

SAE Mini Baja: Suspension

Concept Generation

Zane Cross, Kyle Egan, Nick Garry, Trevor Hochhaus



October 15, 2014



Overview

- Recap of Problem definition and project plan
- Front Suspension
- Rear Suspension
- Steering
- Conclusion

Recap

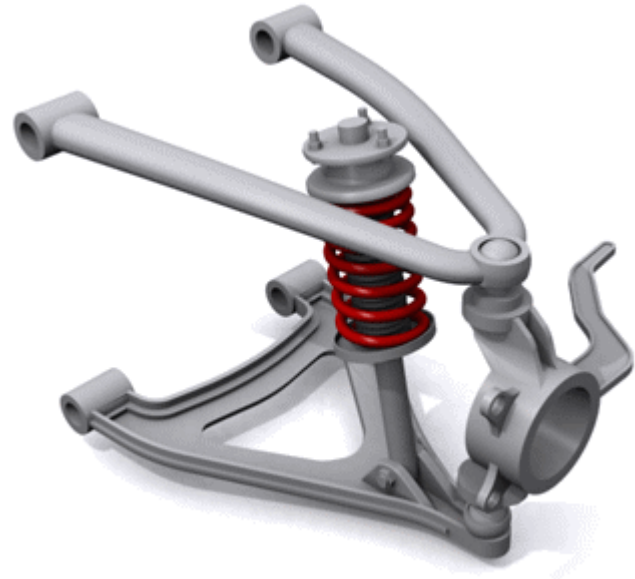
- Design, build, and test Mini Baja Suspension and Steering
- Previous Baja too large, heavy, and lacked maneuverability
- Increase track width, maneuverability, approach angle, reliability
- Conform to constraints given by client
- Examined engineering requirements (QFD)
- Determined how customer needs will affect each other (HOQ)
- Perform state-of-the-art research from resources
- Assign dates for research, design, and building

Front Suspension Concepts

- Double A Arms
- MacPherson
- Torsion Bars
- Extended A Arms

Double A Arms

- Advantages:
 - High strength
 - Highly adjustable
 - Good ground clearance
- Disadvantages:
 - Can be heavy
 - Can be difficult to analyze



www.lostjeeps.com

MacPherson

- Advantages:
 - Lighter weight
 - Less design and machining
- Disadvantages:
 - Higher stresses
 - Requires wheel hub modification



www.multibody.net

Torsion Bars

- Advantages:

- Very high strength
- Only one member
- Large travel

- Disadvantages:

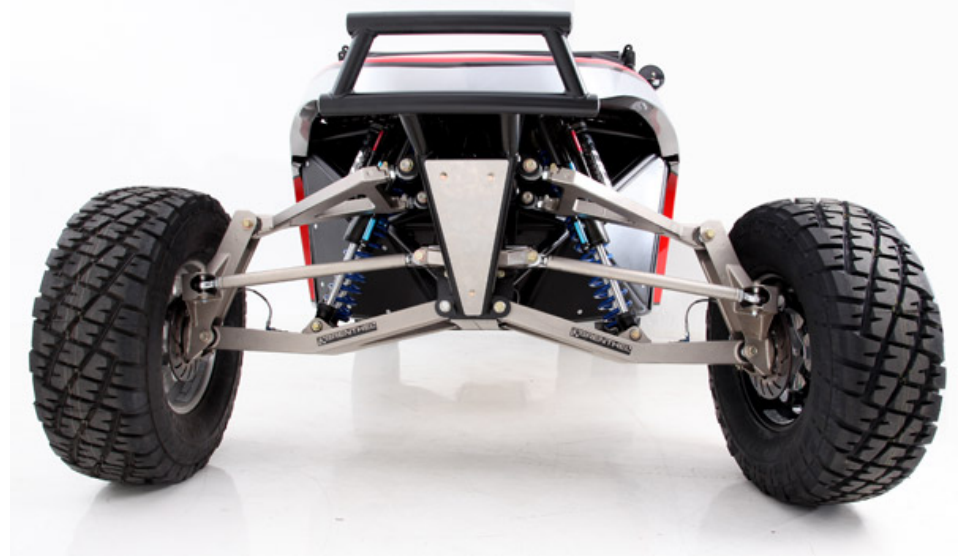
- Less ground clearance
- Heavier design



www.eurobricks.com

Extended A Arms

- Advantages:
 - More travel
 - More ground clearance
- Disadvantages:
 - Heavier
 - Less impact resistance



brenthelindustries.com

Front Suspension Decision Matrix

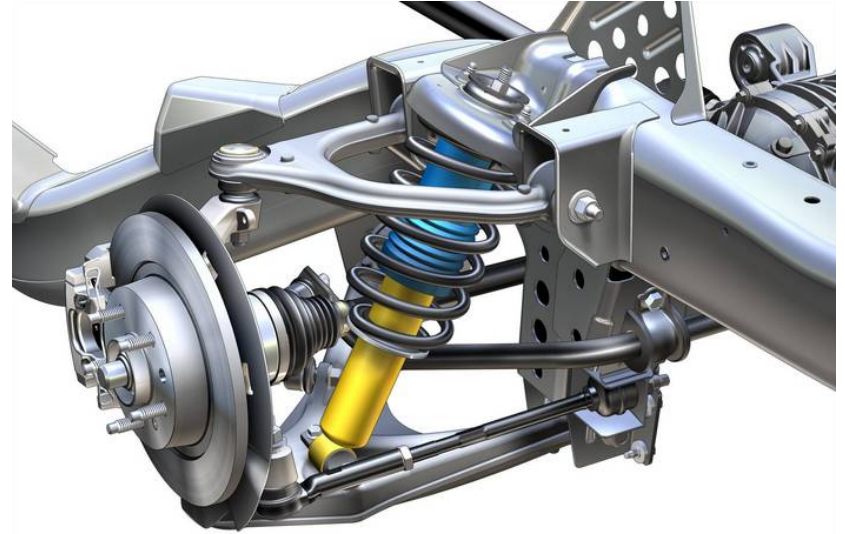
Front Suspension					
	Weight	McPherson	Double A-arms	Torsion Bars	Extended A arms
Cost	10	4	4	3	3
Weight	30	3	3	3	3
Strength	15	3	4	4	4
Ease of Machining	7.5	4	4	4	4
Ease of Design	7.5	3	5	3	3
Safety	2.5	4	4	4	4
Durability	10	3	4	4	4
Ground Clearance	10	3	3	3	4
Total Travel	7.5	3	3	3	3
Raw Total	100	30	34	31	32
Weighted		3.2	3.6	3.4	3.5

Rear Suspension Concepts

- Double A Arms
- 2 link
- 3 link

Double A Arms

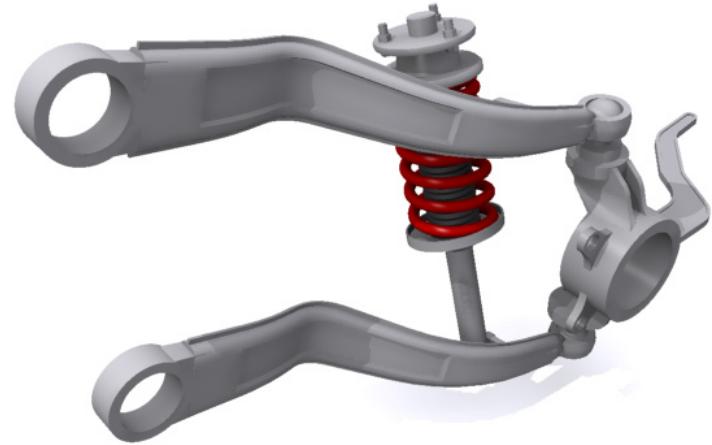
- Advantages:
 - Easy to analyze design
 - High strength
 - Adequate ground clearance
 - Proven design
- Disadvantages:
 - Difficult to machine
 - Space constraint (shock and driveshaft)



www.ultimatecarpage.com

2 Link

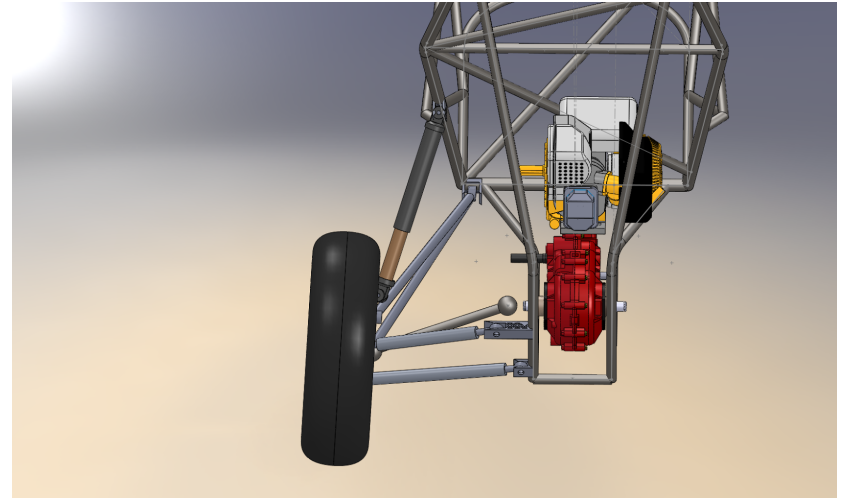
- Advantages:
 - Light weight
 - High strength
 - Low cost
- Disadvantages:
 - Difficult to design
 - Ground clearance



tortoracer.blogspot.com

3 Link

- Advantages:
 - High strength
 - Durable
- Disadvantages:
 - Difficult to analyze
 - High weight
 - High cost



Rear Suspension Decision Matrix

Rear Suspension				
	Weight	Double A arm	2 link	3 link
Cost	10	3	4	4
Weight	30	3	3	3
Strength	15	5	4	3
Ease of Machining	7.5	3	4	3
Ease of Design	7.5	5	3	3
Safety	2.5	5	5	5
Durability	10	5	4	4
Ground Clearance	10	5	3	3
Total Travel	7.5	4	4	4
Raw Total	100	38	34	32
Weighted		4	3.6	3.3

Steering Concepts

- Back mounted
- Front mounted
- Power assist

Back Mounted



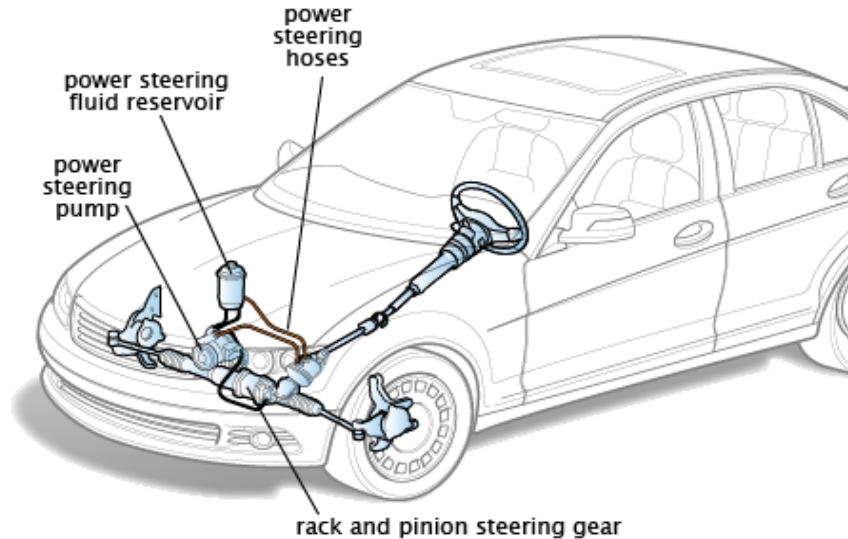
- Advantages:
 - Less likely to break on impact
 - More footwell room
- Disadvantages:
 - Less room for driver's legs
 - Possible for u-joint to bind

Front Mounted



- Advantages:
 - More room for driver's legs
 -
- Disadvantages:
 - More weight
 - More likely to break on impact

Power Assist



- Advantages:
 - Easier for driver
 - Adjustable
- Disadvantages:
 - Much heavier compared to non power assist
 - Uses much needed engine power

Steering Decision Matrix

Steering				
	Weight	Back Mounted 4-1	Front Mounted 4-1	Power Steering
Cost	10	4	4	1
Weight	15	4	4	2
Strength	10	2	2	4
Ease of Machining	5	4	4	1
Ease of Design	5	5	5	1
Safety	5	4	4	4
Durability	10	5	3	4
Turning Radius	20	5	5	3
Ease of turning	15	4	4	3
Foot room	5	2	4	3
Raw Total	100	39	39	26
Weighted		4.1	4	2.7

Conclusion

Front Suspension:

- Double A-arms
- Extended A-arms

Rear Suspension:

- Double A-arms
- 2-link

Steering:

- Back Mounted Rack and Pinion
- Front Mounted Rack and Pinion

References

- www.lostjeeps.com
- www.multibody.net
- www.eurobricks.com
- brenthelindustries.com
- www.ultimatecarpage.com
- tortoracer.blogspot.com
- ucsbracing.blogspot.com
- www.mech.utah.edu
- www.cougar-racing.com
- repairpal.com