Simulation of tract chassis
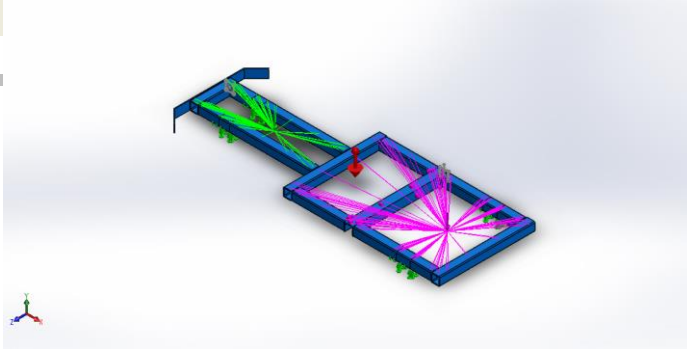
Date: Tuesday, March 1, 2022
Designer: JIBEBE PROJECT
Study name: Frequency 1
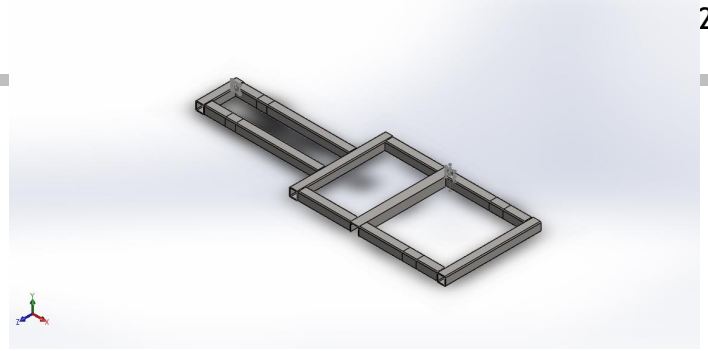**Analysis type:** Frequency

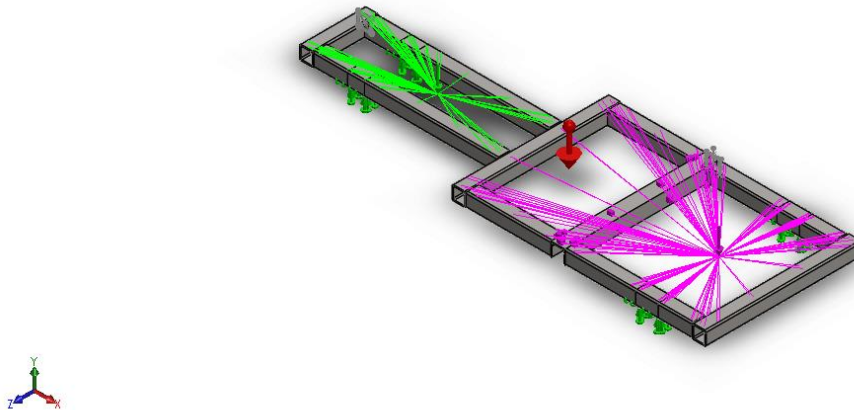## Table of Contents

Description

No Data

Assumptions
JIBEBE
Be on the move

Original Model
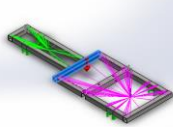
Model Analyzed
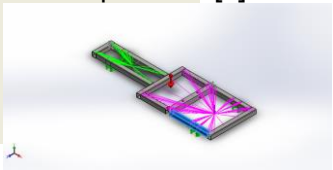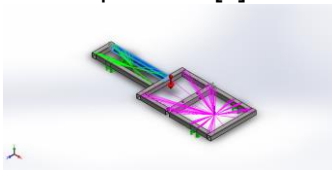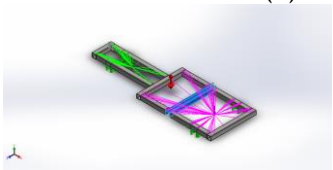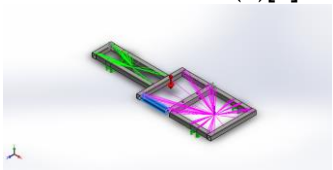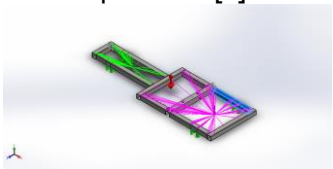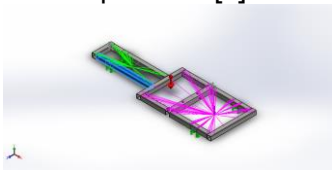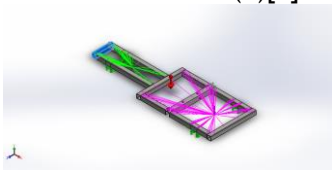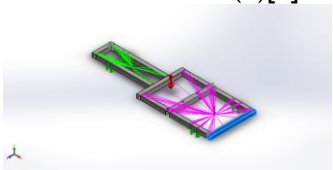
Model Information
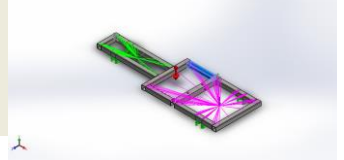
Model name: tract chassis
Current Configuration: with c channel<As Machined>

Solid Bodies

Document Name and Reference	Treated As	Volumetric Properties	Document Path/Date Modified
C channel 75X50(1)[3]	Solid Body	**Mass:3.87693 kg Volume:0.000490751 m^3 Density:7900 kg/m^3 Weight:37.9939 N**	**C:\Users\pc\Desktop\Electric vehicle\Chassis\tract chassis.SLDPRT** Mar 01 22:56:51 2022

Split Line2[1]	Solid Body	Mass:3.17204 kg Volume:0.000401523 m^3 Density:7900 kg/m^3 Weight:31.0859 N	C:\Users\pc\Desktop\Elect ric vehicle\Chassis\tract chassis.SLDPRT Mar 01 22:56:51 2022
Split Line1[2]	Solid Body	Mass:4.58183 kg Volume:0.000579978 m^3 Density:7900 kg/m^3 Weight:44.9019 N	C:\Users\pc\Desktop\Elect ric vehicle\Chassis\tract chassis.SLDPRT Mar 01 22:56:51 2022
C channel 50X50X4(1)	Solid Body	Mass:2.63766 kg Volume:0.000333882 m^3 Density:7900 kg/m^3 Weight:25.8491 N	C:\Users\pc\Desktop\Elect ric vehicle\Chassis\tract chassis.SLDPRT Mar 01 22:56:51 2022
C channel 75X50(1)[8]	Solid Body	Mass:2.11469 kg Volume:0.000267682 m^3 Density:7900 kg/m^3 Weight:20.724 N	C:\Users\pc\Desktop\Elect ric vehicle\Chassis\tract chassis.SLDPRT Mar 01 22:56:51 2022
Split Line2[2]	Solid Body	Mass:3.17204 kg Volume:0.000401523 m^3 Density:7900 kg/m^3 Weight:31.0859 N	C:\Users\pc\Desktop\Elect ric vehicle\Chassis\tract chassis.SLDPRT Mar 01 22:56:51 2022
Split Line1[1]	Solid Body	Mass:4.58183 kg Volume:0.000579978 m^3 Density:7900 kg/m^3 Weight:44.9019 N	C:\Users\pc\Desktop\Elect ric vehicle\Chassis\tract chassis.SLDPRT Mar 01 22:56:51 2022
C channel 75X50(1)[1]	Solid Body	Mass:1.62126 kg Volume:0.000205223 m^3 Density:7900 kg/m^3 Weight:15.8884 N	C:\Users\pc\Desktop\Elect ric vehicle\Chassis\tract chassis.SLDPRT Mar 01 22:56:51 2022
C channel 75X50(1)[2]	Solid Body	Mass:3.87693 kg Volume:0.000490751 m^3 Density:7900 kg/m^3 Weight:37.9939 N	C:\Users\pc\Desktop\Elect ric vehicle\Chassis\tract chassis.SLDPRT Mar 01 22:56:51 2022

| C channel 75X50(1)[9] | Solid Body | Mass:2.11469 kg
Volume:0.000267682 m^3
Density:7900 kg/m^3
Weight:20.724 N | C:\Users\pc\Desktop\Elect ric vehicle\Chassis\tract chassis.SLDPRT
Mar 01 22:56:51 2022 |

Study Properties
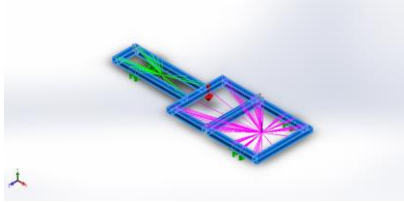
Study name	Frequency 1
Analysis type	Frequency
Mesh type	Solid Mesh
Number of frequencies	5
Solver type	Direct sparse solver
Soft Spring:	Off
Incompatible bonding options	Automatic
Thermal option	Include temperature loads
Zero strain temperature	298 Kelvin
Include fluid pressure effects from SOLIDWORKS Flow Simulation	Off
Result folder	SOLIDWORKS document (C:\Users\pc\Desktop\Electric vehicle\Chassis)

Units

Unit system:	SI (MKS)
Length/Displacement	mm
Temperature	Kelvin
Angular velocity	Rad/sec
Pressure/Stress	N/m^2
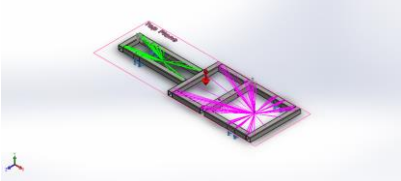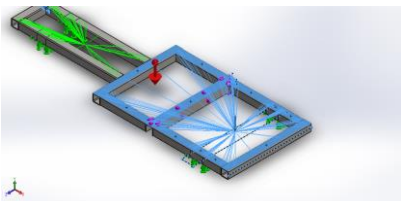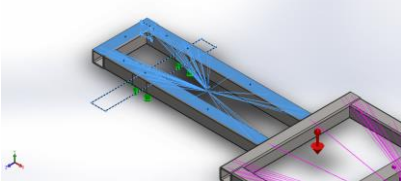
Material Properties

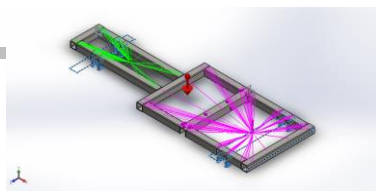| Model Reference	Properties	Components
	Name: AISI 1020 **Model type:** Linear Elastic Isotropic **Default failure criterion:** Unknown **Yield strength:** 3.51571e+008 N/m^2 **Tensile strength:** 4.20507e+008 N/m^2 **Mass density:** 7900 kg/m^3 **Elastic modulus:** 2e+011 N/m^2 **Poisson's ratio:** 0.29 **Thermal expansion coefficient:** 1.5e-005 /Kelvin	SolidBody 1(C channel 75X50(1)[3])(tract chassis), SolidBody 2(Split Line2[1])(tract chassis), SolidBody 3(Split Line1[2])(tract chassis), SolidBody 4(C channel 50X50X4(1))(tract chassis), SolidBody 5(C channel 75X50(1)[8])(tract chassis), SolidBody 6(Split Line2[2])(tract chassis), SolidBody 7(Split Line1[1])(tract chassis), SolidBody 8(C channel 75X50(1)[1])(tract chassis), SolidBody 9(C channel 75X50(1)[2])(tract chassis), SolidBody 10(C channel 75X50(1)[9])(tract chassis)
Curve Data:N/A		

Loads and Fixtures

Fixture name	Fixture Image	Fixture Details
Fixed-1		**Entities:** 4 face(s) **Type:** Fixed Geometry

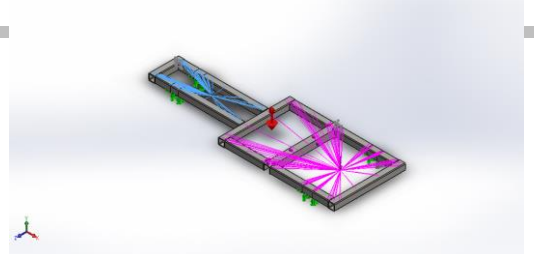| Load name	Load Image	Load Details
Gravity-1		**Reference:** Top Plane **Values:** 0 0 -9.81 **Units:** SI
Remote Load/Mass (Rigid connection)-1		**Entities:** 11 face(s) **Type:** Load/Mass (Rigid connection) **Coordinate System:** Global cartesian coordinates **Force Values:** ---, -3000, --- N **Moment Values:** ---, ---, --- N.m **Reference coordinates:** 1345 0 0 mm **Components transferred:** Force
Remote Load/Mass (Rigid connection)-2		**Entities:** 7 face(s) **Type:** Load/Mass (Rigid connection) **Coordinate System:** Global cartesian coordinates **Force Values:** ---, -3500, --- N **Moment Values:** ---, ---, --- N.m **Reference coordinates:** 350 0 0 mm **Components transferred:** Force

Connector Definitions

No Data

Contact	Contact Image	Contact Properties
Global Contact		**Type:** Bonded **Components:** 1 component(s) **Options:** Compatible mesh

Mesh Information

Mesh type	Solid Mesh
Mesher Used:	Standard mesh
Automatic Transition:	Off
Include Mesh Auto Loops:	Off
Jacobian points	4 Points
Element Size	46.7245 mm
Tolerance	1.26282 mm
Mesh Quality Plot	High
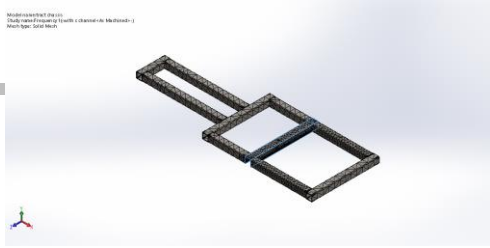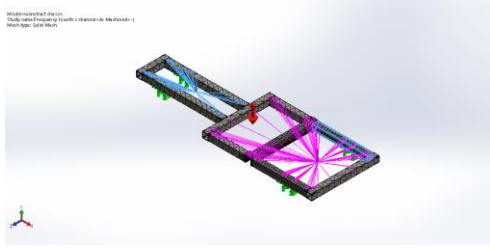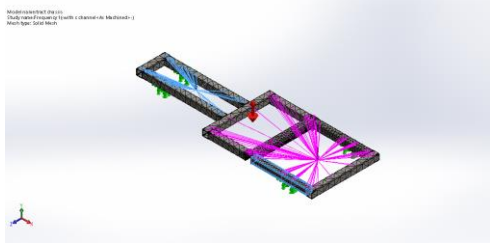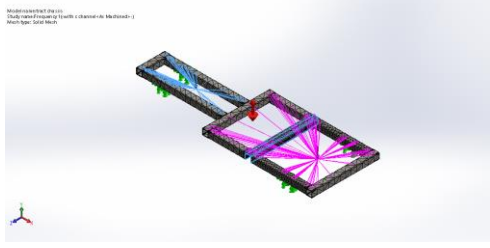
Mesh information - Details

Total Nodes	51500
Total Elements	26062
Maximum Aspect Ratio	50.575
% of elements with Aspect Ratio < 3	56.5
% of elements with Aspect Ratio > 10	5.02
% of distorted elements(Jacobian)	0
Time to complete mesh(hh;mm;ss):	00:00:04
Computer name:	SIR_ALECS

Model name:tract chassis
Study name:Frequency 1(-with c channel<As Machined>-)
Mesh type: Solid Mesh
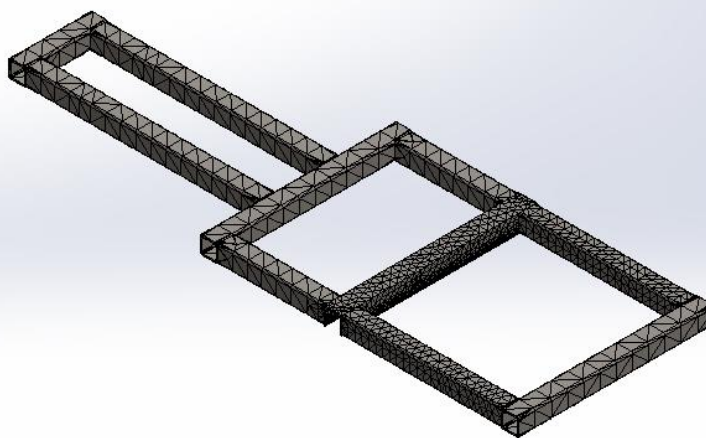
Mesh Control Information:

Mesh Control Name	Mesh Control Image	Mesh Control Details
Control-1		**Entities:** 3 face(s) **Units:** mm **Size:** 19.6499 **Ratio:** 1.5
Control-2		**Entities:** 1 Solid Body (s) **Units:** mm **Size:** 21.1523 **Ratio:** 1.5
Control-3		**Entities:** 1 Solid Body (s) **Units:** mm **Size:** 19.5738 **Ratio:** 1.5
Control-4		**Entities:** 1 Solid Body (s) **Units:** mm **Size:** 18.6266 **Ratio:** 1.5

Sensor Details
No Data

Name	Type	Min	Max
Amplitude1	AMPRES: Resultant Amplitude Plot for Mode Shape: 1(Value = 475.34 Hz)	0.000e+000 Node: 2002	3.262e-001 Node: 1310

Model name:tract chassis
Study name:Frequency 1(-with c channel<As Machined>-)
Plot type: Frequency Amplitude1
Mode Shape : 1 Value =   475.34 Hz
Deformation scale: 0.490479

AMPRES

3.262e-001
2.990e-001
2.719e-001
2.447e-001
2.175e-001
1.903e-001
1.631e-001
1.359e-001
1.087e-001
8.156e-002
5.437e-002
2.719e-002
0.000e+000
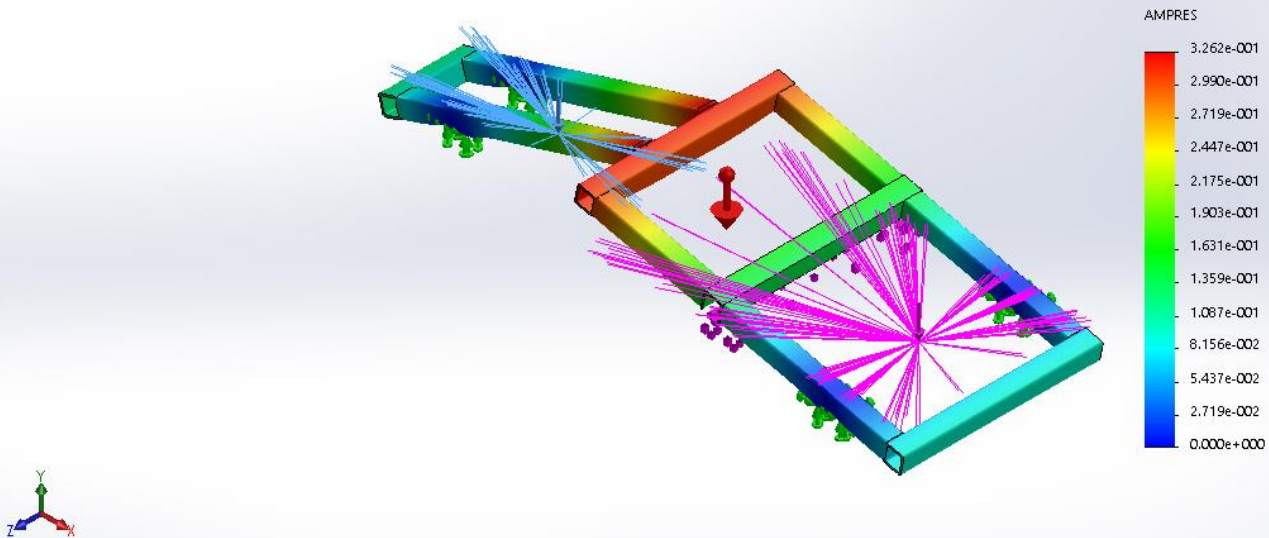
tract chassis-Frequency 1-Amplitude-Amplitude1

Name	Type	Min	Max
Amplitude2	AMPRES: Resultant Amplitude Plot for Mode Shape: 2(Value = 881.856 Hz)	0.000e+000 Node: 2002	2.318e-001 Node: 7493

Model name:tract chassis
Study name:Frequency 1(-with c channel<As Machined>-)
Plot type: Frequency Amplitude2
Mode Shape : 2 Value =   881.86 Hz
Deformation scale:0.690352

AMPRES

2.318e-001
2.125e-001
1.932e-001
1.738e-001
1.545e-001
1.352e-001
1.159e-001
9.658e-002
7.727e-002
5.795e-002
3.863e-002
1.932e-002
0.000e+000

tract chassis-Frequency 1-Amplitude-Amplitude2

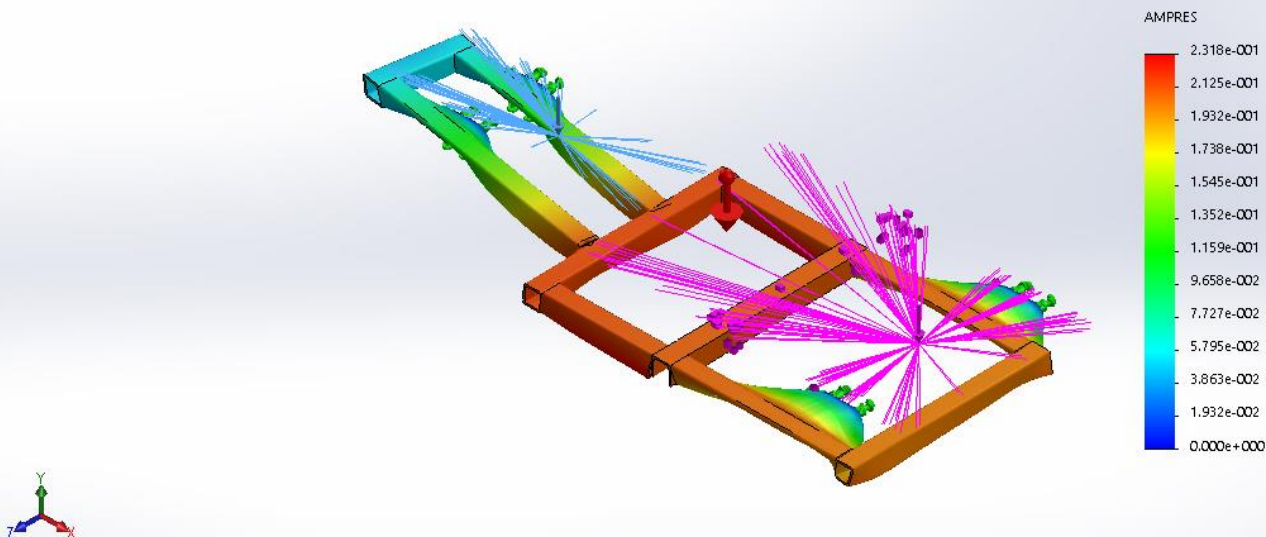| Name	Type	Min	Max
Amplitude3	AMPRES: Resultant Amplitude Plot for Mode Shape: 3(Value = 1811.7 Hz)	0.000e+000 Node: 2002	4.426e-001 Node: 17720

Model name:tract chassis
Study name:Frequency 1(-with c channel<As Machined>-)
Plot type: Frequency Amplitude3
Mode Shape : 3 Value =   1811.7 Hz
Deformation scale:0.36356

AMPRES

4.426e-001
4.057e-001
3.689e-001
3.320e-001
2.951e-001
2.582e-001
2.213e-001
1.844e-001
1.475e-001
1.107e-001
7.377e-002
3.689e-002
0.000e+000

tract chassis-Frequency 1-Amplitude-Amplitude3

Name		Type	Min	Max
Amplitude4		AMPRES: Resultant Amplitude Plot for Mode Shape: 4(Value = 2090.87 Hz)	0.000e+000 Node: 2002	2.256e+000 Node: 25069

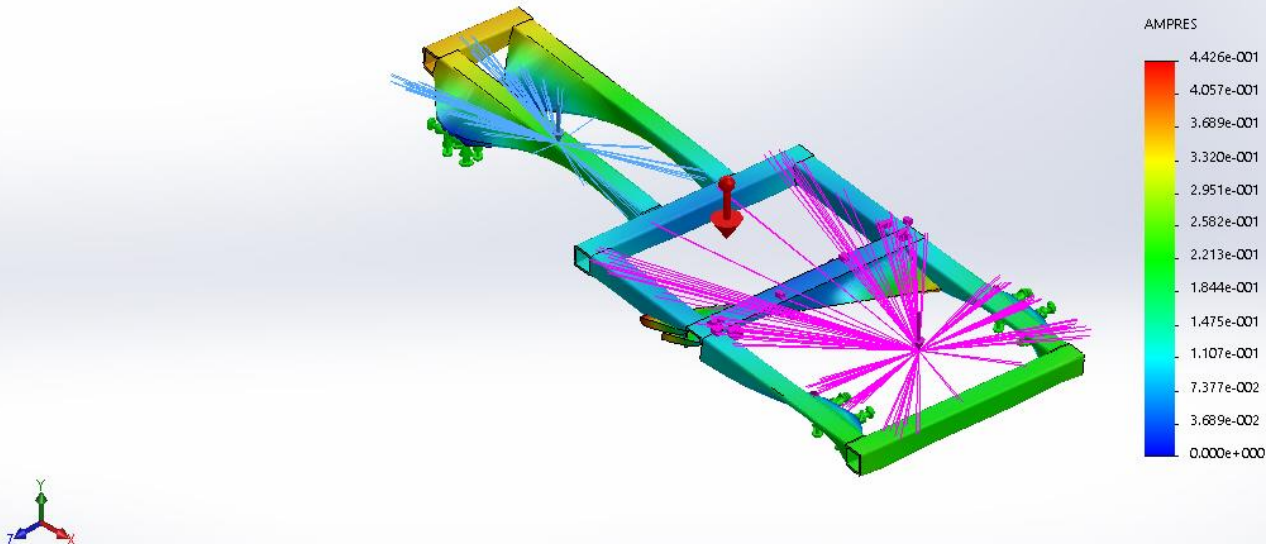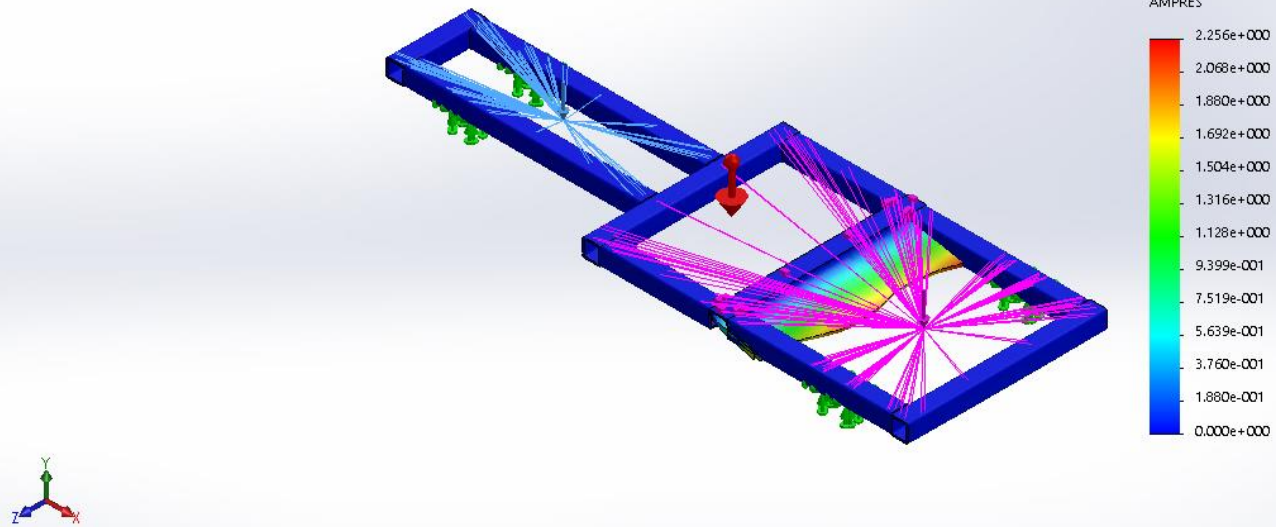Model name:tract chassis
Study name:Frequency 1(-with c channel<As Machined>-)
Plot type: Frequency Amplitude4
Mode Shape :4 Value = 2090.9 Hz
Deformation scale:0.0711111

AMPRES

- 2.256e+000
- 2.068e+000
- 1.880e+000
- 1.692e+000
- 1.504e+000
- 1.316e+000
- 1.128e+000
- 9.399e-001
- 7.519e-001
- 5.639e-001
- 3.760e-001
- 1.880e-001
- 0.000e+000

tract chassis-Frequency 1-Amplitude-Amplitude4

Name	Type	Min	Max
Amplitude5	AMPRES: Resultant Amplitude Plot for Mode Shape: 5(Value = 2121.08 Hz)	0.000e+000 Node: 2002	2.739e+000 Node: 17853

Model name:tract chassis
Study name:Frequency 1(-with c channel<As Machined>-)
Plot type: Frequency Amplitude5
Mode Shape : 5   Value =   2121.1 Hz
Deformation scale: 0.0585683

AMPRES
2.739e+000
2.511e+000
2.283e+000
2.054e+000
1.826e+000
1.598e+000
1.370e+000
1.141e+000
9.130e-001
6.848e-001
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2.283e-001
0.000e+000
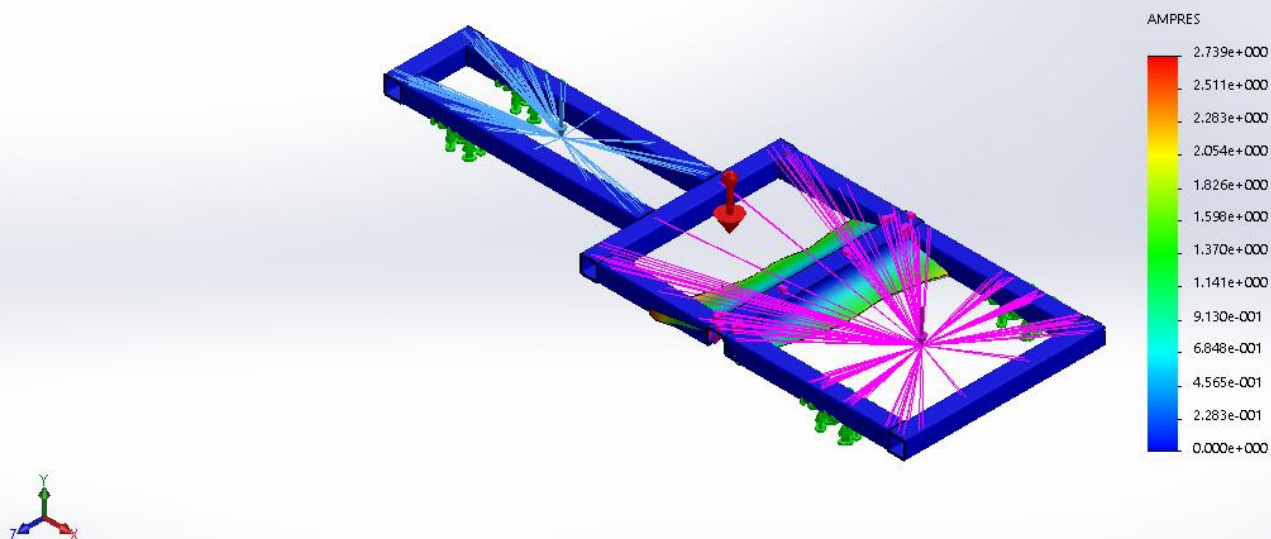
tract chassis-Frequency 1-Amplitude-Amplitude5

Mode List

Frequency Number	Rad/sec	Hertz	Seconds
1	2986.7	475.34	0.0021038
2	5540.9	881.86	0.001134
3	11383	1811.7	0.00055197
4	13137	2090.9	0.00047827
5	13327	2121.1	0.00047146

Mass Participation (Normalized)

Mode Number	Frequency(Hertz)	X direction	Y direction	Z direction
1	475.34	2.4296e-005	0.34868	2.6782e-006
2	881.86	1.5693e-007	9.4623e-009	0.85807
3	1811.7	1.0973e-008	7.1014e-007	0.033538
4	2090.9	0.084195	4.0801e-005	1.1462e-005
5	2121.1	0.0015483	1.5984e-006	0.00030601
		Sum X = 0.085767	Sum Y = 0.34873	Sum Z = 0.89193

Discussion

The battery packs, motor and the gearbox are all to be carried by the chassis. Of these the components that rotate are the motor and the gearbox. Since the motor rotates at very high speeds its operating frequency is calculated as illustrated below.

$$f = \frac{\omega}{2\pi}$$

$$\omega = \frac{2\pi N}{60}$$

Hence for a top speed of 3500rpm

Using the formulas shown above then the operating frequency of the motor is 58.33Hz (366.52rad/s)

 For safe operation of the chassis and avoiding resonance the operating frequency of the motor should never coincide with the natural frequency of the chassis.