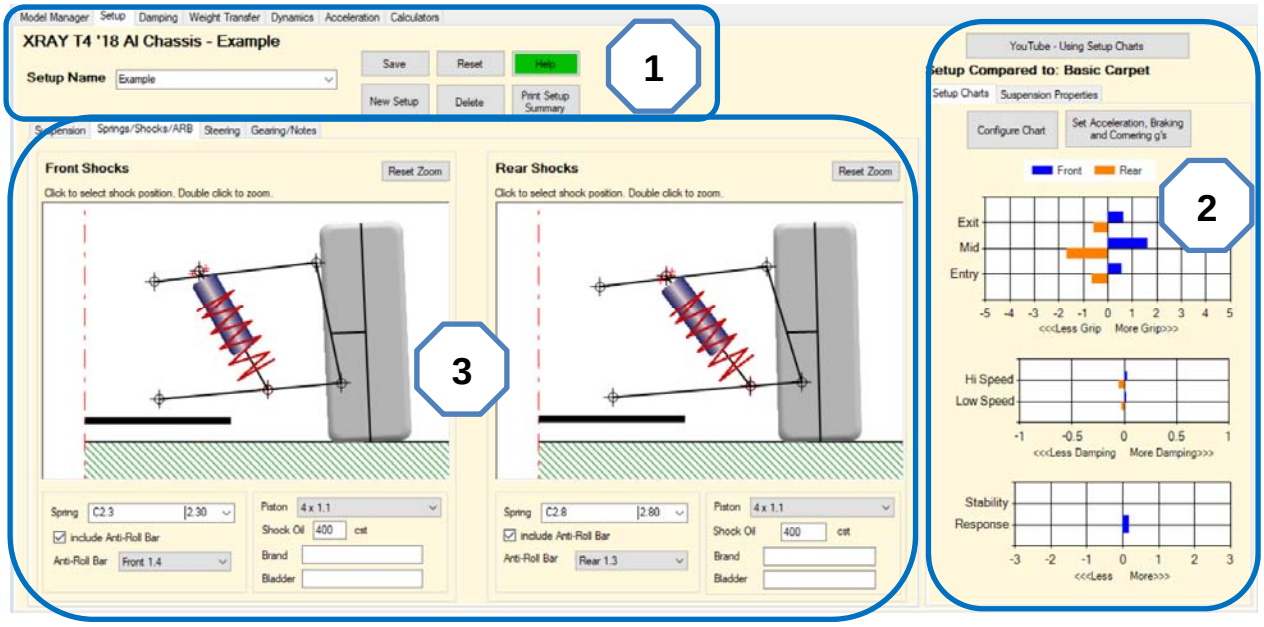
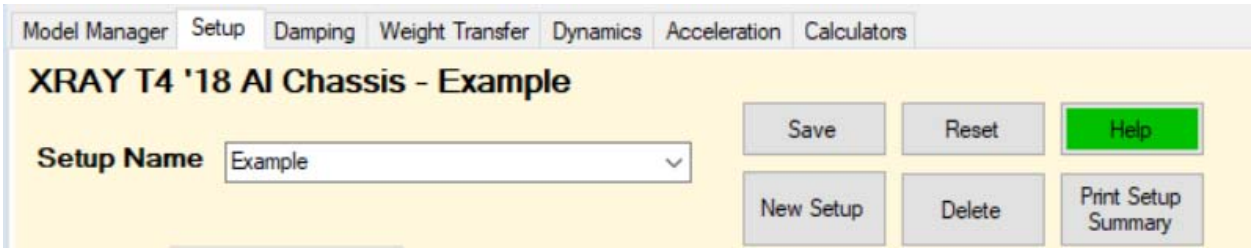
Setup Tab

The **Setup** tab provides a simple graphical interface to implement changes suspension and shock positions, Spring/Anti-Roll Bar (ARB) rates, Steering, Gearing and General Notes. As you make setup changes the effects are displayed in the Suspension Properties box.



Area 1

The Car model and Setup name is displayed in the top left so you always know which car and setup you are working with.



Save – Click to save changes made to the current model. If you try to leave the setup tab and have made changes without saving you will be alerted and given the chance to save changes before leaving. If you do not save changes they will be lost.

New Setup – Click to create a new setup. Enter a name in the box and click **Save**. A suggested convention for naming setups is to use the track or race name and date. This is very helpful to quickly identify setups.

Reset – Resets any changes made back to the last save point for the current setup.

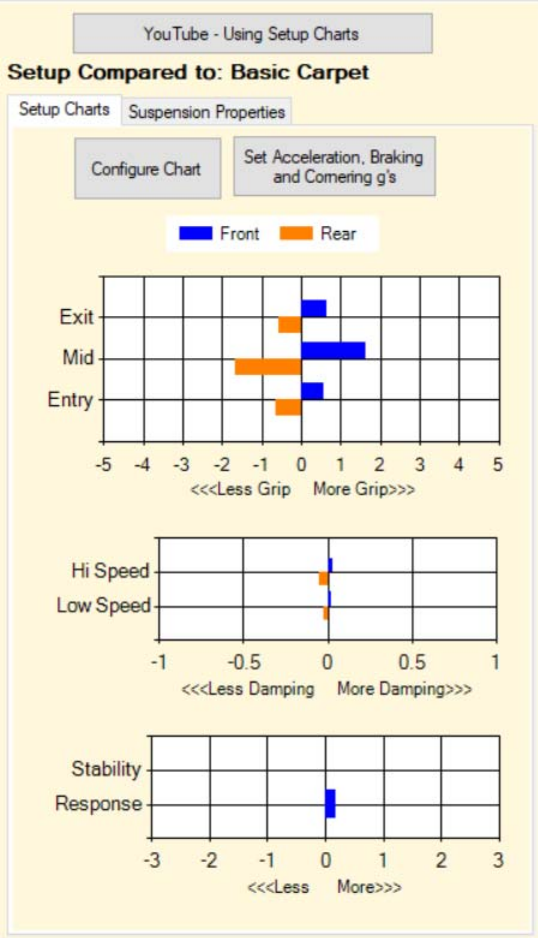
Delete – Just like it says. Delete the currently selected setup file. Once the setup is deleted it cannot be undone.

Help – You made it here so figured that one out.

Print Setup Summary – Click to display and print a convenient one page copy of the current setup.

Area 2

Clicking the button at the top of this section will take you to youtube to view a short demo video on the new Setup Charts feature. The fastest way to get up to speed on this new feature.



What this means there are now two methods available to display the effects of setup changes, **Setup Charts** and **Suspension Properties**.

Setup Charts are split into three bar graph charts. These charts quantitatively illustrate how large or small the setup changes are “Relative” to the setup name displayed after “Setup Compared to:” If the name is **Current Setup** then the bar graphs are relative to the current setup. A word of caution here since if you click **Save** after making changes to the Current Setup it will be overwritten potentially losing a good setup. For this reason it is better to use **New Setup** as this will make copy of the current setup allowing changes to be made and saved without affecting the original.

If you wish to use one of the other setups on your list for comparison click the “**Configure Chart”** button. More on this is described below.

From top to bottom the graphs display the effect

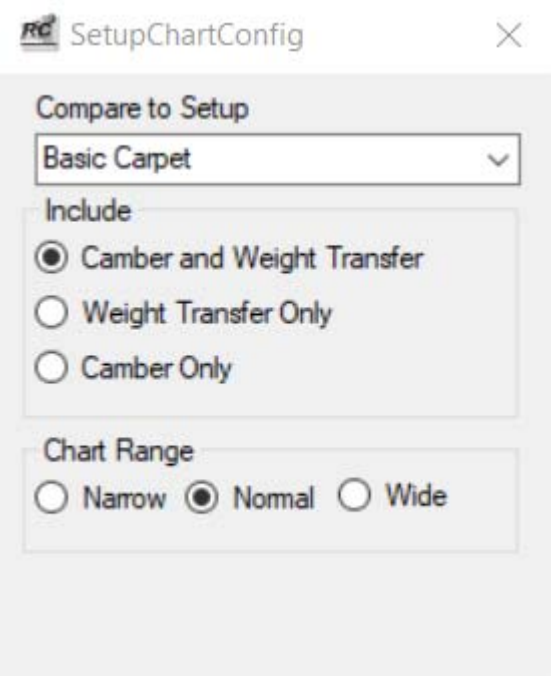
of changes on Front/Rear Grip, Damping and Response/Stability.

Grip changes are split into three corner phases, entry, mid and exit. Front effects are displayed in blue and orange for the rear.

Damping is divided into low and high speed damping. Speed refers to the shock/damper piston velocity where low speed represents response in the handling range and high speed is for bumps and jumps. Blue bar for front and orange bar for rear.

The charts also quantify the magnitude of the change you are making. Some changes will show a small affect others larger. The cumulative effect of multiple changes is also displayed.

If you are happy with the changes click save. Clicking save will reset all graphs and displays. To recover the graphs and resume where you left off click on the “Configure Charts” button and then select the setup you started with or any other setup in the list and the displayed charts and suspension properties will be compared to that setup. Note that the “Setup Compared to:” now displays the name of the setup you selected.



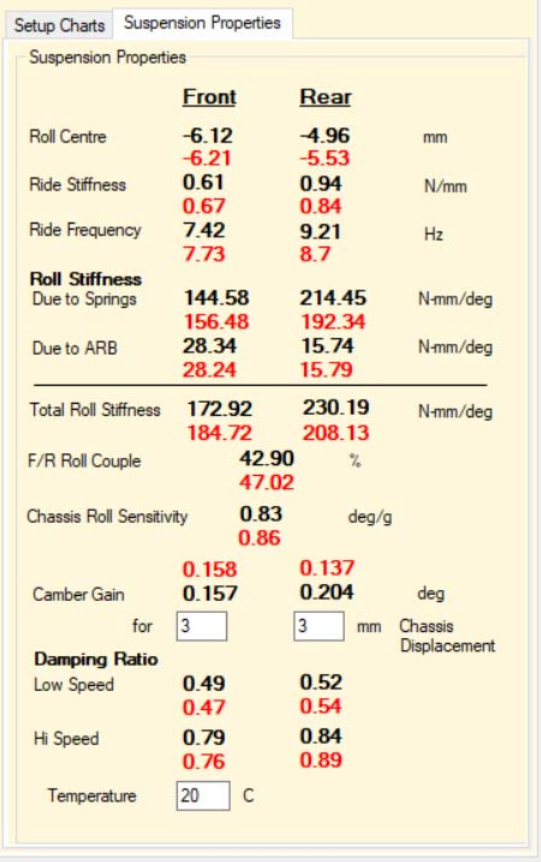
The charts can also be setup to look at look at camber and weight transfer effects separately or in combination. Select the effect you wish to view and the charts will update.

You can also change the scale of the charts if you want to narrow or widen the range.

Lastly you can change the Acceleration and braking g’s used in the weight transfer calculations. The settings here will be the same as the values used on the Weight Transfer Page.

Note that not all setup changes are currently represented in the charts. Any changes that display in the Suspension properties are considered, plus Caster and Kick up on the Steering tab. Droop and Steering Ackermann effects are not currently included.

The other option to view the effect of suspension setup changes is to look at the **Suspension Properties** tab. Not everyone likes numbers but these are important to understanding the handling of your car. When you change a setting the values displayed will update to reflect the change. The current setting value will be displayed in Black and the original or the **Compare Setup to:** value will be displayed in Red.



For example if you change a link position the Camber Gain, Roll Centre position and Chassis Roll Sensitivity will change.

Changing the shock position will affect the Ride Stiffness, Roll stiffness, Ride Frequency, F/R Roll Couple and Chassis Roll Sensitivity.

Adding or changing an Anti-Roll Bar (ARB) will change Roll stiffness, F/R Roll Couple and Chassis Roll Sensitivity.

Having a sound understanding of these numbers and how you can manipulate them is a big step towards understanding chassis setup.

Note that as you change link positions, shock positions and entered values the current setup suspension property values affected by the change will be displayed in red until the setup is saved or changed.

The Suspension Property terms are:

Roll Centre – The roll centre is an imaginary point in space that is a function of the geometry of the suspension arms. The static roll centre position is shown on the suspension graphics. The term static means the roll centre value and position shown is for the chassis at ride height with no roll. As the chassis rolls the roll centre position will change.

The location of the roll centre establishes the magnitude of the rolling moment which must be resisted by the springs and ARB's it is also the instantaneous point about which the sprung mass rotates. The lower the roll centre is the larger the rolling moment. The higher the smaller. A good way to think of the effect of roll centre position is a higher roll centre results in a stiffer chassis in roll, much like adding a stiffer ARB.

Ride Stiffness – The ride stiffness is the suspension stiffness due to vertical motion. If you push down on the front or rear suspension this is what you feel. A soft ride rate means the car can easily absorb bumps but may bottom out. To stiff and the car will lose contact with the ground over bumps.

Ride Frequency – Also called bounce frequency. This is the natural frequency at which the suspension will oscillate. It is calculated separately for the front and rear as normally you want the rear frequency slightly higher than the front to ensure that bump induced oscillations die out quickly. If the front frequency is higher than the rear the chassis can go into pitch oscillations after a bump. On bumpy tracks this value can be very important.

Roll Stiffness – Roll Stiffness is similar to ride stiffness except in roll. The higher the value the less chassis roll will be experienced in the turns. Also a higher roll stiffness will mean the car will be more responsive.

Separate values are provided for the contribution of the springs and the ARB to the roll stiffness. Note that the ARB only contributes to roll stiffness, it does not affect the ride stiffness.

F/R Roll Couple - The ratio of Front-Rear roll stiffness is represented by this value. A value of 50% equates to a balanced Front-Rear roll stiffness. Values greater than 50% mean the front roll stiffness is greater than the rear. Values less than 50% mean the rear is stiffer than the front. These values are very important. For example a perfectly balanced 4 wheel drive sedan (CG at the centre of car) with F/R Roll Couple of 50% will have neutral handing with neutral throttle (no over or under steer). For a handling tendency towards under steer (push) a setup with the F/R Roll Couple greater than 50% (front roll stiffness higher than the rear) will induce this. This is an oversimplified example as there are many other factors that affect the under/over steer (push/loose) tendency. However the F/R Roll Couple is very high on the importance list.

Chassis Roll Sensitivity- This term is derived by equating the resisting mechanical roll stiffness (springs and ARB's) to the roll moment induced by the Sprung Mass CG height times the distance to the roll centre. The resultant value is displayed as degrees of chassis roll per lateral g of acceleration. This value is an indication of the overall responsiveness of the car. The lower the value the more responsive the chassis is in roll. Be aware though that while a low value will make the car more responsive it will also make it harder to drive as the car may become twitchy.

Camber Gain – Is the amount the tire camber angle changes as the chassis is displaced downward. A positive value means the tire will lean more inward increasing the negative camber. A negative value means the tire camber angle will reduce. Normally you will run a positive value. The reason being that as the chassis rolls the camber angle of the outside tire will reduce. Using positive camber gain will reduce the amount of change in the camber angle since by

adding camber as the chassis rolls. The amount of camber gain is primarily a function of the length and angle of the upper suspension link relative to the lower arm. More downward angle on this link will provide greater camber gain. Also a shorter link will have more camber gain than a longer one. So a long camber link parallel to the lower arm will have the least camber gain.

The amount of chassis displacement used to calculate the camber gain can be adjusted to suit the vehicle. The value selected should be less than ride height.

The goal when selecting camber gain is to maintain as much of the tire footprint in contact with the racing surface as possible though out all conditions. Monitor your tire wear and adjust either the static camber or upper suspension link to change the camber gain and maintain uniform tire wear.

The Dynamic page simulation discussed later will be very useful tool to help optimize static camber and camber gain.

It is worth noting here that the angle of the upper suspension link also affects the position of the roll centre.

Damping Ratio

Damping Ratio is the ratio of the actual shock damping coefficient to what is called the critical damping coefficient. Critical Damping Coefficient is a function of the unsprung mass and the spring rate calculated at the wheel. The equation is:

$$C_{crit} = 2\sqrt{m_{us} k_w}$$

$$Where$$

$$m_{us} = unsprung\ mass\ on\ one\ wheel$$

$$k_w = effective\ spring\ rate\ at\ wheel$$

The Damping Coefficient (C) for the system is a function of the shock piston geometry, oil viscosity, temperature, friction, wheel to shock motion ratio, and piston velocity. The program calculates the system damping coefficient based on the user entered variables.

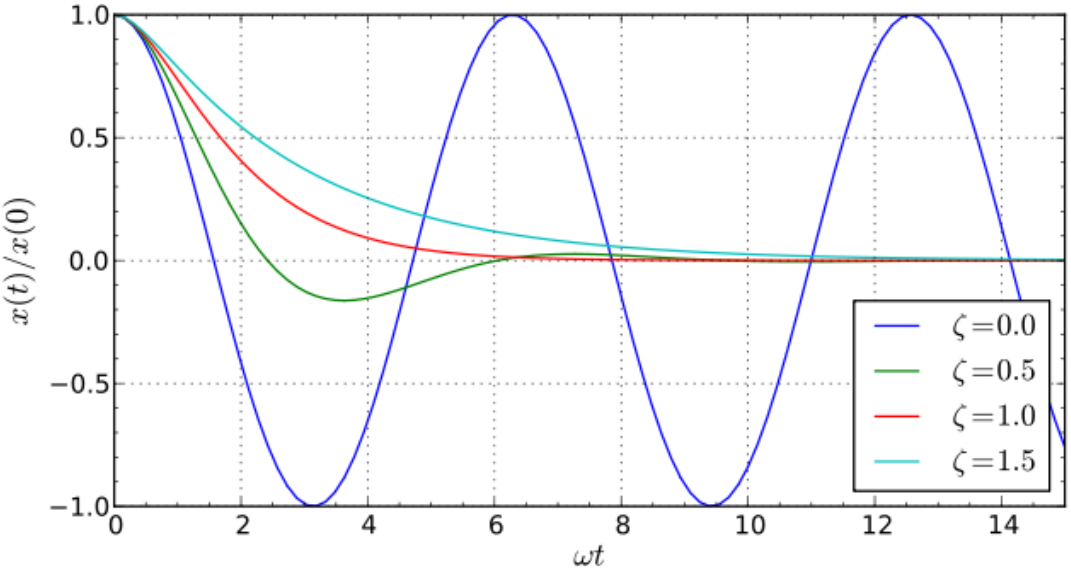
The Damping Ratio (zeta or ζ) is then:

$$\zeta = C / C_{crit}$$

The Step Response test is a standard test that provides valuable insights into the level of damping in the system. Response can be zero damped, underdamped, critically damped or overdamped. Damping Ratio (zeta or ζ) is an indicator of how light/heavy the damping is for the current shock oil/piston combination. There are four terms generally used to describe the level of Damping:

Zero Damped ζ =0 System will oscillate indefinitely (impossible in real world conditions)
Under Damped ζ < 1, System responds with decaying oscillations
Critically Damped ζ = 1, System responds with no oscillations.
Over Damped ζ >1 System responds slowly without oscillating.

The graph below represents the system response to a step input for the four different damping levels.

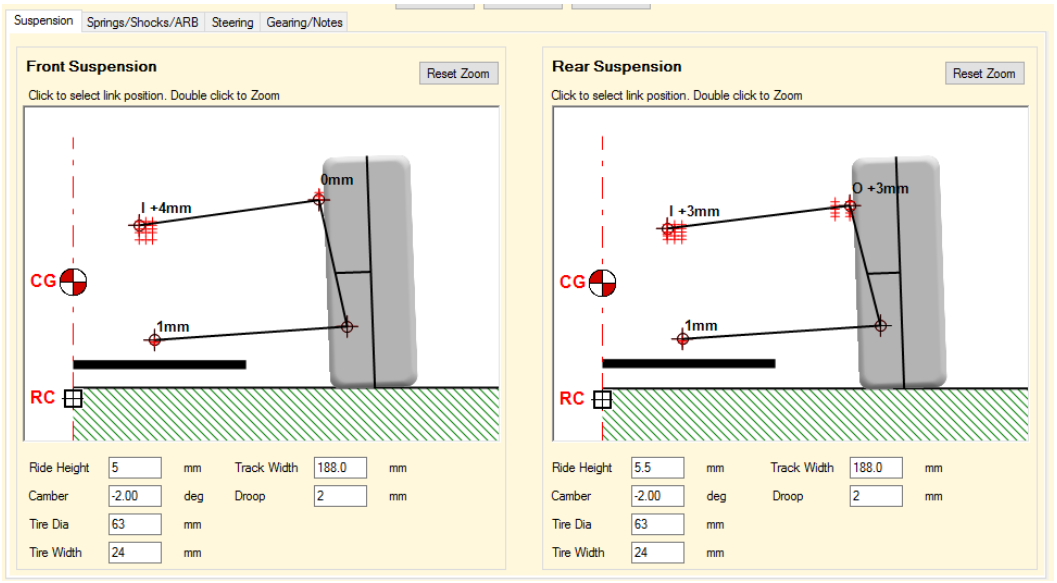


The Damping Coefficient is calculated using the selected piston, shock angle, oil viscosity and temperature. Note that if a shock model has not been entered in the **Chassis Manager** damping properties will not be displayed

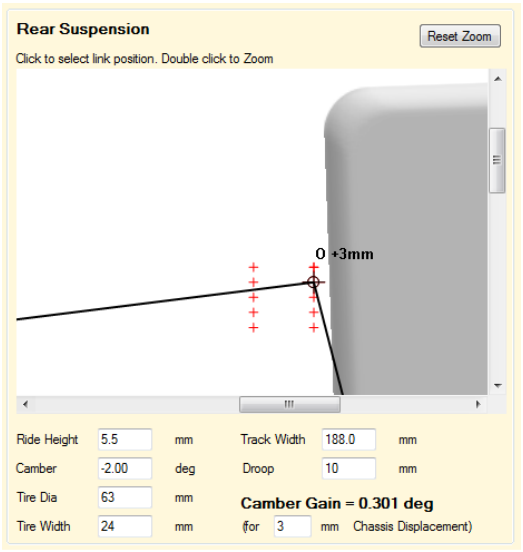
Area 3

This is where you enter the setup values for your car. There are four sub Tab pages, Suspension, Shocks/Springs/ARB, Steering and Gearing/Notes.

Suspension sub Tab



The Suspension Tab has two graphics that provide scale illustrations of the front and rear suspension. Static Roll Centre and Centre of Gravity of the model are also displayed. Link positions are selected by simply clicking on the alternate position. The suspension link will automatically connect and the suspension properties discussed above will update. To add additional link positions edit the chassis model using the **Chassis Manager**. Also if you enter a name for the point the name of the selected point will be displayed as seen in the graphic. Using this feature makes it easier to quickly determine links positions and shims.



If the alternate position grid for the links is closely spaced you can zoom into an area by double clicking in the area of interest. Scroll bars will also appear to allow the image to be repositioned if it is not zoomed to the location required. The link position can then be easily selected. When finished click **Reset Zoom.**

Enter the chassis and tire setup values in the boxes provided.

Required values for the front and rear chassis:

Ride Height - Measured from the underside of the chassis to ground

Camber - Negative when the top of the tire leans inward, positive outward

Tire Dia – Outside diameter of the tire

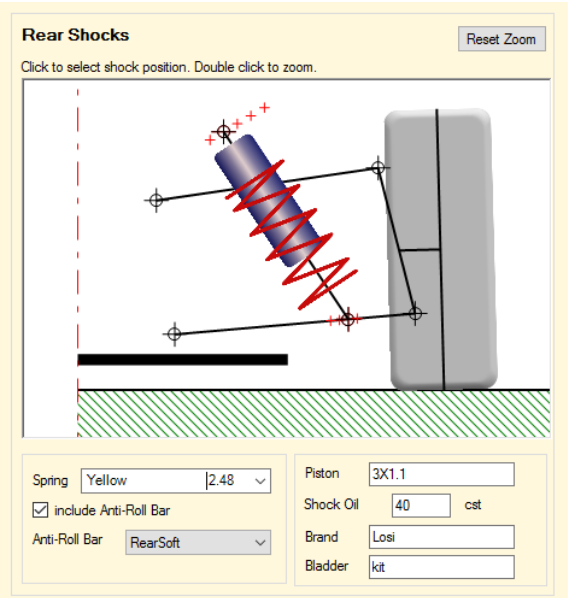
Tire Width – Maximum width of tire

Track Width – Width measured to outside of tires.

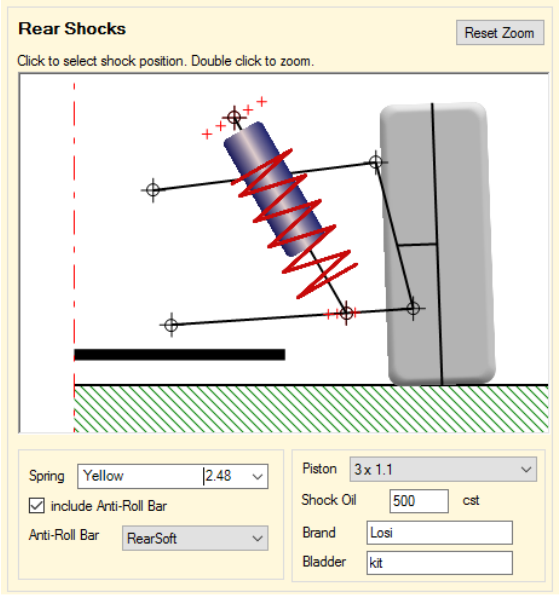
Droop – Measured as up travel from ride height

Shock subTab

Shock/Spring/ARB settings are entered in the next tab. Again separate graphics are provided to select the front and rear shock positions and double clicking on the image will zoom the graphics. To select the upper and lower shock mounting holes just click on the desired position. Springs and ARB (if selection box is checked) are selected from the drop down boxes. Additional springs and ARB's can be added in the **Chassis Manager**.



No Shock Model Entered



Shock Model Entered

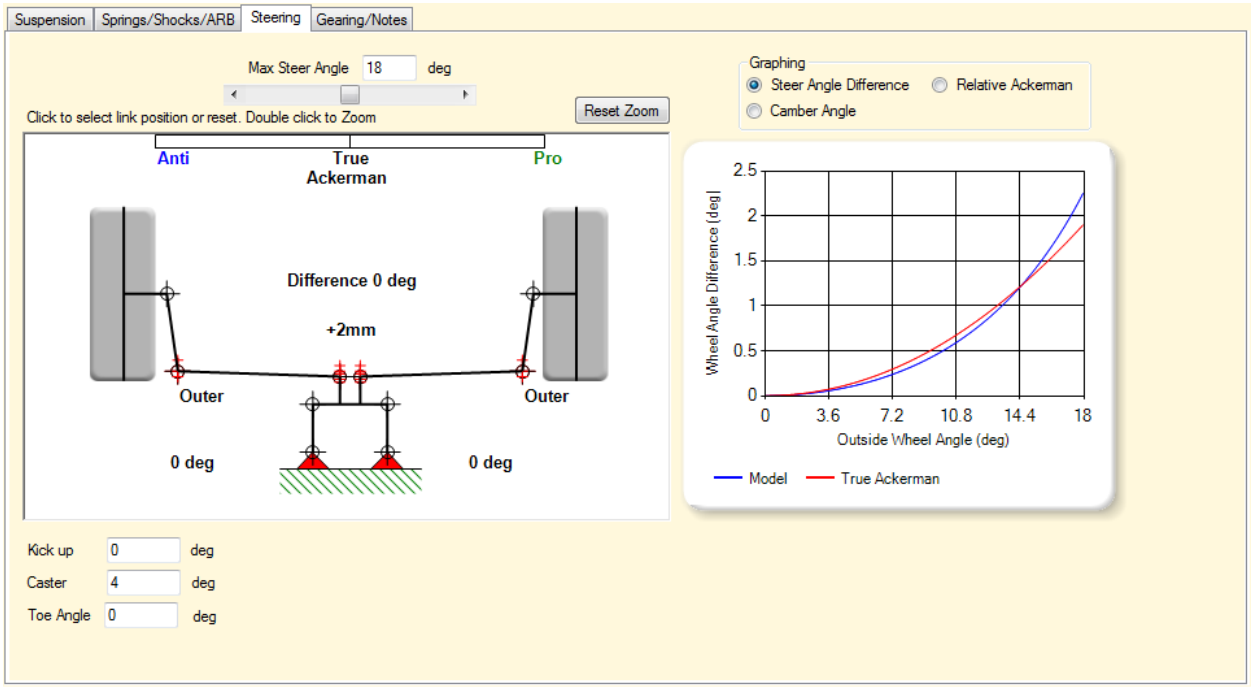
The display for piston, shock oil weight, brand, and bladder will be different if a shock model has been entered in the **Chassis Manager**. If no shock model is entered then all values entered are for record keeping purposes only. Users are strongly encouraged to take a few moments and add a shock model. Generic models are provided that make entry a breeze, or actual measurements

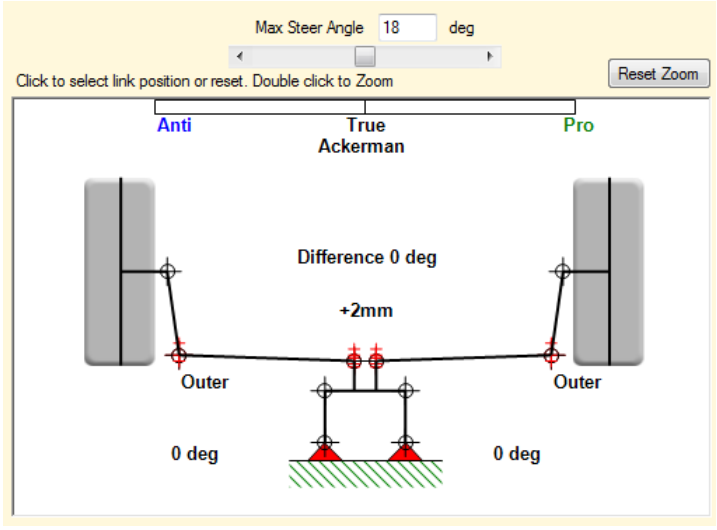
can be entered. Once the shock model is entered different pistons can be selected from the drop down box and changing oil viscosity and shock position will affect the displayed damping ratio.

As changes to the shock position, springs and ARB are applied the suspension properties will update to display the new ride and roll stiffness and the chassis roll sensitivity.

Steering subTab

Adjusting the steering geometry is achieved by clicking on the desired position. Double click to zoom in. If names have been assigned to the alternate positions they will be displayed in the graphic.

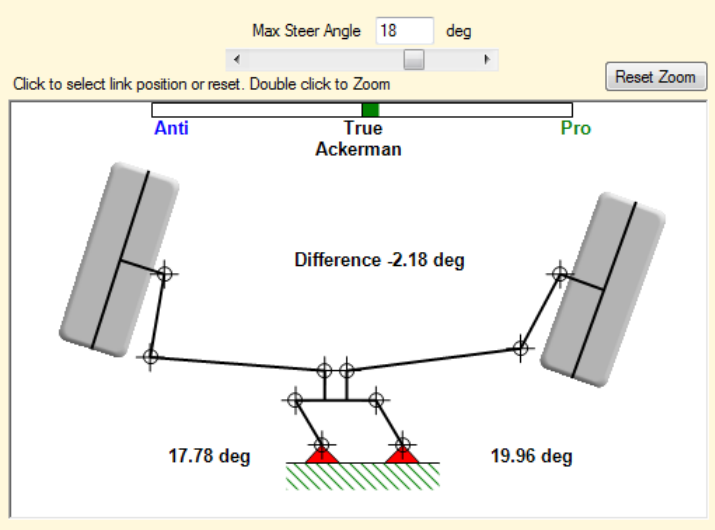




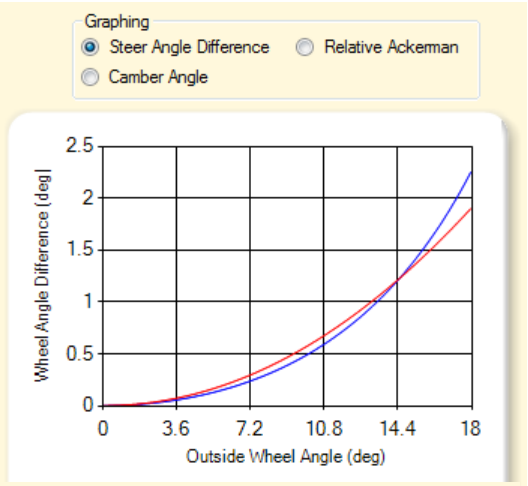
The graphic area has two modes.

Mode 1 is a static display as shown on the left which allows selecting alternate positions to adjust the steering Ackermann. The name of the selected position for the current setup is displayed. Names of the

positions are assigned in the **Chassis Manager.**

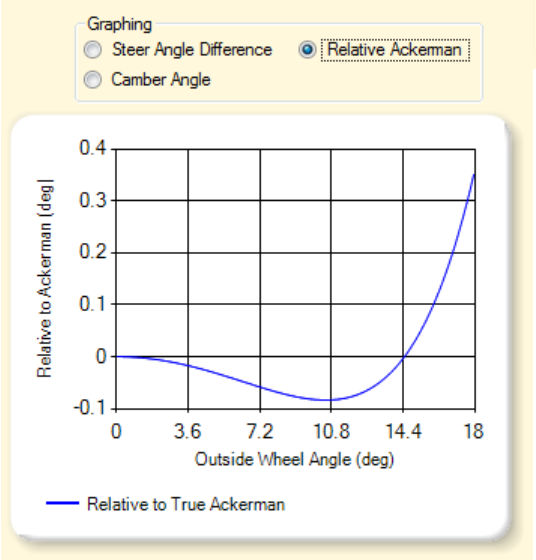


Mode 2 is activated by moving the scroll bar which will animate the steering. The actual angle of each wheel is displayed beneath each wheel and the difference between the wheel angles is displayed above the rack. At the top of the graphic a bar graph displays the relationship of the actual geometry to “True Ackerman”. Pro-Ackerman, green bar, means the difference between the inside and outside wheel angle is greater than true Ackerman. Anti- Ackerman, blue bar, means the difference between the inside and outside wheel angle is less than true Ackerman.



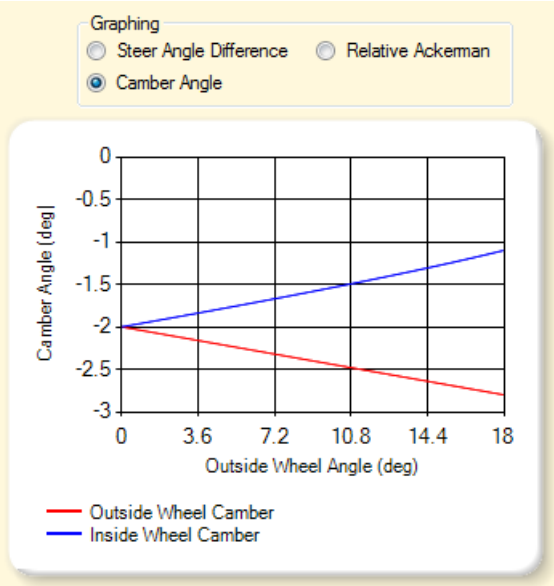
The remainder of the steering information is displayed in three graphs.

Steer Angle Difference graphs the Inside – Outside Wheel Angle versus the Outside Wheel angle. The red line displays True Ackerman values and the blue line the steering model. Use this graph to quickly see the effect of making geometry and toe angle changes.



Relative Ackerman graphs the angular difference between the model and True Ackerman versus the outside wheel angle. This is the same information as that provided in the animation bar graph. Where the graph is negative (below zero) represents Anti-Ackerman. Positive values Pro-

Ackerman. If the line is exactly zero then the steering geometry exactly replicates True Ackerman. Note that matching True Ackerman is not always the goal as tire slip angles will determine the best steering geometry.



The final graph shows the effect of steering angle on tire camber angle. Changing Caster and/or Kickup will affect the amount of camber change due to steering angle. In this graph you can see the tire camber angle for both wheels starts at -2 deg and the camber on the outside wheel increases with steering angle and the inside wheel camber angle decreases. The Dynamic page adds chassis roll and steer angle to help better understand the effects.

Gearing/Notes sub Tab

The final tab is provided to record gearing and tire, track and general setup notes. Overall gear ratio and rollout is displayed for the selected pinion/spur. Record settings such as rear toe, diff settings shock rebound and other parameters in the Setup Notes.