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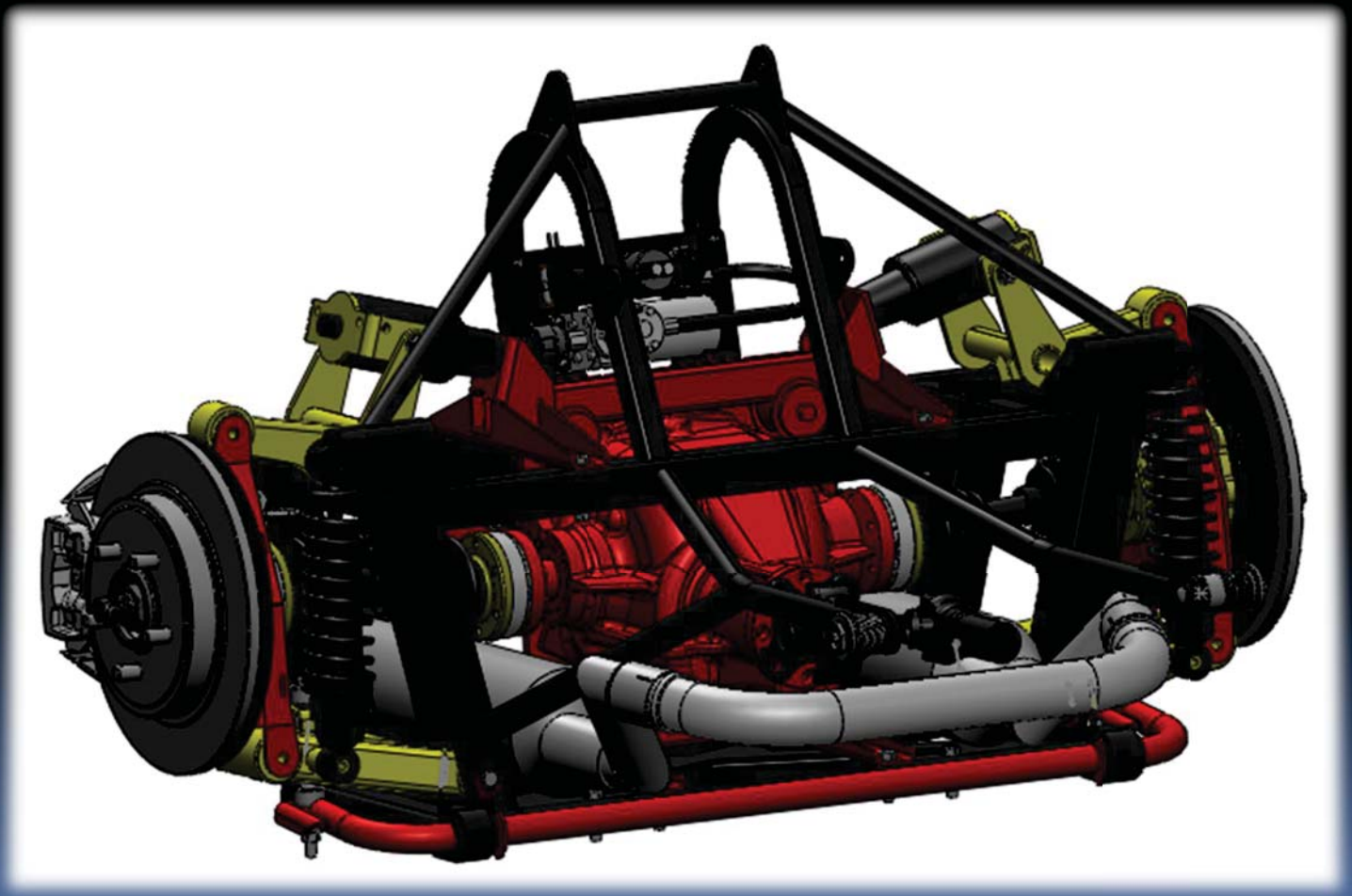
WHY CHOOSE MOTOR TRIKE INDEPENDENT REAR SUSPENSION?



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WHY CHOOSE MOTOR TRIKE INDEPENDENT REAR SUSPENSION?

- NOT ALL INDEPENDENT REAR SUSPENSIONS (IRS) ARE CREATED EQUALLY.
  - THIS IS WHY A BMW AND A HYUNDAI DON'T HAVE THE SAME PERFORMANCE CHARACTERISTICS.
  - THIS IS WHY A CADILLAC AND A CORVETTE DON'T HAVE THE SAME RIDE QUALITY.

- AT MOTOR TRIKE, WE UNDERSTAND WHAT MAKES A SUSPENSION GOOD OR BAD. OUR IRS WAS DEVELOPED TO PROVIDE WHAT OUR CUSTOMERS WANT & NEED BASED ON OUR EXPERIENCE BUILDING TRIKES SINCE 1994.

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WHY CHOOSE MOTOR TRIKE INDEPENDENT REAR SUSPENSION?

- DESIGN TEAM EXPERIENCE:
  - ONE NASCAR SPRINT CUP CHAMPIONSHIP
  - ONE 1ST PLACE AND ONE 2ND PLACE FORMULA SAE CHAMPIONSHIP
  - THREE ROAD & TRACK FORMULA SAE SHOOTOUT VICTORIES
  - CREATED AND DESIGNED TMS STALLION

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DESIGN CRITERIA

- TRACTION/GRIP
  - CAMBER GAIN
  - CG HEIGHT
- RIDE QUALITY
  - OPTIMIZE NATURAL FREQUENCY
  - NOISE VIBRATION AND HARSHNESS
- LEANING/SWAY CONTROL
  - CORRECT ROLL STIFFNESS
  - BALANCE ANTI ROLL BAR WITH ROLL CENTER HEIGHT
- BUMP STEER / STABILITY
  - TIRE SCRUB/ROLL CENTER HEIGHT
  - TOE CHANGE
- INSTALL TIME
  - INSTALL TIME REDUCTION
  - IF OUR DEALERS SUCCEED, WE SUCCEED

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WHY CHOOSE MOTOR TRIKE?

IRS SELECTION

- COMPETITORS OPTIONS
  - TRAILING ARM
  - SEMI TRAILING ARM
  - SHORT LONG ARM

- TRAILING ARM
  - ADVANTAGE = INEXPENSIVE AND SIMPLE
  - DISADVANTAGE = HIGH ROLL CENTER AND NO CAMBER CONTROL

- SEMI TRAILING ARM
  - ADVANTAGE = STILL INEXPENSIVE AND SIMPLE WITH SOME CAMBER CONTROL
  - DISADVANTAGE = UNWANTED TOE CHANGE CAN OCCUR WITH CAMBER GAIN. STILL HAS HIGH A HIGH ROLL CENTER

- SHORT LONG ARM WITH A-ARMS
  - ADVANTAGE = PRECISE CAMBER CONTROL AND ROLL CENTER HEIGHT CONTROL
  - DISADVANTAGE = EXPENSIVE TO PRODUCE AND DIFFICULT TO PACKAGE AROUND EXHAUST

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WHY CHOOSE MOTOR TRIKE?

IRS SELECTION

- MOTOR TRIKE'S IRS SELECTION
  - SHORT LONG ARM SUSPENSION WITH H-ARM AND CAMBER LINK
- ADVANTAGES
  - MIDDLE OF THE ROAD COST OPTION PROVIDES A REASONABLY PRICED KIT
  - PACKAGE AROUND EXHAUST AND STILL ACHIEVE GOOD DESIGN PARAMETERS
  - ABILITY TO DESIGN FOR:
    - LOW ROLL CENTER HEIGHT
    - NO TOE CHANGE IN BUMP OR ROLL
    - PRECISE CAMBER CONTROL
    - SMALL AMOUNTS OF SCRUB
    - SMALL JACKING FORCES
- DISADVANTAGES
  - CANNOT USE FOR A STEERING APPLICATION
  - MUST MAINTAIN RIDE HEIGHT DUE TO CAMBER CHANGE (AIR SPRINGS)

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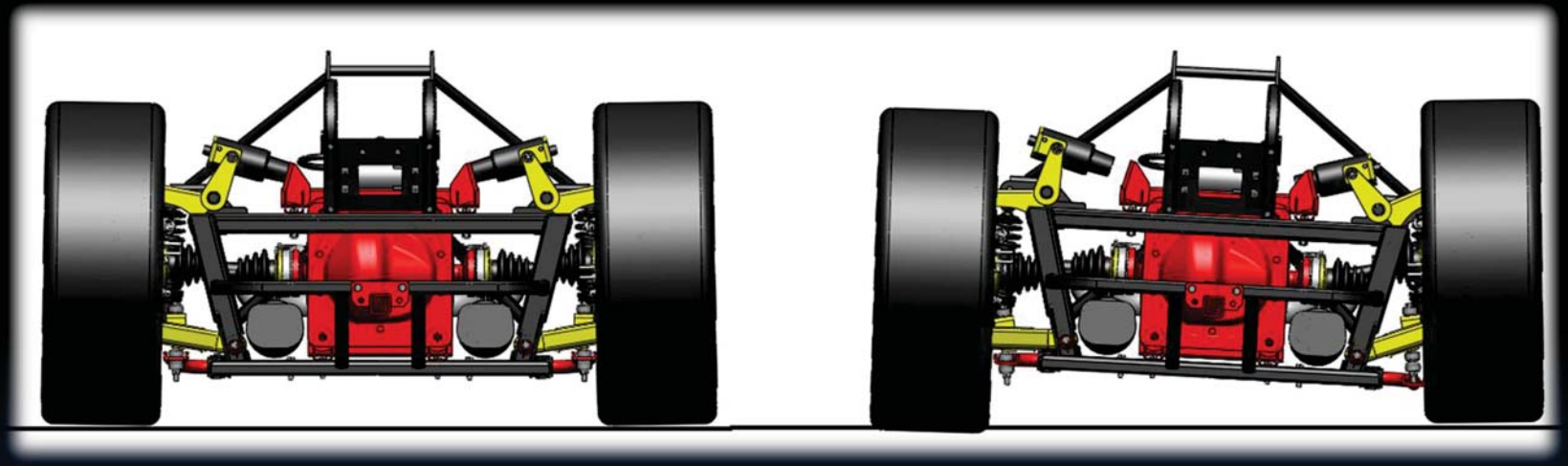
WHY CHOOSE MOTOR TRIKE?

TRACTION /GRIP

- CAMBER GAIN: WE INCREASE TRACTION BY KEEPING OUR TIRE CONTACT PATCH FLAT TO THE ROAD WHEN IT IS IMPORTANT



- PICTURE DEPICTS A SEVERE CORNER WITH LOTS OF BODY ROLL. NOTICE THE OUTSIDE TIRE IS STILL FLAT TO THE ROAD

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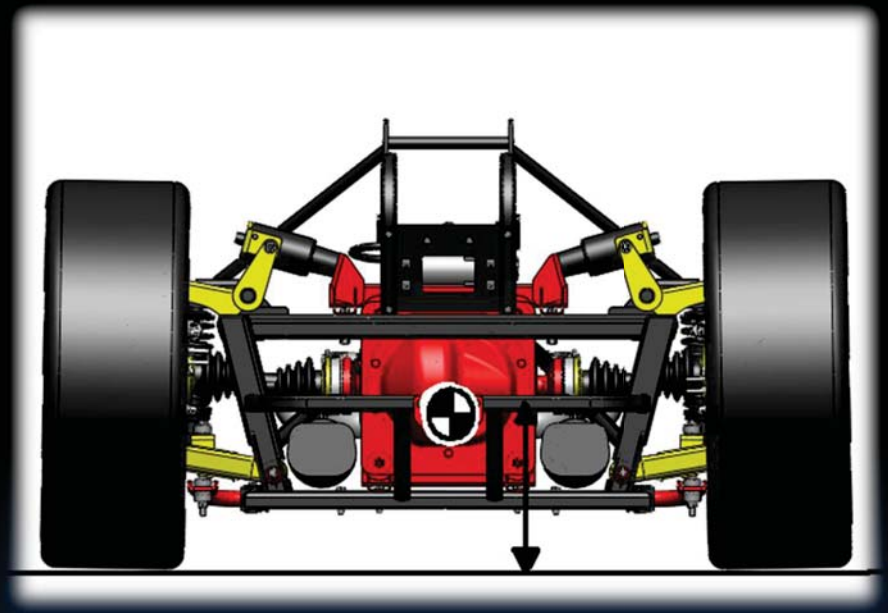
WHY CHOOSE MOTOR TRIKE?

TRACTION /GRIP

- CG HEIGHT: WE PLACED OUR HEAVIEST COMPONENTS AS LOW AS POSSIBLE
  - REDUCES LOAD TRANSFER TO THE OUTSIDE TIRE
  - KEEPS THE INSIDE TIRE ON THE GROUND



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WHY CHOOSE MOTOR TRIKE?

RIDE QUALITY

- WHAT IS NATURAL FREQUENCY?
  - NATURAL FREQUENCY IS A TOOL THAT ENGINEERS USE TO MEASURE THE RIDE QUALITY OF A SUSPENSION.
  - EVERY SUSPENSION HAS A FREQUENCY THAT IT WILL NATURALLY OSCILLATE AT. IT IS BASED ON SPRING RATE AND WEIGHT.

$$NATURAL\ FREQUENCY = \sqrt{\frac{SPRING\ RATE}{MASS}}$$

  - THE OPTIMUM NATURAL FREQUENCY THAT HUMANS PREFER IS BELOW 2.5 Hz. THE LOWER IT IS THE MORE WE LIKE IT.
  - THE CHALLENGE IS TO KEEP THE SPRING RATE AS LOW AS POSSIBLE WITHOUT RUNNING OUT OF SUSPENSION TRAVEL.

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WHY CHOOSE MOTOR TRIKE?

RIDE QUALITY

- SUSPENSION TRAVEL
  - SUSPENSION TRAVEL IS THE GATEWAY TO RIDE QUALITY.
  - WITH OVER 4 INCHES OF WHEEL TRAVEL, WE WERE ABLE TO OPTIMIZE RIDE QUALITY BY LOWERING THE SPRING RATE & THEREFORE THE NATURAL FREQUENCY.
  - THIS IS ONLY POSSIBLE IF YOU HAVE ENOUGH TRAVEL TO ACCOMMODATE THE SOFT SPRINGS.
- OUR TRIKES ARE LIKE PICKUP TRUCKS???
  - THEY ARE SIMILAR TO A TRUCK SINCE WE MUST ACCOMMODATE LARGE LOAD VARIATIONS AND MAINTAIN RIDE QUALITY.
- HOW DO WE RIDE WELL WITH ONE 120 lb RIDER OR TWO 250 lb RIDERS?
  - WE UTILIZE AIR SPRINGS TO ADJUST THE SPRING RATE AND MAINTAIN RIDE HEIGHT AND NATURAL FREQUENCY.

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WHY CHOOSE MOTOR TRIKE?

RIDE QUALITY

- NOISE VIBRATION AND HARSHNESS (NVH)
  - WHAT IS THE SOURCE OF NVH?
    - ENGINES, BRAKES, GEARS, TIRES AND ROAD IRREGULARITIES ALL CREATE NOISES AND VIBRATIONS.
    - NOISES AND VIBRATIONS ARE TRANSMITTED TO THE RIDERS THROUGH THE VEHICLES CHASSIS.

- SOLUTION:
  - IT IS IMPOSSIBLE TO ELIMINATE THE SOURCE OF ALL NVH, SO THE ONLY SOLUTION IS TO CREATE A BARRIER BETWEEN THE SOURCE AND THE RIDERS
  - RUBBER BUSHING MOUNTED DIFFERENTIAL
  - RUBBER BUSHINGS FOR ALL SUSPENSION COMPONENTS (ANTI ROLL BAR, SHOCKS, AND SUSPENSION ARMS).

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WHY CHOOSE MOTOR TRIKE?

SWAY CONTROL

- LEANING/SWAY CONTROL
  - THE CORRECT ROLL (CORNERING) STIFFNESS GIVES THE DRIVER COMFORT AND FEEDBACK.
  - TOO STIFF = NO FEEDBACK. THE RIDER GETS OVER CONFIDENT BECAUSE THE MACHINE CORNERS TOO FLAT (NO SENSE OF DANGER). IT ALSO RUINS RIDE QUALITY IN ONE WHEEL BUMP.
  - TOO SOFT = FALSE SENSE OF DOOM. IF THE BIKE LEANS TOO MUCH, THE RIDER FEELS LIKE HE/SHE ARE ABOUT TO TIP OVER OR SLIDE OUT OF CONTROL.
- ROLL CENTER HEIGHT
  - WHY IS IT IMPORTANT? THE ROLL CENTER HEIGHT CONTROLS MANY SUSPENSION PARAMETERS INCLUDING THE “LEVER ARM” THAT CAUSES BODY ROLL.
  - WE DESIGNED OUR ANTI ROLL BAR TO WORK WITH OUR ROLL CENTER HEIGHT.

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WHY CHOOSE MOTOR TRIKE?

BUMP STEER/STABILITY

- ROLL CENTER HEIGHT
  - HOW DO YOU AVOID BEING CALLED “UNSAFE AT ANY SPEED” (CORVAIR)? LOWER THE ROLL CENTER HEIGHT.
  - WHAT IS THE ROLL CENTER? THINK OF IT AS THE PIVOT POINT FOR THE SUSPENSION IN ROLL & THE REACTION POINT FOR CORNERING FORCES.
  - THE EARLY CORVAIRS (ALONG WITH MANY OF OUR COMPETITORS) HAVE A REALLY HIGH ROLL CENTER. THIS CAN CAUSE OVER STEER STABILITY PROBLEMS DURING AGGRESSIVE CORNERING.
  - HIGH JACKING FORCES CAUSE THE BODY (AND THE CG) TO LIFT WHILE CORNERING. (ESPECIALLY DANGEROUS ON A TRIKE!)

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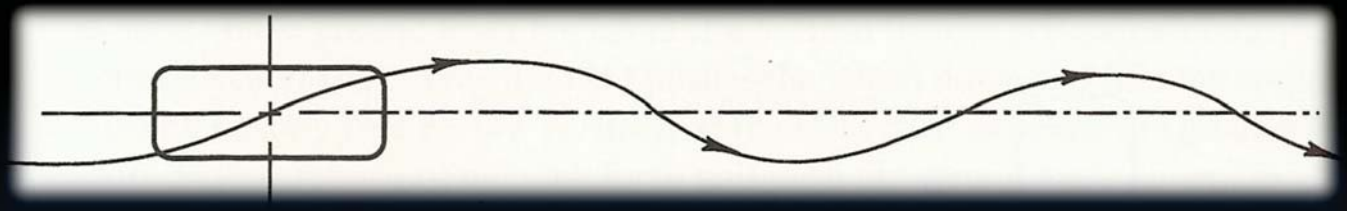
WHY CHOOSE MOTOR TRIKE?

BUMP STEER/STABILITY

- SCRUB (BUMP STEER)
  - WHAT IS SCRUB? THIS IS A TERM USED TO DESCRIBE A VEHICLES TENDENCY TO CHANGE TRACK WIDTH AS THE SUSPENSION TRAVELS.



  - WHY IS IT IMPORTANT? MINIMIZING SCRUB REDUCES THE TENDENCY TO WANDER OR SKIP SIDEWAYS OVER ROUGH ROADS.
  - SMALL AMOUNTS OF SCRUB REDUCE TIRE WEAR

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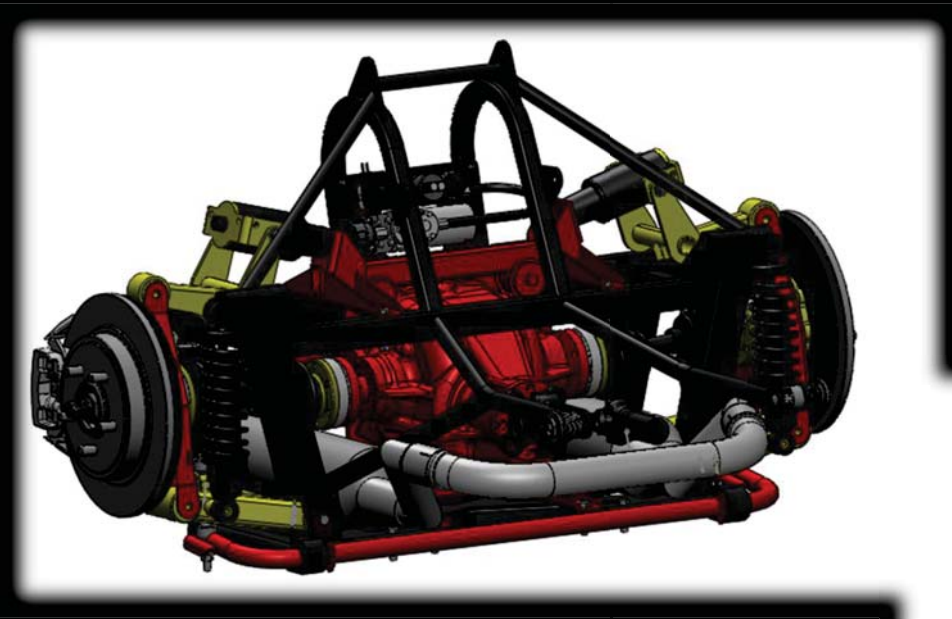
QUESTIONS?



Contact Mid-State Trikes
607-279-2599