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Suspension Kinematics and Geometry and how it is used in Drifting

Academic and Laboratory Skills

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2 Introduction

In this investigation, the report will be examining the base principals of suspension kinematics and suspension geometry. The report will be looking at parameters such as, Camber, Spring stiffness, spring height, caster, toe etc... The report will explore how these Variables are set up, utilized and how they are Optimised Specifically in Competitive Drifting where, contrary to common belief, the drift cars are set up to have as much mechanical grip as possible, whilst maintaining oversteer in a controlled and predictable manner, at high angles and speed.

Suspension kinematics and Geometry themselves, play a role of upmost importance in determining how a vehicle behaves in different dynamic conditions, affecting handling characteristics, tyre contact, and stability. In drifting, the suspension setup is an absolute key factor in making sure the car can produce controlled oversteer, at high speeds and at large amounts of angle.

The report will look at real drift car setups, looking at what aspects of the setup are essential, what parts of the setup are differentiating between different drivers' preferences around how they want the car to react to their own inputs, and how the cars react differently in relation to the surface of the tarmac.

3 Background research.

The research conducted shows that the suspension setups on drift cars in the modern age, are actually very different to what people believe. One of the most common misconceptions about how drift cars are setup, is the spring rates of the vehicle. According to SuspensionSecrets (Drift car setup), “Drift cars are often known as really low, extremely stiff cars on cheap coil overs”. The misconception came from most people knowing drift cars as they were in Japan during the 70s-90s, where according to “TheKickerBlog” (2024) drift cars originated from Japanese street racers, drifting around the mountainous terrains. The drift cars were also modified more to look good, rather than prioritising upmost performance, for instance, Redbull.com states that the cars ride height was so low they were “scraping across the ground” and that drifting was “about style” and “looking good”. This was called “gusheshe” and was where drifting got its popularity. This is where drift cars start to develop their extreme setups that they are known for. For example, lowering these cars meant the suspension had to be stiffer, to stop the cars from hitting the surface of the road too much. The Stiffer suspension makes a car more responsive and minimizes body roll, allowing for the “predictability” that the drivers would have wanted during those times.

4 Main research and discussion

4.1 Spring stiffness and ARB.

The setups in modern drifting are different, SuspensionSecrets(Drift car setup) stated that “Atypical set up in drifting uses 10 to 12kg springs at the front wheels and 8 to 10kg springs at the rear wheels”. They state that these softer setups “allow the tires to grip” and to “absorb bumps in the circuit effectively”. Supashock.com (Drift suspension setup) states that the stiffer front springs help reduce body roll as well as sharpening the response of the vehicle.

Contrary to “helping reduce body roll” Suspensionsecrets tells us due to the fact that the cars are constantly counter steering around the track, the front ARB can be removed to help improve weight transfer and produce “more grip at the front wheels” to “allow the rear end to pivot around the front” helping with predictability in transitions.

Suspensionsecrets also states that the rear ARB can either be kept in or removed completely. This is dependent on how powerful the car is and “how much grip is

wanted”, which in higher power “modern” drift cars, as much grip as possible is often required.

4.2 Camber and Toe

Camber settings on drift cars vary drastically to those on other motorsport vehicles, most drift cars are set up with high levels of negative camber on the front wheels, often ranging between 4-7 degrees. The amount of camber depends on how quickly the vehicle gains camber on lock this varies depending on what components are used. The high amount of negative camber is a result of drift cars needing the leading wheel to have maximum contact to the circuit at $\frac{3}{4}$ steering lock. Due to the wheel losing negative camber as the steering angle increases, high levels of negative camber when the car is being set up combat this by allowing the wheel to have as much traction in the front wheels as possible during counter steer (SuspensionSecrets (drift car setup)).

Toe alignment is crucial in drifting, toe alignment on the front is either neutral or, more commonly. Toe out is used. Toe out causes the wheels to point away from the car, this helps get the car to turn in faster and creates a more responsive steering feel. Lots of drivers run toe out on the front wheels, as it helps with initiation (the act of entering a drift) and helps to maintain control of the angle of the car one drifting (slrspeed.com, mastering toe alignment).

Toe alignment on the rear wheels, is often set to toe in, this is where the wheels would be slightly pointing inwards towards the body of the car. Drift cars set toe in at the rear depending on how much grip the driver wants, the more toe in, the more grip when the vehicle is on power. Drivers won't ever run more than 12mm toe in as after this point mechanical damage of components starts to regularly occur.

4.3 Ackerman

Research shows that Ackermann angle is a grey area in drifting. Even though Ackermann angle is one of the most important aspects of steering, drift cars often have very different levels of Ackermann. Ackermann angle is effectively the difference in the steering angle between both front wheels. A difference in the steering angle between the wheels is needed, as the wheels are turning in circles of a different radius between the inner and outer wheel in relation to the turn centre. On normal road cars, positive Ackermann steering is used, with the inside wheel having slightly more angle at any one point than the outer, allowing the car to corner without scrubbing as much.

Geometrically speaking, reverse Ackermann would be needed in a drift car, as the wheels are counter steering, however reverse Ackermann is used very rarely in drifting, with drivers disliking the difficulty needed to steer at high steering angles and often run positive Ackermann. Some drivers prefer to run a neutral setup to not sacrifice speed or

lock unlike positive Ackermann (Wisefab.com, Everything you need to know about Ackermann).

Figure 1 demonstrates the differences between positive, neutral and reverse Ackermann.

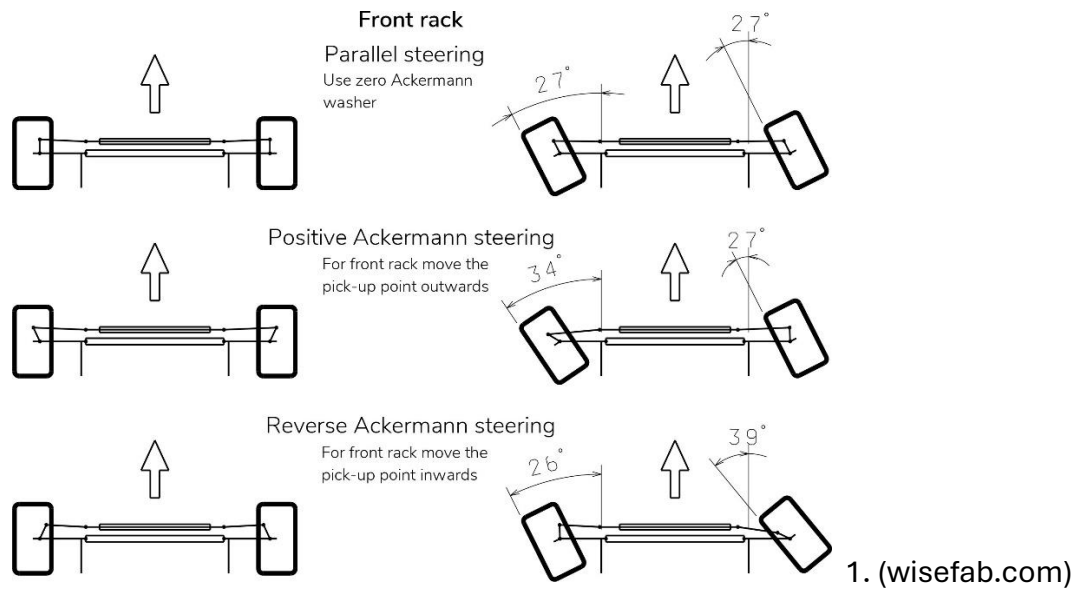
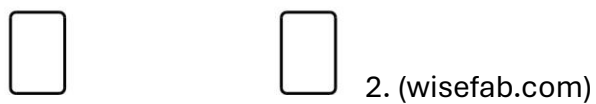
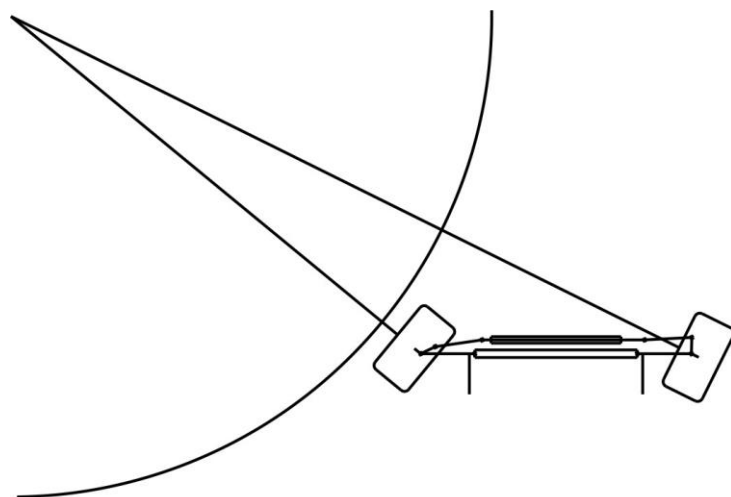


Figure 2 demonstrates reverse Ackermann around a turning point.



5 Conclusions.

The research shows that suspension is of utmost importance in the setup of a professional drift car. The research showed that there was a slight element of driver preference when setting the cars up, for instance in the Ackermann angle. The results still confirm that the cars suspension geometry is in fact set up to have more grip than expected. The results showed that drivers tune their suspension to promote as much response through the vehicles steering as possible and showed that the cars are statically set up at such extremes to prepare for the kinematic movement of the vehicle's suspension once in applied oversteer. The report also demonstrates that drift cars are setup very differently to your average road car, with the extreme Toe angles, excessive camber, and the very stiff spring rates, confirming that suspension kinematics and geometry are absolutely essential. in setting up a drift car

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