

# KS9 Rear End Design

Wednesday, August 13, 2025 10:34 PM

## Reasons to Redesign:

- Interactions with Damper to Yoke Plate
- Bolts on rear sprocket are very close
- \*Could lose weight
- Would not need to buy and make a Yoke Plate
- Gives more freedom with Rear Sprocket Selection
- Sprocket Alignment Method
- Axle Alignment could be improved
  - o Axles contact the hub currently
- Could improve part integration
  - o Jacking bar

Initial axle lengths from hub to tulip outer face, left 17.57 right 17.57

## Reasons to not redesign:

- Very large scope change
  - o Frame
  - o Driveline
  - o Suspension
- All of which have new leads
- Current driveline ... Drives
  - o Not enough testing mileage to feel safe about it though
- Yoke plate is technically still reusable

## Things needed for different rear end concept:

- Different motor plates with differential mounting
- Eccentric differential mounting and tensioning
- New sprocket adapter with mates on splines
  - o Copy over from IC
- Front sprocket output shaft change
- Larger rear sprocket for final drive
- Suspension configuration changing
  - o Control arm
  - o Shock and rocker mounting

## Shit I need david and micah to do:

08/15/2025:

- Open chassis RnD, check out, make a new config " rearend\_explorer"
  - o If CAD angry, save locally - nuclear option
- Get the V3 cad of the diff and put the IC sprocket adapter
- Find the CAD for the big boi rear sprocket and mate to the sprocket adapter
- Make sure you import the fucking driveline skeleton sketch and adjust till axle lengths arent more than 1" delta
- KEEP THE FRAME THE SAME
  - o See where shit hits and report back

## Rear end investigation(Seeing what all is needed if we put the V3 on the KS9)

Friday, August 15, 2025 1:56 PM

### Random ideas

Config in CAD (frame touched)

Remove Yoke plate

Put in v3 diff

Moved closer in to chassis for 0 degree axle alignment

Widened rear ox to 10x10in

Moved drexler 0.25in to the right for clearance on the left diff carrier

Gives 0.5in difference in axles

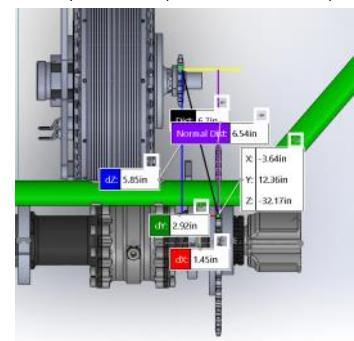
Very little weight increase

Cannot say exactly until diff carriers made

### Chassis Weights (bare frame with yoke plate if included)

Original with yoke plate	Diff Cage	No yoke plate	
69.1624lbs	66	64.37lbs	

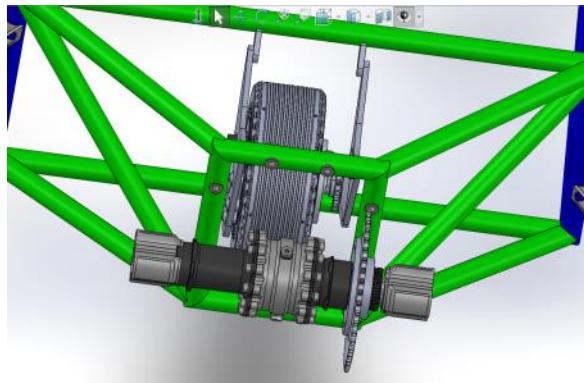
Currently with this setup there is 1.45 inches of sprocket misalignment



### Axle Sizing

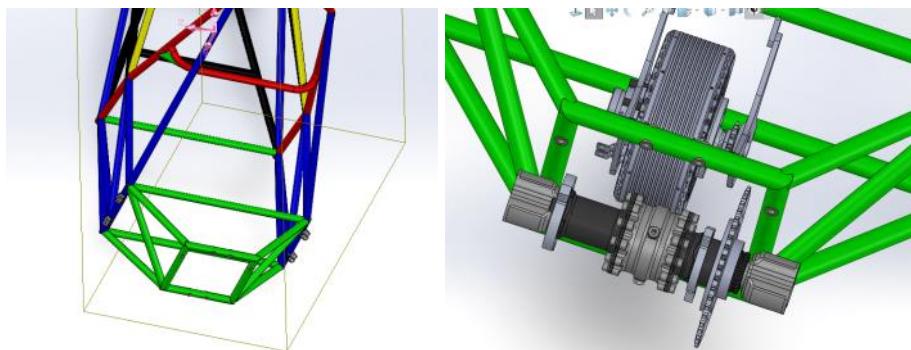
17.82left 17.32right .5 in of misalignment

With yoke (not in image but weights and sizing same)



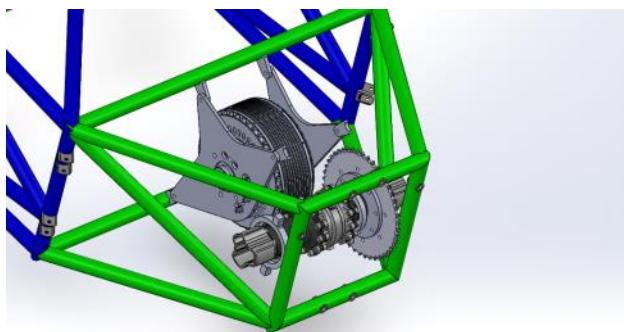
No yoke plate no cage

Widened box that yoke would normally mount on to 10x10in



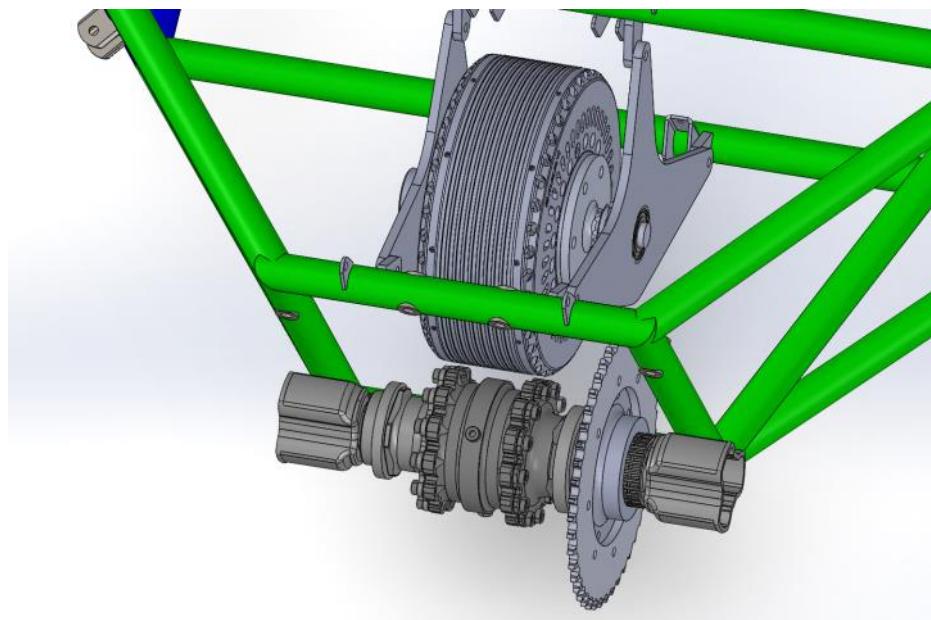
Diff Cage built off of previous no yoke design, just increased rear length by 4.75in, 3d sketch dimension went from 9.25in to 14in

Another variation of this could be to remove the top rear most tube and the others that go to it. Would have to make sure it meets rear impact protection. Would make sus mounting evil



Most likely option: V2 Drexler with just diff carriers and no yoke plate

Drive sprocket would extend to the outside of the motor plate for proper alignment, probably outsourced tbh



Left 18.95  
Right 17.39

Hytech maybe broke something like this  
On dyno  
They broke their gearbox due to missalignment

Rules investigation  
• Chinguard/fingerguard  
• Scatter Shield (t.5.3)  
• Kinda evil sprocket adapter  
•

Axles now equal length in CAD 18.19in from end of tulip to driveline skeleton point

With the current design the things that would need to change are

- Diff carriers
- Motor plate
- Axles

## BLANK

### Rear Bulkhead (EV Only)

**F.11.3.1** From the rear, all HV components must be protected with an upper tube, a lower tube, and a diagonal tube or tubes completely triangulating the upper and lower tubes.

Triangulation may be asymmetric. **F.11.3.3, F.2.3.1:** Rear impact verticality tolerance: +/- 25mm longitudinally.

If a billet plate replaces all three tubes, it must fully overlap the tractive side protection tubes.

**F.11.3.4** Increase from Size C to Size B if the accumulator is < 100mm [3.937in] from the rear impact .

**F.11.3.4** The Rear Protection must be fully triangulated back to the Upper and Lower SIS.

If a billet plate replaces all three tubes, 4x 30kN, 6x 20kN or 8x 15kN mounts are required.

Bolted joints must be documented if a removable panel or tube is used.

EQ		
<b>F.11.3.1.b</b>	Min distance from Accumulator to Rear Bulkhead?	254 in
Tractive Rear Bulkhead	Minimum	Tube
<b>F.3.2.1.n</b>	Example: 1.0in x 0.047in round	Size C
<b>F.3.2.1.c</b>	Wall thickness:	1.246 in
	Outer Diameter (OD):	0.984 25.4 in
	Wall thickness:	1.2 31.6 mm
	Outer Diameter (OD):	25.0 645.2 mm
	Tube cross sectional area (A):	91 60915 mm <sup>2</sup>
	Tube second moment of inertia (I):	6695 2.87E+09 mm <sup>4</sup>

**F.11.3.2** The entire top edge of the upper tube or plate must be at least 265mm above the lowest point of the top surface of the Lower SIS tube.

Idea from Emil, find kinematic points for both diff cage and bearing carrier setups and run a torsion test for each.

## Less schizoid list of things for new rear end packaging

Sunday, August 31, 2025 4:10 PM

### Frame changes

- Diff Cage
  - o Extend the rear of the frame by 7in (GYAT)
    - Can submit a rules inquiry regarding this, needs to stick out really far to fit an extra tube for triangulations but other teams that have done this didn't really have the extra tube
  - o Can widen or shrink the rear box structure depending on what suspension needs
- Diff Carriers
  - o Lower rearmost tube by 1in
  - o Frame maybe be able to move further forward slightly if motor can also move forward a bit (need to talk with dom)
  - o Top tube can come down slightly, limited by rules by 1.34in, limited by sprocket by 1.6in

### Driveline Changes

- Diff cage TBD
  - o Make diff carrier and motor plate one piece
  - o Drive sprocket adapter extended past the motor plate
  - o Driven sprocket goes on the splines
  - o Diff can shift for = axle length
  - o Diff can move forward for Odegree axle alignment vertical and horizontal
- **[DT] 9/3/25 Eccentric Diff carriers**
  - o Diff carriers go straight to frame (Need to be cadded still)
  - o Need to make tabs (Currently using the motor mount tabs for reference at the moment)
  - o Need to remake front sprocket output shaft and front sprocket depending which final drive we go for, Needs to be remade anyway to fit the splined rear sprocket.
  - o Rear Sprocket adapter needs to be remade, Make it similar to ic with the splines just need to change diameters so that things match up
  - o Main carriers with eccentric feature in the middle for chain tensioning
  - o Needs a new rear sprocket

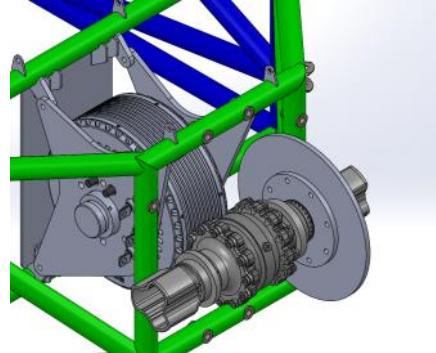
Suspension changes (wasim pls fill out)

### Main reasons for investigation:

- Axle alignment
- Sprocket alignment
- Driveline clearances
- Possible weight decreases in frame and suspension
- Sprocket sizing and clearances

09/08/2025 - Work Session

- Possible redesign, extend motor plate into diff carrier



- Biggest limiting factor for this design is suspension integration
- Nodes that would change in each view:
  - Top View:
    - o Control arm loading
    - o Toe rod mounting
  - Side View:
    - o Anti geometry
    - o Instance centers
  - Front View:
    - o Bump Steer
    - o Camber Gain
- Other suspension interactions:
  - o Damper bell crank mounting
  - o Possible arb mounting?
  - o Jacking bar

Shit Needed for next meet:

Wasim:

- CAD for articulation
  - o Bell Crank + Damper across the top
  - o Difference in motion ratio for upper and lower control arm mounting
- Control arm linkage loading
  - o Depends on location of rear box node
  - o Under the same force what is the difference in the loading

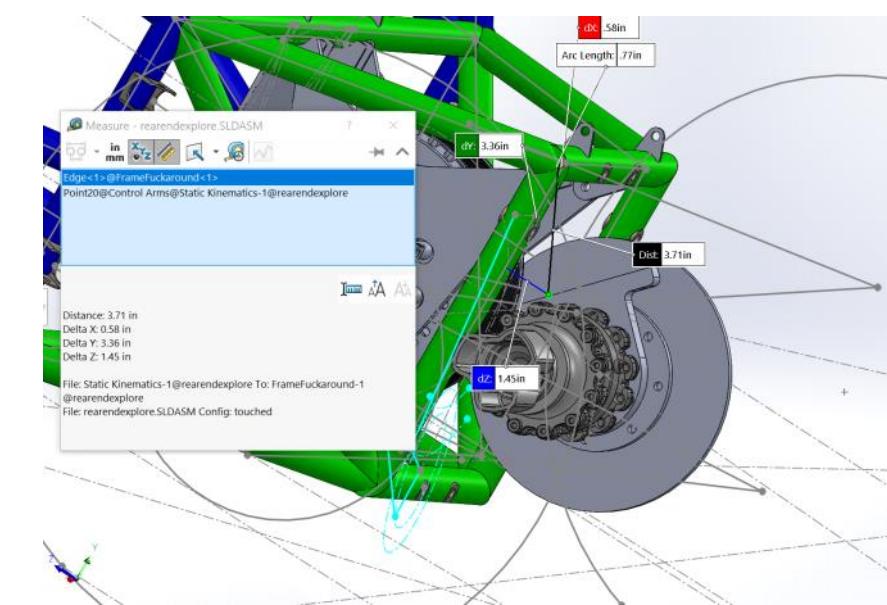
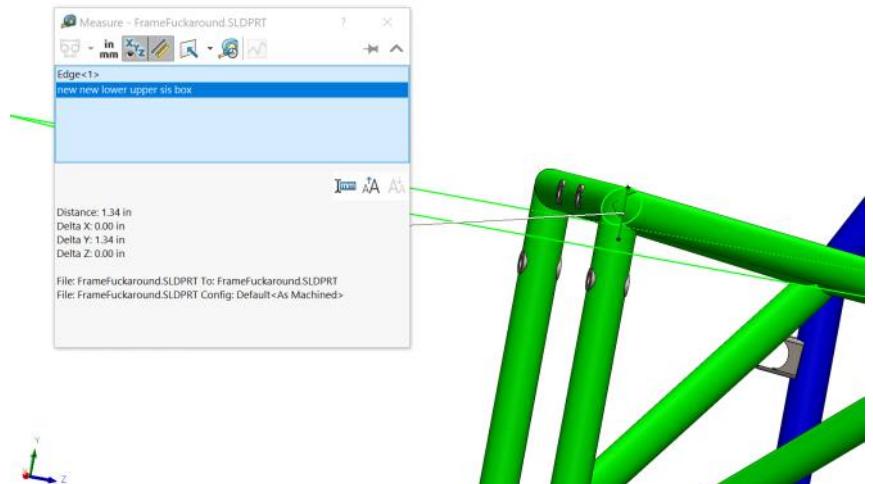
Micah:

- See if legal for rear diff package integrate maybe
- How much longer can we make the rear box nodes
- How much could we drop them for sure
  - o Put with anti-geometry

Sam Yang

- How much motion ratio we want?

Weight			
Current	Cage optimal	Cage thickkkkk	Carriers
69.1624lbs		67lbs	64



# Front tube delete

Friday, September 5, 2025 11:24 PM

Top SIS tube can come down 1.4in in the front (not accounting for clearances)  
Front hoop brace can be 4in above or 2in below the upper SIS stube

Distance between current Upper SIS and the FHB is 3.24in

After lowering the upper SIS tube by 1.2 in the joe tube is 2.24 in away from the sis tube.

I want front moved up slightly more than rear

## More Finalized Design (almost)

Tuesday, September 16, 2025 8:37 PM

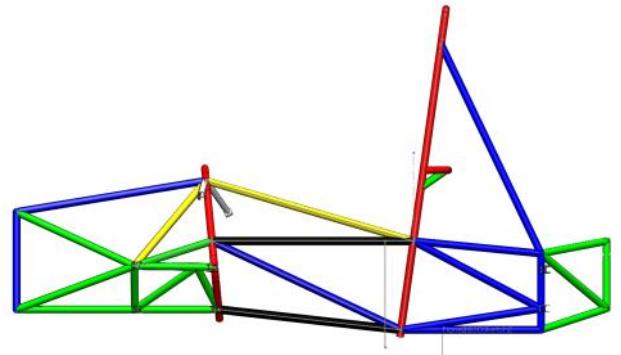
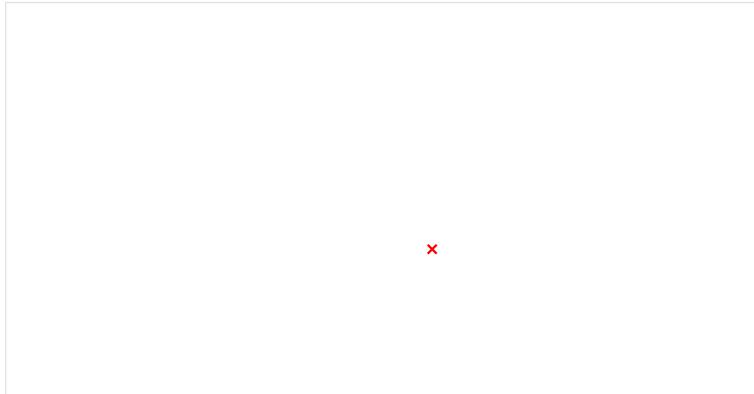
Front extra tube is gone, upper suspension nodes moved up by 0.4in (rear) and 0.65in (front)

Rear hoop widened by 2in

Rear upper SIS node moved to the top of the SIS box

Mass estimate is: 63.85lbs

KS8 Mass estimate is: 64.96lbs



# SES KS9 Submission Deviation

Wednesday, October 22, 2025 10:20 PM

Rule	Cell	Old Value	New Value
F.5.7.5	Q76	2.92	2.668
F.5.7.6	Q79	6.51	5.57