREATH DEEPLY - GUARANTEED!

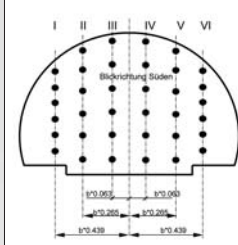
Numerous tests have been performed in various conditions to be sure:

*We keep our promises ...*

and we can prove it!

The Banana Jet® creates a more intelligent distribution of the air flow in the tunnel. Comparative measurements have been executed in real tunnels and show the impressive effects!

Beratende Ingenieure		Beratende Ingenieure	
<b>Tunnel:</b> Uznaberg West		<b>Tunnel:</b> Uznaberg West	
<b>Betrieb:</b> Hauptbauschichtung (A→B)		<b>Betrieb:</b> Hauptbauschichtung (A→B)	
<b>Datum:</b> 04.09.2003		<b>Datum:</b> 18.09.2003	
<b>Querschnitt:</b> LW1 (120m)		<b>Querschnitt:</b> LW4 (20 m)	
<b>Richtung:</b> N→S		<b>Richtung:</b> N→S	
<b>Zeit Anfang/Ende:</b>	02:37 02:56	<b>Zeit Anfang/Ende:</b>	22:07 22:22
<b>Temp. t<sub>a</sub>/t<sub>b</sub> [°C]</b>	14,5 14,5	<b>Temp. t<sub>a</sub>/t<sub>b</sub> [°C]</b>	15,7 15,7
<b>p<sub>Umgeb</sub> A/E [mbar]</b>	977 977	<b>p<sub>Umgeb</sub> A/E [mbar]</b>	977 977
<b>Grundstr. A/E [m/s]</b>	2,17 1,72	<b>Grundstr. A/E [m/s]</b>	1,38 1,59
<b>max. Breite b [m]</b>	10,12	<b>max. Breite b [m]</b>	10,12
<b>Breite am Boden [m]</b>	9,88	<b>Breite am Boden [m]</b>	9,88
<b>Mitte am Boden [m]</b>	4,93	<b>Mitte am Boden [m]</b>	4,93



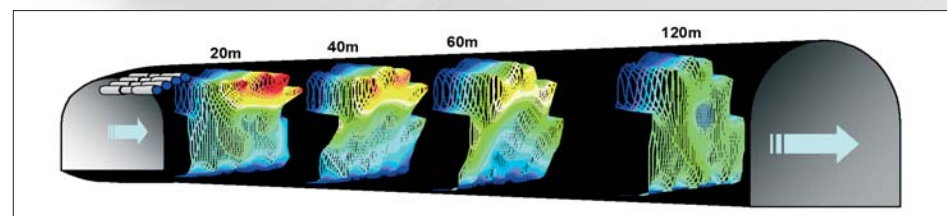
Renowned test institutes have determined the effective values and confirmed our results!



To compare the Banana Jet® with a traditional jet fan, the Banana Jet® was modified with adapters to straighten out the flow. Air flow grid measurements according to the "Log-Tchebycheff-Method" have shown the clear superiority of the Banana Jet® principle!



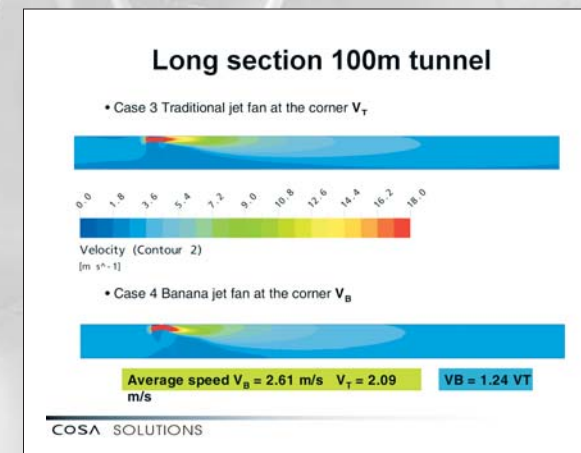
Air flow measurements in the tunnel have been conducted by external engineering companies and demonstrate the high efficiency of the Banana Jet®.



**Air flow profile traditional jet fan:** Air velocity peaks on the tunnel ceiling, even after 120m low velocity in the middle of the tunnel cross section.

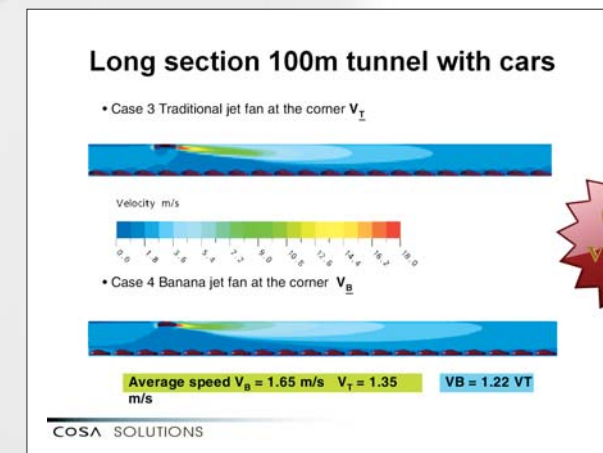
The results have been verified with CFD simulations by independent specialists:

Compared to traditional jet fans the Banana Jet® increases the average air velocity in the tunnel with the same motor power and directs the impulse away from off the friction areas (walls and ceiling). This means: higher air velocity with lower friction loss!



Source: COSA SOLUTIONS

**Thrust + 53%**

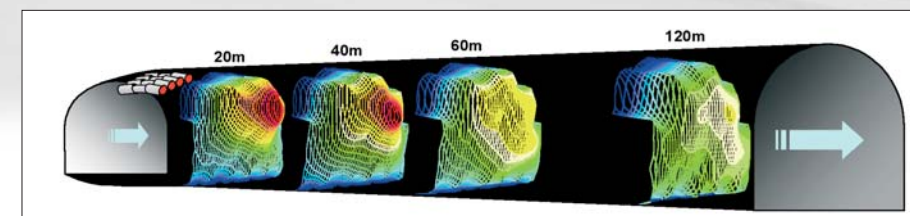
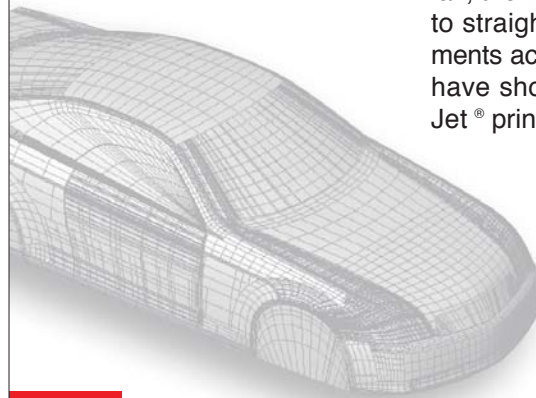


Source: COSA SOLUTIONS

**Thrust + 48%**

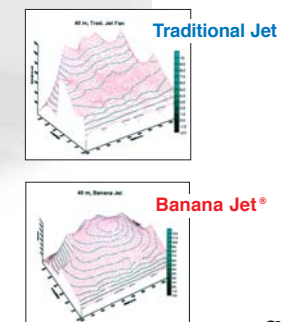


An established and independent engineering bureau calculated CFD simulations comparing the fluid mechanics of the Banana Jet® and a comparable traditional jet fan. Different scenarios in the tunnel have been considered.



**Air flow profile Banana Jet®:** High air velocities in the upper half of the tunnel, also 120m behind the Banana Jet®.

Source: Witt & Sohn



q.e.d.!