The Effects of Inertia

Light-weight wheels are without a doubt the best performance product you can purchase for your motorcycle.

Instant performance is gained in all major areas - it's something the rider feels immediately – it's instant gratification.

When comparing wheels and weights, it is not always the overall weight that matters, but rather the weight distribution in each particular wheel which affects the performance of the wheel. A lighter **rim** = better performance. Carbon wheels generally have much lighter rims and carry the bulk of their weight in the hub – and the hub has little effect on the performance of the wheel. Often, unfair comparisons are made between wheels which are completely different e.g. a forged magnesium race wheel versus carbon road wheel, which is designed for road use. Interestingly, even if they did weigh the same, the carbon wheel will still have better performance – remember the lighter rim. In most cases the carbon road wheel is still lighter than a forged race wheel: the carbon part of a BST road front wheel weighs only + 1.450 kg. Of that, the outer rim is only + 1.100kg. The completed wheel weighs between 2.2 kg and 2.4 kg (depending on the motorcycle). Therefore you have a wheel with an incredibly light rim and the weight of the hub at the centre, which gives you a truly high performance wheel.

To get a proper picture, compare apples with apples: i.e. compare a **16.5"**carbon race wheel to a **16.5"** magnesium race wheel . The size of the wheel makes a fundamental difference as the distance from the rim to the hub affects the performance (more on this later), and of course more material is used to produce the bigger wheel, thus increasing its weight.

In recent tests, BST carbon Race wheels were compared to team supplied GP wheels (wheels were the same size and for the same motorcycle): *Carbon race front wheel was 15% lighter but had a **25%** better inertia figures. Carbon race rear wheel was 10% lighter but had **33%** better inertia figures. Reducing the weight of your wheels is the most effective and therefore most important performance change you can make to your motorcycle.*

But weight is NOT the only consideration, and this is where BST Carbon wheels excel:

Lighter wheels will make a major difference to the handling of your bike. They will also improve your acceleration and deceleration (braking) of your bike.

Why is this the case?

Let's have a look at some basic calculations: Any object that has a mass and that moves at a velocity has a certain energy, which is
coming directly from your motor. If you move a wheel at a certain speed (no rotation of the wheel) the energy can be calculated using the following formula:

$$E = \frac{1}{2} m v^2$$

m being the mass and **v** being the velocity at which the wheel moves. Once the wheel turns, the total energy is made up from two components, namely the **translational** (moving) part and the **rotational** (turning) part. The new formula looks like this:

$$E = \frac{1}{2} m v^2 + \frac{1}{2} J w^2$$

J being the Rotational Inertia and ***w*** being the Rotations per second. The rotational Inertia is made up of the mass of the object and the distance it is away from the rotating axis. Remember the flywheel effect: the further the mass is away from the axis, the more energy it takes to accelerate or brake it. If the mass is twice the distance away from the axis, it will require 4 times as much energy (or engine power) to
accelerate and brake.

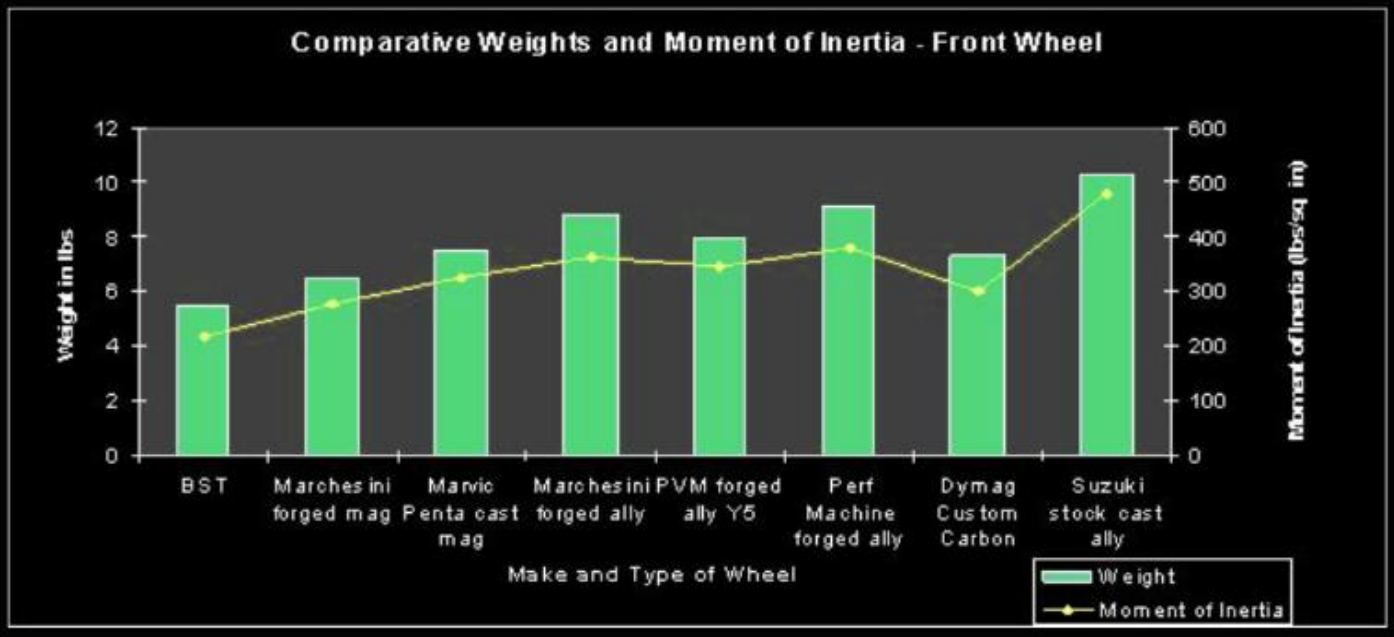
Example:

0.1 kg (or approx 1 N) which is 20 mm away from the axis will have a Rotational moment of Inertia of 40.
If you have the same weight 40 mm away from the axis the Moment of Inertia will be 160 (factor of 4).

So how does this exercise look when applied to wheels?

The weight of the wheels is not the only consideration: **what is much more important is the Rotational Inertia of the wheels,** namely how much weight is close to the axle and how much weight is further away from the axle.

The following graphs will show the difference between some wheel weights and Inertia Values:



Graphs show all wheel weights as a % of the standard aluminium wheels on a Suzuki GSXR1000.
Graphs based on actual measurements of wheels for Suzuki GSXR1000, weights may change depending on model.
Weights and MoI measurements done by Sport Rider and published in their February 2004 edition.

How does this affect your performance?

The energy needed to turn these wheels obviously comes from the engine. If you need less energy or power to turn your wheels, the available power accelerates the wheel quicker and you will end up with a higher maximum speed. But how much power can be saved by using Carbon wheels?

	Total weight	Front 3.5" x 17"	Rear 6" x 17"
Std set cast Aluminium wheels	10 kg	3.5kg	6.5kg
BST Carbon Race wheels	5kg	2.1kg	2.9kg
Weight saving	5kg or 100%		
Inertia saving:	**140%**		
Power saving to accelerate wheels from 0 to 200 km in 10 seconds:	3KW or 5hp		
Increase in top speed	4-7 km/h		
Decrease in lap time (depending on circuit)	**1.3 seconds**		

Handling and Gyroscopic effects

How do wheels affect your handling?
The lighter the wheels, the less your un-sprung mass. This means that your suspension has to work less to dampen the wheels. This will result in less energy and less power being consumed from the engine.

It is more difficult to move or steer a rotating mass than a is stationary mass (try to move a spinning bicycle wheel). If you **reduce the mass and specifically the rotating inertia**, the force required to move or steer the mass is reduced significantly. Putting lighter wheels on your bike will reduce the steering forces significantly and therefore has a positive influence on driver fatigue. Try to workout in a gym with half the weight and
see how much longer you can last.

Summary:

BST Carbon wheels will give you significant performance improvement, and better and quicker (crisper) handling at lower steering forces which will result in less driver fatigue.

No other performance enhancing product will give you the same benefit/price ratio.

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