FAMU-FSU Formula SAE

Senior Design
Suspension and Chassis

Users Manual
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Adjustability Overview

The design of the suspension was done with the intent of full adjustability, as drivers have different preferences as to their own driving style. The camber, caster, toe, damping rate, sag, and spring rate may all be adjusted on the 2002-2003 model FSAE car to the driver's preference.

Camber

The camber may be adjusted on all four wheels of the car. In order to change the camber, spacer blocks must be placed between the upper ball joint housing and the wheels "upright" or "steering knuckle". Increasing the thickness of the spacer block will increase positive static camber, while using a narrower spacer will decrease positive static camber, or make it more negative. An exploded view of the assembly, including the wheel upright, spacer block, and upper ball joint housing is shown below in figure 1.

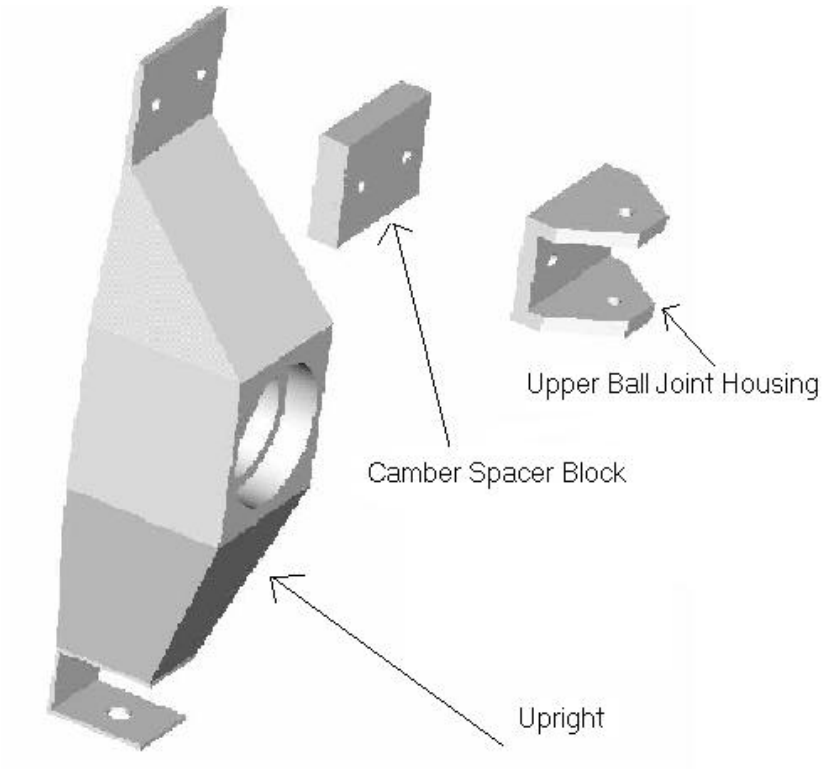

Figure 1: Exploded view illustrating replaceable spacer block to adjust camber

Caster

Caster may be adjusted on all four wheels of the car. In order to change the caster, a new upper ball joint location must be made. In order to accomplish

this, a new upper ball joint housing with a different ball joint location must be put in place of the existing one. The further towards the front of the vehicle the upper ball joint location moves, the caster becomes increasingly negative. As the upper ball joint location moves toward the rear of the car, the caster becomes increasingly positive. Examples of ball joint housings that accomplishes positive and negative caster are shown below with the uprights and spacer blocks in figures 2 and 3.

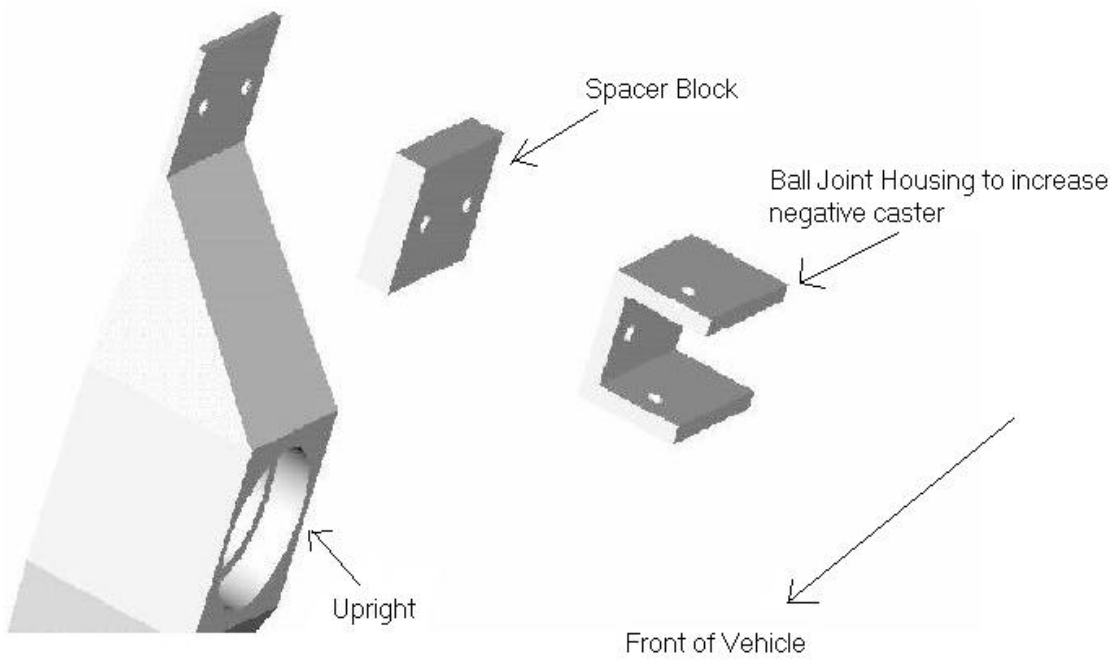

Figure 2: Ball Joint Housing Arrangement to Increase Negative Caster (or Decrease Positive Caster)

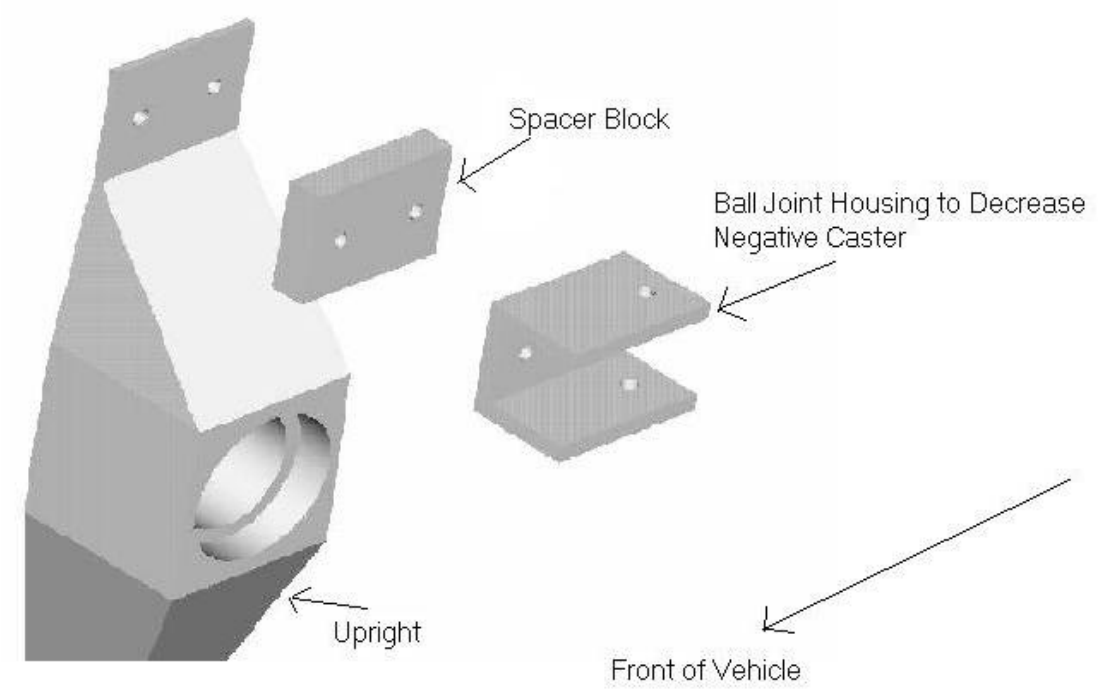

Figure 3: Ball Joint Housing Arrangement to Decrease Negative Caster (or Increase Positive Caster)

Toe

Toe on the car may also be adjusted on each wheel to the driver's preferences and race conditions. One left hand and one right hand threaded rod end was used on each adjustment arm to allow for easy adjustment of the toe. Turning the adjustment rod one direction will result in a shorter overall length (toe in), due to the rod ends screwing into the adjustment rod. Turning the adjustment rod the opposite direction will result in a longer overall length (toe out), due to the rod ends unscrewing.

CAUTION: The rod ends should have at a minimum half of the length of the threads screwed into the adjustment rods. Exposing more than half of the rod ends' threads may result in part failure that could lead to injury.

Figure 4: Front Suspension with Steering Rod Shown

Front Toe

To adjust the toe on the front wheels, the user must rotate the steering rod along its center axis. For toe out, the steering rod must be rotated counterclockwise as viewing it from the wheel to the chassis. For toe in, the steering rod must be rotated clockwise as viewing it from the wheel to the chassis. This procedure is illustrated below in figure 5.

Figure 5: Front Toe Adjustment

Rear Toe

To adjust the rear toe, a specific rear toe adjustment rod is provided. This adjustment rod runs from the mounting bracket on the rear upright to the mounting tabs on the rearmost portion of the chassis. For toe out, the rear toe adjustment rod must be rotated counterclockwise as viewing it from the wheel to the chassis. For toe in, the rear toe adjustment rod must be rotated clockwise as viewing it from the wheel to the chassis. This is shown below in figures 6 and 7.

Figure 6: Rear Suspension with Rear Toe Adjustment Rod Shown

Figure 7: Rear Toe Adjustment

Damping Rate

WARNING: The Fox Racing Vanilla RC shock absorbers are pressurized with nitrogen and could result in injury if an attempt to open the pressurized cylinder is made. Do not attempt to pull apart, disassemble, or otherwise service a shock if it is stuck in a compressed state or will not return to its original equilibrium length under no load. Serious injury may result.

Adjustable shock absorbers allow for the changing of the damping rate. Both compression damping and rebound damping may be adjusted. On the Vanilla RC Fox Shocks, to adjust the damping for compression, the blue adjustment knob located on the outer cylinder (reservoir) must be turned clockwise to increase the damping rate (harder to compress), and counterclockwise to decrease the damping rate (compresses under a lighter load). The compression adjustment setting will change for different track conditions and dynamic events.

To adjust the damping for rebound, the red upper adjustment knob, located on the eyelet, must be turned clockwise to increase the damping causing the spring to return slower and counterclockwise to decrease the damping rate causing the spring to return faster. The adjustment knobs are further illustrated in figure 8.

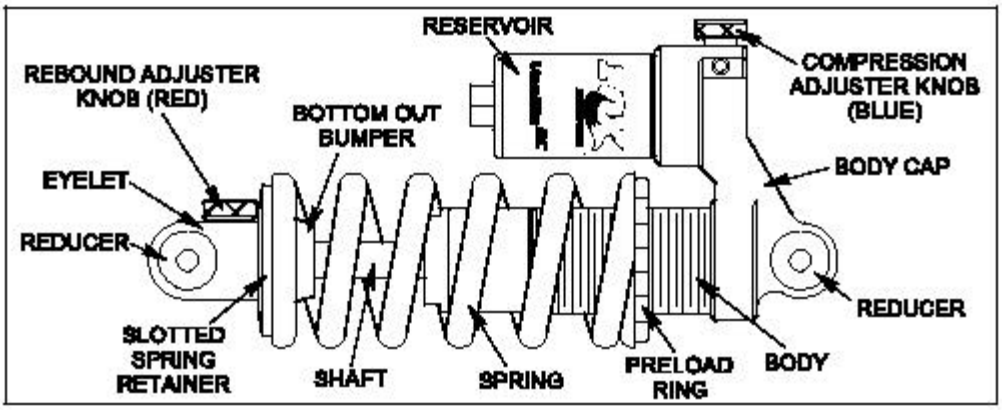

Figure 8: Coil Spring/Shock Absorber Assembly Diagram

Sag

Sag is how much the shocks compress when the driver sits in the vehicle. Sag is adjusted by changing the preload on the springs or, if necessary, changing the spring rate. Increasing the preload by tightening the preload ring (compressing the spring slightly) will decrease the sag. Decreasing the preload by loosening the preload ring (elongating the spring slightly) will increase sag.

The preload ring is illustrated below in figure 8. The sag should be adjusted according to table 1, below.

CAUTION: If more than 2 turns of the preload ring is required, a higher rate spring should be installed. Turning the preload ring more than 2 times may cause the spring to bind during normal travel, which may result in injury.

Table 1: Recommended Sag Settings (obtained from Fox Racing Shox 2002 Owners Manual[1])

Shock Travel		Recommended Sag	
(inches)	*(millimeters)*	*(inches)*	*(millimeters)*
1.00	25.4	.25	6.4
1.25	31.7	.31	7.9
1.50	38.1	.38	9.5
1.75	44.4	.44	11.1
2.00	50.8	.50	12.7
2.25	57.1	.56	14.3
2.50	63.5	.63	15.9
2.75	69.9	.69	17.5

Spring Rate

The spring rate may be changed on each of the wheels. To change the spring rate, the coil springs must be removed from the coil-over assembly, and the new rate springs must be installed in their place.

To remove the coil-over shock:
1) Raise and safely support the vehicle.
2) Remove the chassis to coil-over retaining bolt.
3) Remove the coil-over to rocker arm retaining bolt.

To remove spring from coil-over:

CAUTION: When removing the springs, the preload ring must be unscrewed slowly to avoid injury. The springs are preloaded and may cause injury.

1) Unscrew preload ring to loosen the spring until the spring retainer can be removed from the shock.
2) Remove the reducers from the shaft end of the shock.
3) Remove spring retainer.
4) Slide spring over the eyelet.

To install spring into coil-over:

1) Slide the new spring over the eyelet.
2) Re-install spring retainer. The slotted spring retainer slot must rest on the flat side of the spring.
3) Re-install the reducers.
4) Tighten the preload adjuster according to table 1.
5) Align the slotted spring retainer so that the rebound knob is in the middle of the slot.

To install coil-over into vehicle:

1) Install coil-over to rocker arm retaining bolt. Torque to 19 ft-lbs.
2) Install chassis to coil-over retaining bolt. Torque to 19 ft-lbs.
3) Lower vehicle and test to make sure the spring will compress under a load.

References

1. Fox Racing Shox, *2002 Rear Shock Owners Manual*, Watsonville, CA, 2002.