Design Support

Suspensions & Vehicle Dynamics

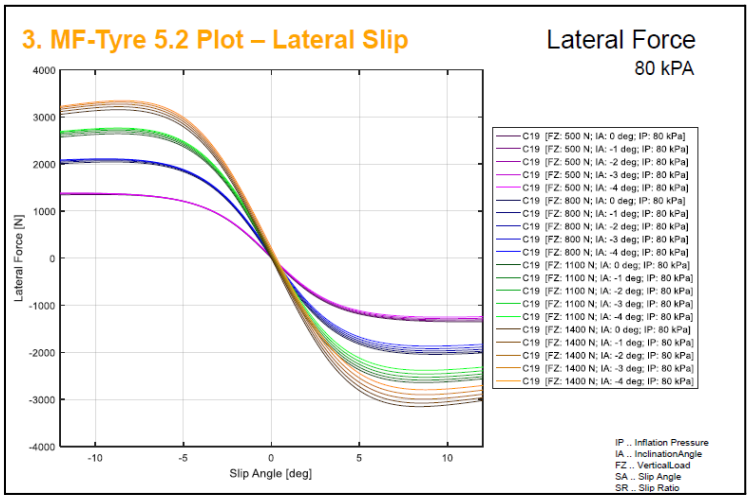
Objectives

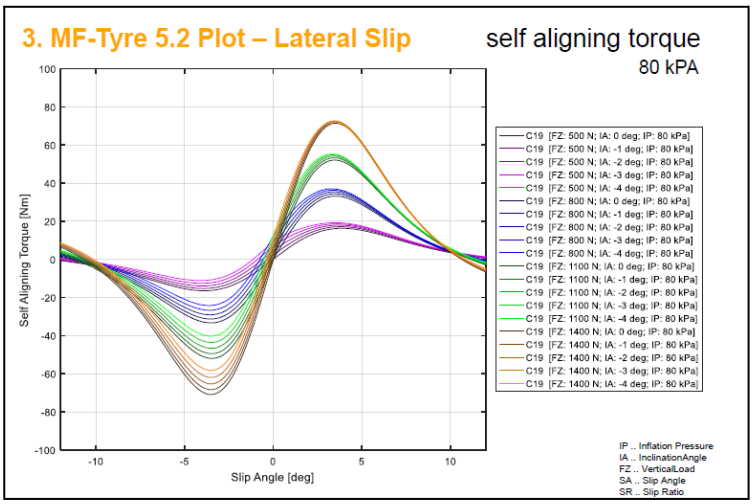
- Predictable behavior of the car for non-professional drivers
- Extract maximum grip from the tires
- Easily adjustable
- First EV : reliability and ease of operations first

Conception steps

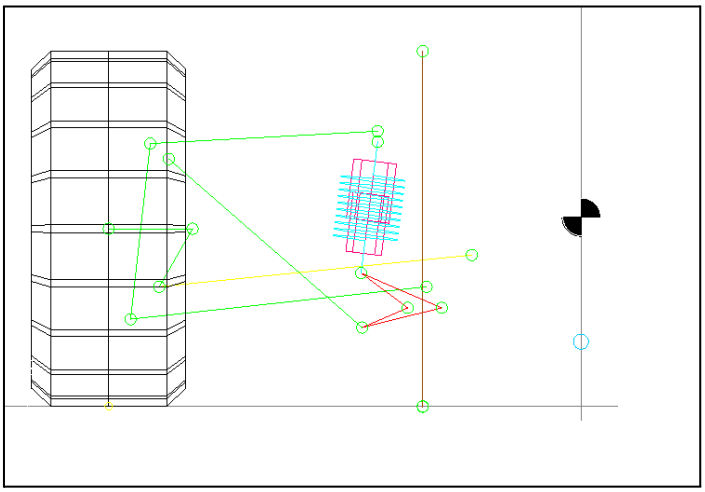
1st Step : tyre choice & tyre study

	Continental C19	Hoosier HB137	Goodyear Eagle
Grip capability	4	3	5
Weight	5	4	5
Price	5	5	3
Ease of supply	3	3	1
Total	17	15	14





2nd step : Suspension geometry and kinematics



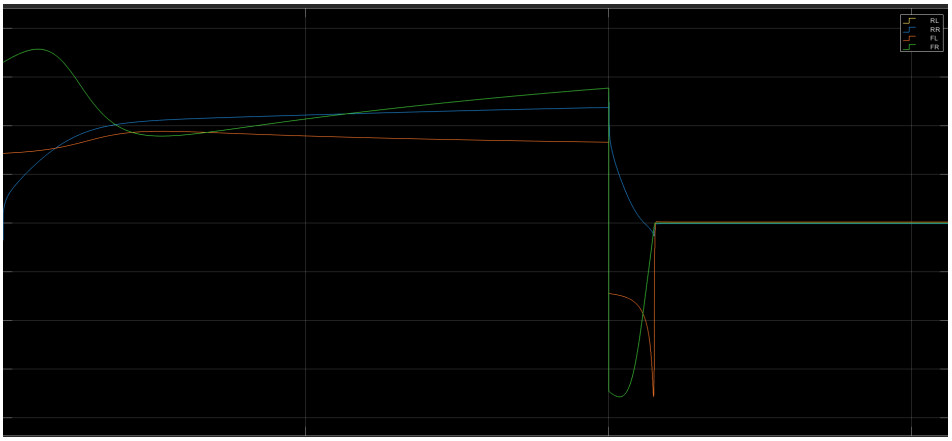
Front suspension geometry

X (mm)	Y (mm)	Z (mm)	
-160.10	205.00	138.00	Point 1: Lower wishbone front pivot
139.90	205.00	138.00	Point 2: Lower wishbone rear pivot
-10.10	593.58	65.20	Point 3: Lower wishbone outer ball joint
-132.04	270.00	344.00	Point 5: Upper wishbone front pivot
117.96	270.00	344.00	Point 6: Upper wishbone rear pivot
-7.04	568.92	297.94	Point 7: Upper wishbone outer ball joint
-7.04	544.32	280.47	Point 8: Push rod wishbone end
-7.04	282.32	60.07	Point 9: Push rod rocker end
-66.96	597.95	110.55	Point 11: Outer track rod ball joint
-120.00	144.78	185.00	Point 12: Inner track rod ball joint
-7.04	253.00	327.00	Point 16: Damper to body point
-7.04	299.56	131.01	Point 17: Damper to rocker point
-0.30	512.03	184.66	Point 18: Wheel spindle point
0.19	623.24	186.02	Point 19: Wheel centre point
-7.04	185.00	110.00	Point 20: Rocker axis 1st point
-8.04	185.00	110.00	Point 21: Rocker axis 2nd point
240.00	297.54	148.30	Point 22: Part 1 C of G
230.00	414.06	370.69	Point 23: Part 2 C of G
28.12	453.50	363.08	Point 24: Part 3 C of G
155.45	493.96	294.44	Point 25: Part 4 C of G
155.00	152.25	241.07	Point 26: Part 5 C of G
135.84	758.88	307.66	Point 27: Part 6 C of G
-7.04	228.87	99.98	Point 0: ARB to rocker

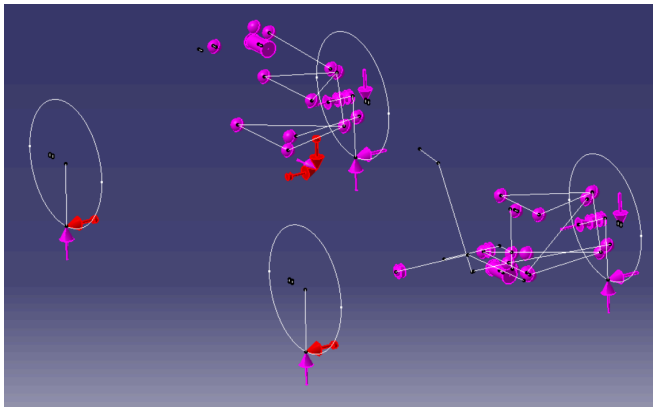
Suspensions hard points

3rd step : CAD and mechanical design

Load cases through a 7DOF car model then into MecaMaster :



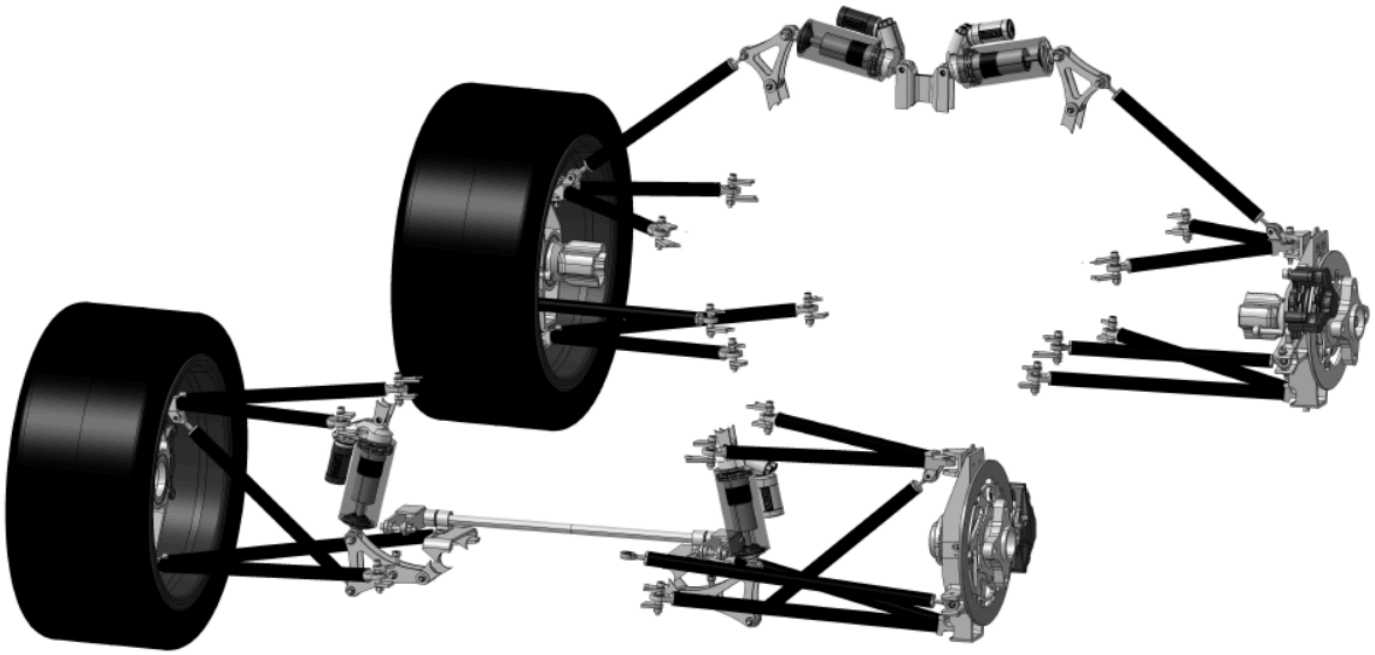
Load cases for a 10° steering maneuver



Car model on MecaMaster

	Nom Meca Master	Nom	Type	Part 1	Part 2	Rx	Ry	Rz	F
Front Suspension	BJ_Front upper front inner BJ	Upper A-arm Front Ball Joint	BJ	frame	front upper f	522,735	1262,927	-68,583	1368,554
	BJ_Front upper rear inner BJ	Upper A-arm Rear Ball Joint	BJ	frame	front upper r	64,667	156,236	8,484	169,30294
	BJ_Front upper front outer BJ	N/A	BJ	front upright	front upper f	-522,735	1262,927	68,583	1368,554
	BJ_Front upper rear outer BJ	N/A	BJ	front upright	front upper r	-64,667	-156,236	-8,484	169,30294
	BJ_Front lower front inner BJ	Lower A-arm Rear Ball Joint	BJ	frame	front lower fi	-574,995	1506,487	164,832	1620,8923
	BJ_Front lower rear inner BJ	Lower A-arm Front Ball Joint	BJ	frame	front lower r	-1082,543	2836,262	-310,329	3051,6529
	BJ_Front lower front outer BJ	N/A	BJ	front upright	front lower fi	574,995	1506,487	-164,832	1620,8923
	BJ_Front lower rear outer BJ	N/A	BJ	front upright	front lower r	1082,543	2836,262	310,329	3051,6529
	BJ_front tie rod inboard	Inboard Tie-rod Ball Joint	BJ	frame	front tie rod	-58,87	518,871	50,688	524,65423
	BJ_front tie rod outboard	Outboard Tie-rod Ball Joint	BJ	front upright	front tie rod	58,87	-518,871	-50,688	524,65423
	BJ_front pullrod outboard	Outboard Push-Rod Ball join	BJ	front upright	front pullrod	0	1119,053	974,098	1483,6261
	BJ_front pullrod inboard	Inboard Push-Rod Ball Joint	BJ	front rocker	front pullrod	0	1119,053	-974,098	1483,6261
	BJ_front absorber inboard	Inboard Shock Ball Joint	BJ	frame	front absorb	0	-259,085	-1135,99	1165,1602
	BJ_front absorber outboard	Outboard Shock Ball Joint	BJ	front rocker	front absorb	0	259,085	1135,99	1165,1602
	PI_front rocker	Rocker Pivot	PI	front rocker	frame	0	1378,139	-161,892	1387,6153
	SS-XZ_front outer bearing	Radial Force Outer Bearing	SS	front upright	front wheel	-1665,296	-16,773	-932,611	1908,7314
	SS-XZ_front inner bearing	Radial Force Inner Bearing	SS	front upright	front wheel	536,29	-50,329	-2798,42	2849,7885
	PO-Y_front wheel axis force	Axial Force Bearing	PO	front upright	front wheel	0	-777,983	13,992	778,10881
	PO-Z_front brake force	Brake Force	PO	front wheel	front upright	0	-46,543	-2588,033	2588,4515
	PO-Z_FL normal force	Normal Force on tire	PO	front wheel	ground	0	0	-1129,005	1129,005
	PO-Z_FR normal force	Normal Force on tire	PO	frame	ground	0	0	-826,157	826,157
Rear Suspension	BJ_rear upper rear inner BJ	Upper A-arm Front Ball Joint	BJ	frame	rear upper fr	-189,104	251,325	-21,228	315,23833
	BJ_rear upper rear inner BJ	Upper A-arm Rear Ball Joint	BJ	frame	rear upper re	924,468	1228,648	-103,779	1541,0993
	BJ_rear upper rear outer BJ	N/A	BJ	rear upright	rear upper fr	189,104	-251,325	21,228	315,23833
	BJ_rear upper rear outer BJ	N/A	BJ	rear upright	rear upper re	-924,468	1228,648	103,779	1541,0993
	BJ_rear lower rear inner BJ	Lower A-arm Rear Ball Joint	BJ	frame	rear lower fr	-507,226	1051,341	94,928	1171,1565
	BJ_rear lower rear inner BJ	Lower A-arm Front Ball Joint	BJ	frame	rear lower re	-1363,445	2826,051	-255,171	3148,1199
	BJ_rear lower rear outer BJ	N/A	BJ	rear upright	rear lower fr	507,226	1051,341	-94,928	1171,1565
	BJ_rear lower rear outer BJ	N/A	BJ	rear upright	rear lower re	1363,445	2826,051	255,171	3148,1199
	BJ_rear tie rod inboard	Inboard Tie-rod Ball Joint	BJ	frame	rear tie rod	-59,53	317,991	11,352	323,71433
	BJ_rear tie rod outboard	Outboard Tie-rod Ball Joint	BJ	rear upright	rear tie rod	59,53	-317,991	-11,352	323,71433
	BJ_rear pushrod outboard	Outboard Push-Rod Ball join	BJ	rear upright	rear pushroc	0	1218,09	920,939	1527,0468
	BJ_rear pushrod inboard	Inboard Push-Rod Ball Joint	BJ	rear rocker	rear pushroc	0	1218,09	-920,939	1527,0468
	BJ_rear absorber inboard	Inboard Shock Ball Joint	BJ	frame	rear absorbe	0	1078,929	236,215	1104,4842
	BJ_rear absorber outboard	Outboard Shock Ball Joint	BJ	rear rocker	rear absorbe	0	1078,929	-236,215	1104,4842
	PI_rear rocker	Rocker Pivot	PI	rear rocker	frame	0	139,161	1157,154	1165,4918
	SS-XZ_rear outer bearing	Radial Force Outer Bearing	SS	rear upright	rear wheel	-1762,404	3,016	155,688	1769,2698
	SS-XZ_rear inner bearing	Radial Force Inner Bearing	SS	rear upright	rear wheel	567,567	-91,343	-4715,287	4750,2008
	PO-Y_rear wheel axis force	Axial Force Bearing	PO	rear upright	rear wheel	0	1171,245	22,689	1171,4647
	PO-Z_rear brake force	Brake Force	PO	rear upright	rear wheel	0	64,735	3342,073	3342,6999
	PO-Z_RL normal force	Normal Force on tire	PO	rear wheel	ground	0	0	-1194,837	1194,837
	PO-Z_RR normal force	Normal Force on tire							

Individual forces



Mechanical Design