BRAUN

TUDelft

HOME

Appendices

A

Depest study

Demographic

Women road race cycling

The number of female participants in road race cycling is growing (Algemeen dagblad,2017). The focus of most of the female participants is not on the racing or climbing aspects in contrary to the male cyclist. It seems that the social aspect of cycling is the leading driver of the average female cyclist.

Bron vrouwen wierlennen
https://www.ad.nl/wonen/wielrennen-is-booming-zeker-onder-vrouwen~aa269a32/

- Immigranten uit midden oosten
- 1% groei aantal vrouwelijk leden tussen 2011 en 2014
- Vergrijzing
- bevolking groeit
- Groei in wielrenner aantal
- wedstrijdlicenties blijft gelijk
- merendeel wielrenners 30+
- pieken ledenaantal op jeugd(10tot14) en (45tot49)
- licentiehouders voornamelijk in de jeugd
- 1% groei aantal vrouwelijk leden tussen 2011 en 2014

Ecological

growing interest of the bicycling industry in sustainability

Some of the biggest brands in road race bicycling industry (Trek, Specialized) have launched recycling programs of their bicycle frames. This is marketed in magazines, websites, etc. This could is a sign that the sustainability movement is getting a grip on the bicycling industry. The old carbon frames of road race cycles are ground down, stripped from resin and used as plastic fillers or in low strength carbon products.

- Ocean clean-up
- Growing interest sustainability big bicycling companies
- Pollution of the planet earth

Political

Forbidden to use phone on the bicycle

A new law that starts in 2019 states that cyclists may not have a mobile, navigation or reading device in their hands whilst using a bicycle. This because using a mobile device while cycling improves the chance of being involved in an accident by 10%. The mobile device may be mounted on your bicycle but may not be a distraction for the user. (NRC,2018) What will this law imply for the road race cyclist? A large group of the cyclist use strava whilst cycling or any other means of navigation. The cyclist gets more and more direct feedback on their cycling performance on screen, this could definitely be a form of ‘distraction’.

- no more weight limit rule UCI?
- niet meer appen op de fiets

Economic

More money being spend on bicycles

The average price that the consumer pays for their bicycle is rising. This could be partly due to the coming of the E-bike, but also the amount of money being spend on road race cycling bikes and equipment has risen to a price of 1.724,- on average. 5% of the road race community is being classified as the ‘big spenders’, this group is willing to pay around 5.250,- for a new bike. (NTFU, 2016)

- more money being spend on bicycles
- benzine prijzen hoger

Social

The rise of social media

Road race cyclist have their own social media platform to share their rides, and records with the world, it is called STRAVA. Strava is an app on the smartphone that can be used as a navigation tool during cycling. Next to keeping track of where you have ridden it also keeps track of you performances, times and speeds. The cyclist can choose to upload their rides and share them on facebook and etc. This probably fits the trend of people showing how healthy and youthful they are.

- ride Posting on social media
- following the pro
- cyclist fora
- bike share

Technological

Carbon frames

Most of today's bicycles are made out of carbon. The ultra-light material seems to be the status quo in the bicycle scene. The question rises if it really is that much better than steel or aluminium? The only thing we can say is it is new and here to stay.

Electric bicycles

The electric bicycle is on the rise. Where the electric bicycle was firstly only a transportation device for elderly and disabled, now also the younger consumer is persuaded by the convenience of the electric bicycle. Even the road cycling industry has an E-road bike market that is steadily growing. Is this a correlation with the rising average age of the road race cyclist?

Aero Aero Aero

2018 was the year of the aero road race bicycle. Around 45km/h the aerodynamics of the cyclist and the bicycle is becoming the dominant factor which holds back speed. Where aerodynamic frames firstly were only applied in time-trials and velodrome cycling now it is also being applied in ‘normal’ road cycling. The new group of bicycles that has been created than also is called the road-aero bicycle. This is interesting because weight used to be the main optimisation focus for many companies where aerobicycles are usually much heavier than normal road bicycles.

Steel is real

The steel is real movement is on the rise. The whole bespoken bicycle community steadily grows as steel is the choice of most of the custom frame builders around the world.

- Carbon frames
- electric cycling
- aero-frames
- Steel is real
- diskbrakes
- softer tire
- ‘flex’ frame
- oversized tubes
- power measure
- autonomous driving
- quest for comfort

B

The history of the road race bicycle frame

Pre diamond frame era

Draisines

The first bicycle liked products merely existed out of two wheels, handlebars and a wooden frame connecting the wheels. The rider of these machines called draisines moved forward by skipping their feet on the ground. One of the first recorded races on draisines was in 1819 in Essex (Hadland 2001). During this competition the riders competed on who could go furthest in an hour. The winner of the race nearly achieved to cover 8 mile in these 60 minutes.

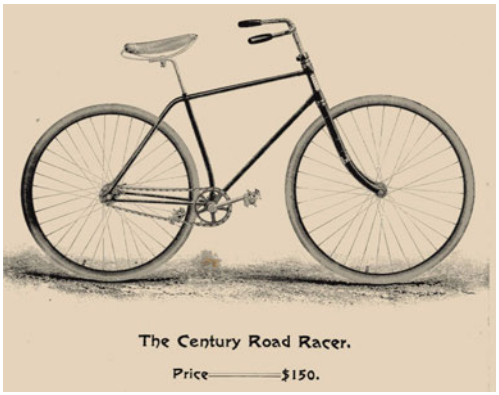
Michaux-style velocipede

40 years after the first races on the draisines a new kind of bicycle was introduced, the michaux style velocipede (Hadland 2001). In 1868 multiple race events on these velocipedes had been held all around western (soon to be) Europe. The speeds that were achieved on the velocipedes were around 14.5 miles at the hour races. One year later James moore was the first to win the Paris-to-Rouen race, he is believed to be the first long-distance bicycle race winner. (Roberts 1991, 64ff.).This milestone led in an era of road race bicycles and a constant development to go faster and/or further.

The evolution of frame geometry

The first diamond style frames

Around the year 1890 it was concluded that the front drive velocipedes were not safe for the riders and already at the top of their game speed wise. A new triangular frame style entered the market, these frames were a lot safer as the driver could brake without falling over the front of their bike. One example of on of these diamond framed bicycles is the 1892 Sunbeam (Hadland 2001). The Sunbeam weighed in at around 27 pounds. The first diamond style frames had a rearward-sloped top-tube which gave the rider a bit more upright position on the bicycle. Compared to modern bicycles the Sunbeam had fairly large wheels.



By the year 1899 the backward-sloped top-tubes were going out of fashion. Top-tubes began facing forward as the search for speed went on. The forward facing top-tube meant a new more aggressive position of the rider on the bicycle. This in turn meant that there was less room for big (front) wheels. A good example of this new innovation can be seen in the 1907 Raleigh bicycles.

After WWI bicycles

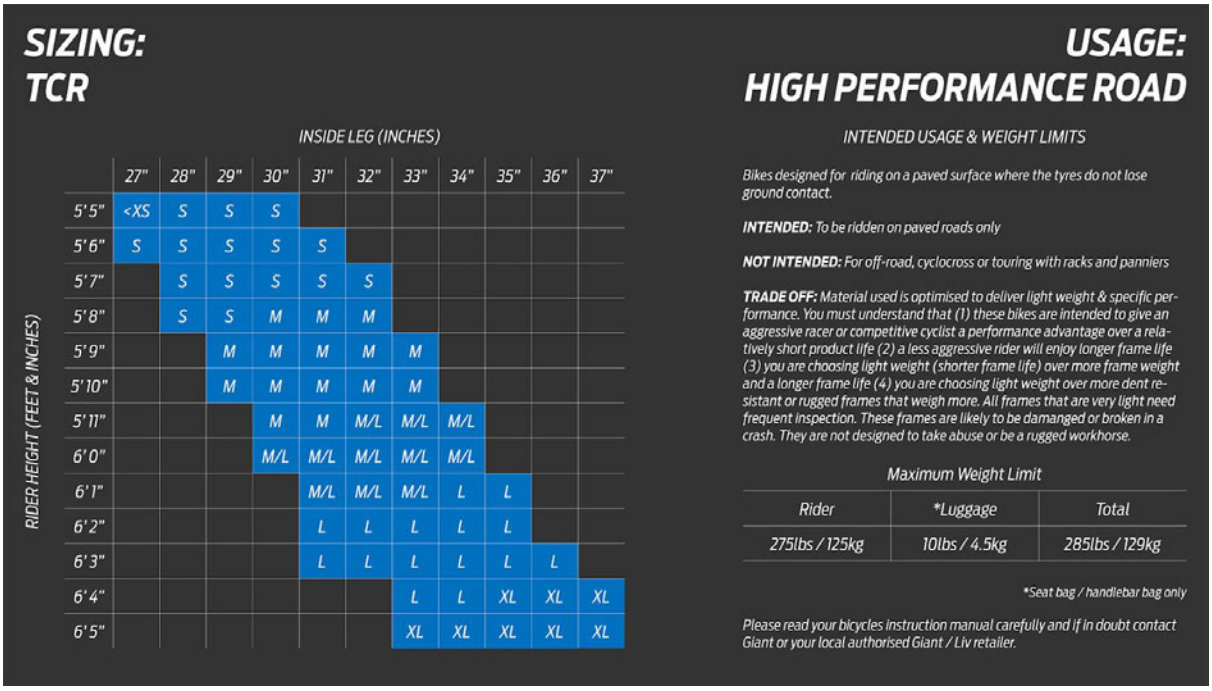
After the first world war the horizontal top tube was the new ‘fashion’. This created a sort of hybrid between the first styles of frames described before, a mix of speed and comfort. The wheels on the bicycle became even smaller and became the same size again. This new style of bicycle became the status quo for frame design in many years to come.

Early racing bicycles tended to have shorter rear triangles and seat- and head-tube angles of about 68° (Hadland 2001). Later bicycles developed steeper and steeper frame angles, ranging in between 72° to 75° for the head-tube and 71° to 73° for the seat-tube. Frame builders tried to keep the wheelbase as short as possible without letting the front wheel touch the riders toes. This short wheelbase improved the manoeuvrability of the bicycle. Wheelbases ranging from 39 to 42 inches are very common in racing bicycles. (Hadland 2001; Moore 2013)

Confection bicycles

Since 1997, racing frames went back to the style of the first sunbeam bicycle. The top-tubes started to slope backwards again. In contrary to the Sunbeam the wheels on the new road bikes had gotten noticeably smaller. This meant the rider could speed up faster and corner better. A good example of such a new style road bike is the Giant TCR from 1997. The geometry of the newest road bikes of today are not that different from the TCR.

Herman Braun thinks this new geometry helps to fit as many sizes of people on the frames.The angled back top tube gives more room to change the height of the saddle. Giant changed the frame sizes with the launch of the TCR to sizes small, medium and large. This meant the bicycles would cost less to produce because there was less variance in the frames. This in turn meant that the profit per bike was becoming larger for the producers of the confection frames.



SIZING: TCR

INSIDE LEG (INCHES)

RIDER HEIGHT (FEET & INCHES)

	27"	28"	29"	30"	31"	32"	33"	34"	35"	36"	37"
5'5"	<XS	S	S	S							
5'6"	S	S	S	S	S						
5'7"		S	S	S	S	S					
5'8"		S	S	M	M	M					
5'9"			M	M	M	M	M				
5'10"			M	M	M	M	M				
5'11"				M	M	M/L	M/L	M/L			
6'0"				M/L	M/L	M/L	M/L	M/L			
6'1"					M/L	M/L	M/L	L	L		
6'2"					L	L	L	L	L		
6'3"					L	L	L	L	L	L	
6'4"							L	L	XL	XL	XL
6'5"							XL	XL	XL	XL	XL

USAGE: HIGH PERFORMANCE ROAD

INTENDED USAGE & WEIGHT LIMITS

Bikes designed for riding on a paved surface where the tyres do not lose ground contact.

INTENDED: To be ridden on paved roads only

NOT INTENDED: For off-road, cyclocross or touring with racks and panniers

TRADE OFF: Material used is optimised to deliver light weight & specific performance. You must understand that (1) these bikes are intended to give an aggressive racer or competitive cyclist a performance advantage over a relatively short product life (2) a less aggressive rider will enjoy longer frame life (3) you are choosing light weight (shorter frame life) over more frame weight and a longer frame life (4) you are choosing light weight over more dent resistant or rugged frames that weigh more. All frames that are very light need frequent inspection. These frames are likely to be damanged or broken in a crash. They are not designed to take abuse or be a rugged workhorse.

Maximum Weight Limit

Rider	*Luggage	Total
275lbs / 125kg	10lbs / 4.5kg	285lbs / 129kg

*Seat bag / handlebar bag only

Please read your bicycles instruction manual carefully and if in doubt contact Giant or your local authorised Giant / Liv retailer.

An assumption that could be made is that the sloping top tube makes the frame a bit less stiff compared to frames that have a similar top tube but that runs straight. This could be seen as the top tubes and down tubes became more oversized over time since the launch of the TCR.

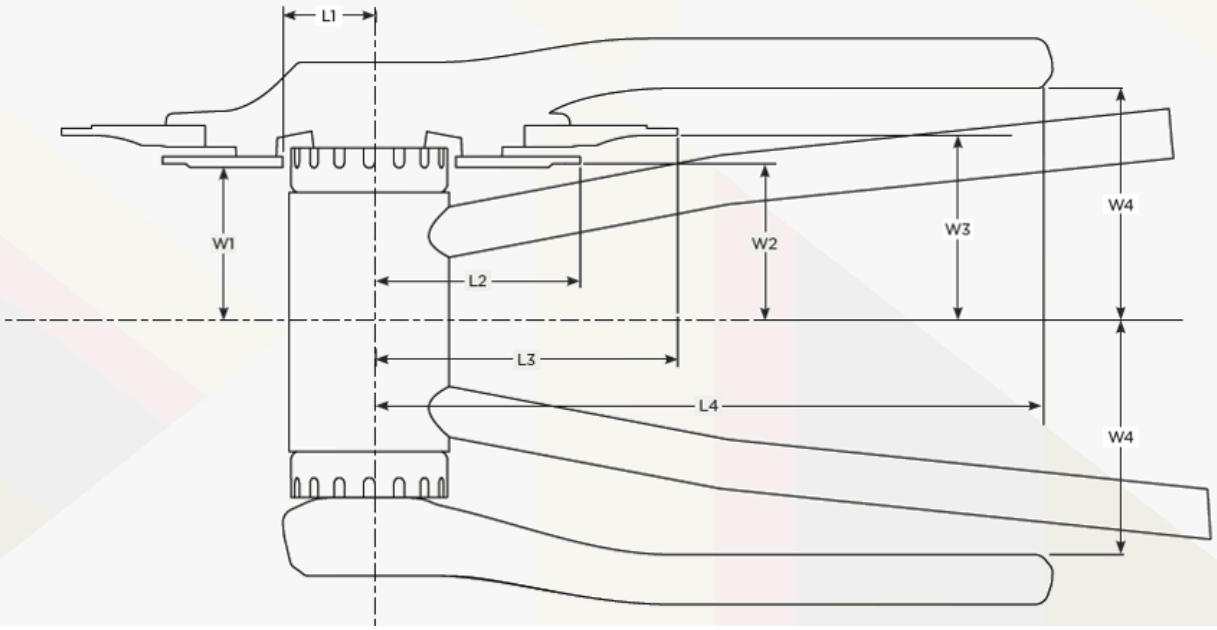
C

Parts of the bottom bracket

XX™ Cranksets

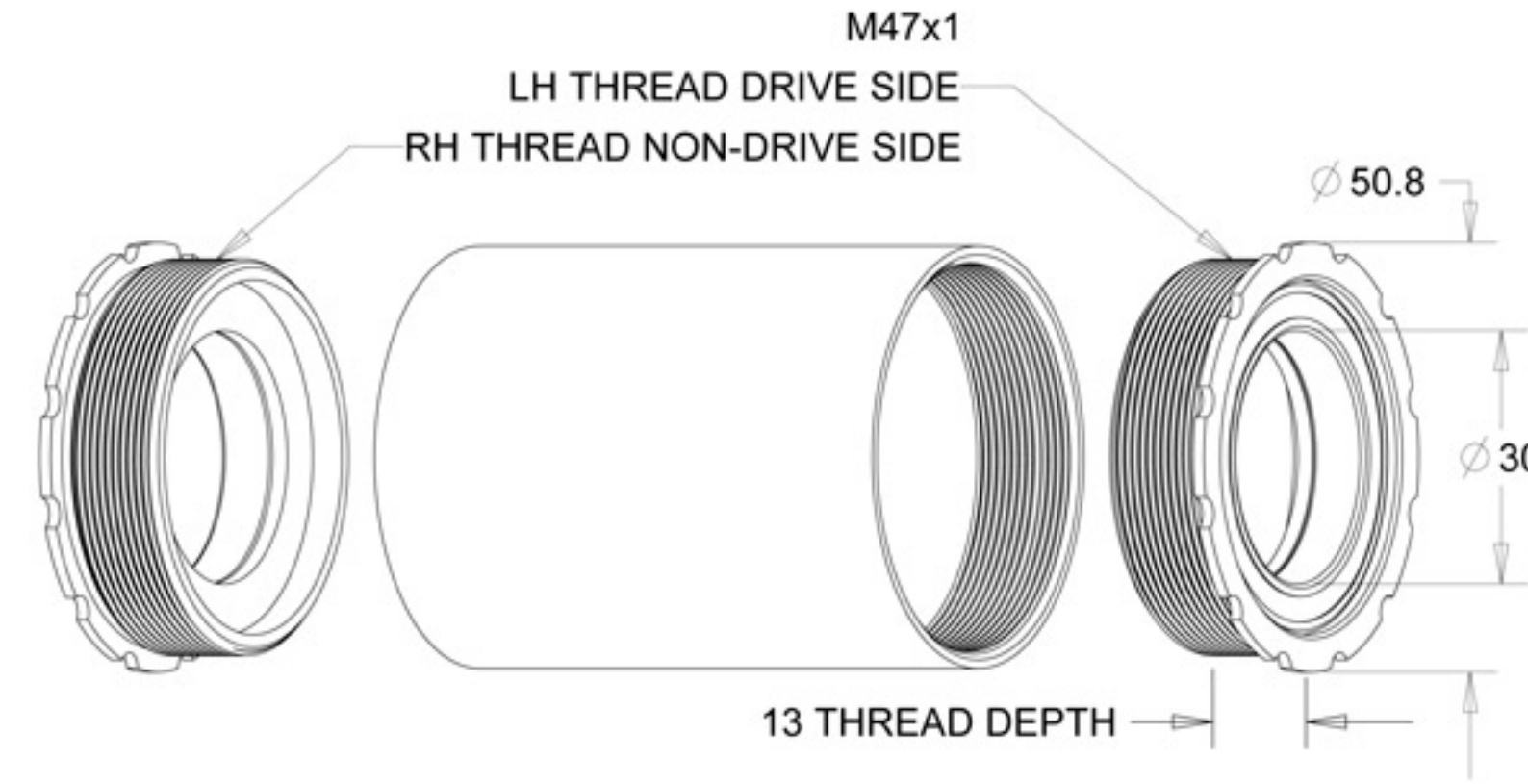
CRANKSET FRAME CLEARANCE INFORMATION

Chain Ring Combination	L1	L2	L3	L4	W1	W2	W3	W4	W4	W4
26/39	31 mm	55 mm	81 mm	190 mm (175 mm crank arm length)	43.5 mm	44.5 mm	52.5 mm	65.7 mm	69.5 mm	70.5 mm
28/42		60 mm	87 mm							
30/45		64 mm	93 mm							
Q-factor								Q156	Q164	Q166
Bottom Bracket Type(s)								GXP BB30 PressFit™ 30	BB30 PressFit 30	GXP PressFit 30

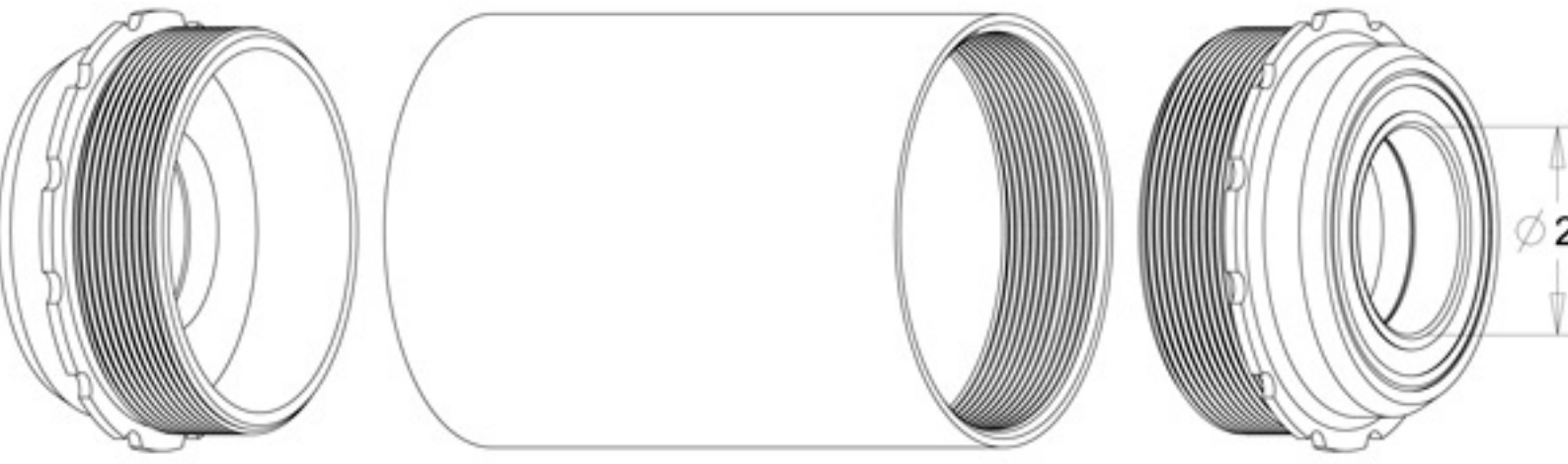


Crankset

T47 BOTTOM BRACKET



30MM SPINDLE (e.g. SRAM®)



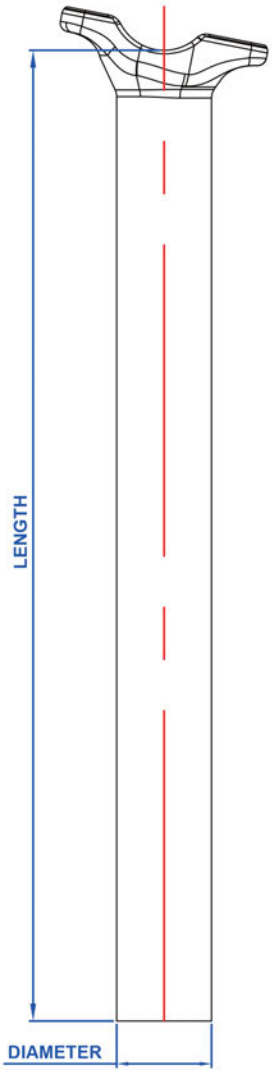
24MM SPINDLE (e.g. SHIMANO®)

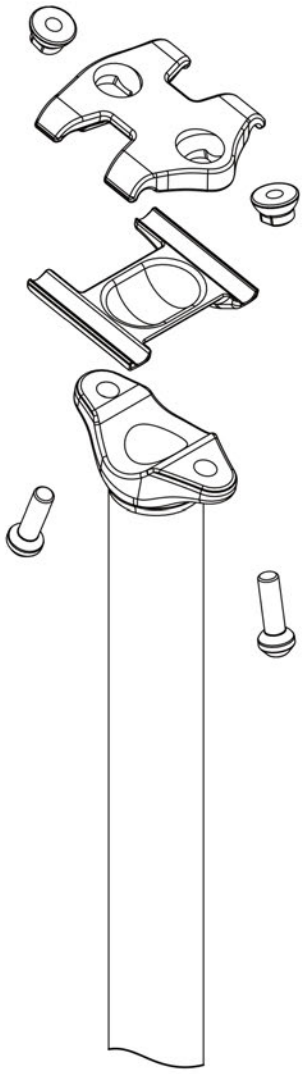
Parts of the seat tube lug

RITCHEY
BICYCLE COMPONENTS

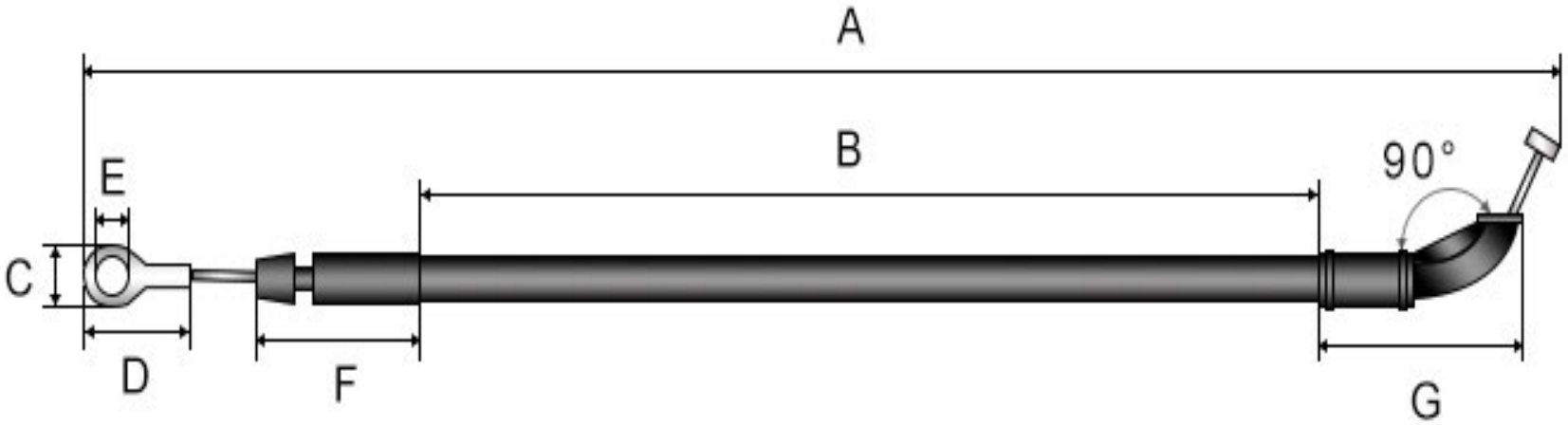
CARBON 0MM OFFSET

DIA	LENGTH
Ø27.2	400mm
Ø30.9	400mm
Ø31.6	400mm





seat post



A=1070mm B=1000mm C=8mm D=14mm

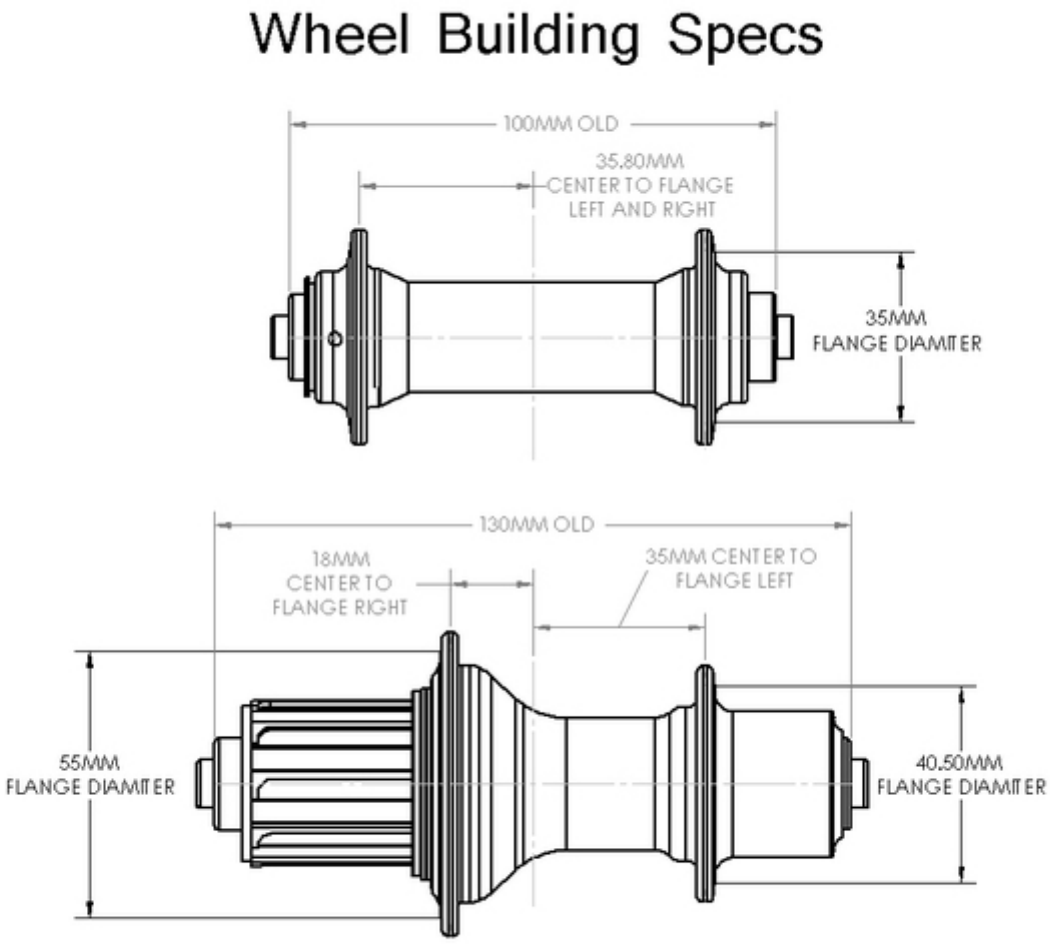
E=4mm F=22mm G=33mm

all dimensions customize available

Brake cable

seat clamp

Parts of the drop out



Parts of the head tube lug

bearings

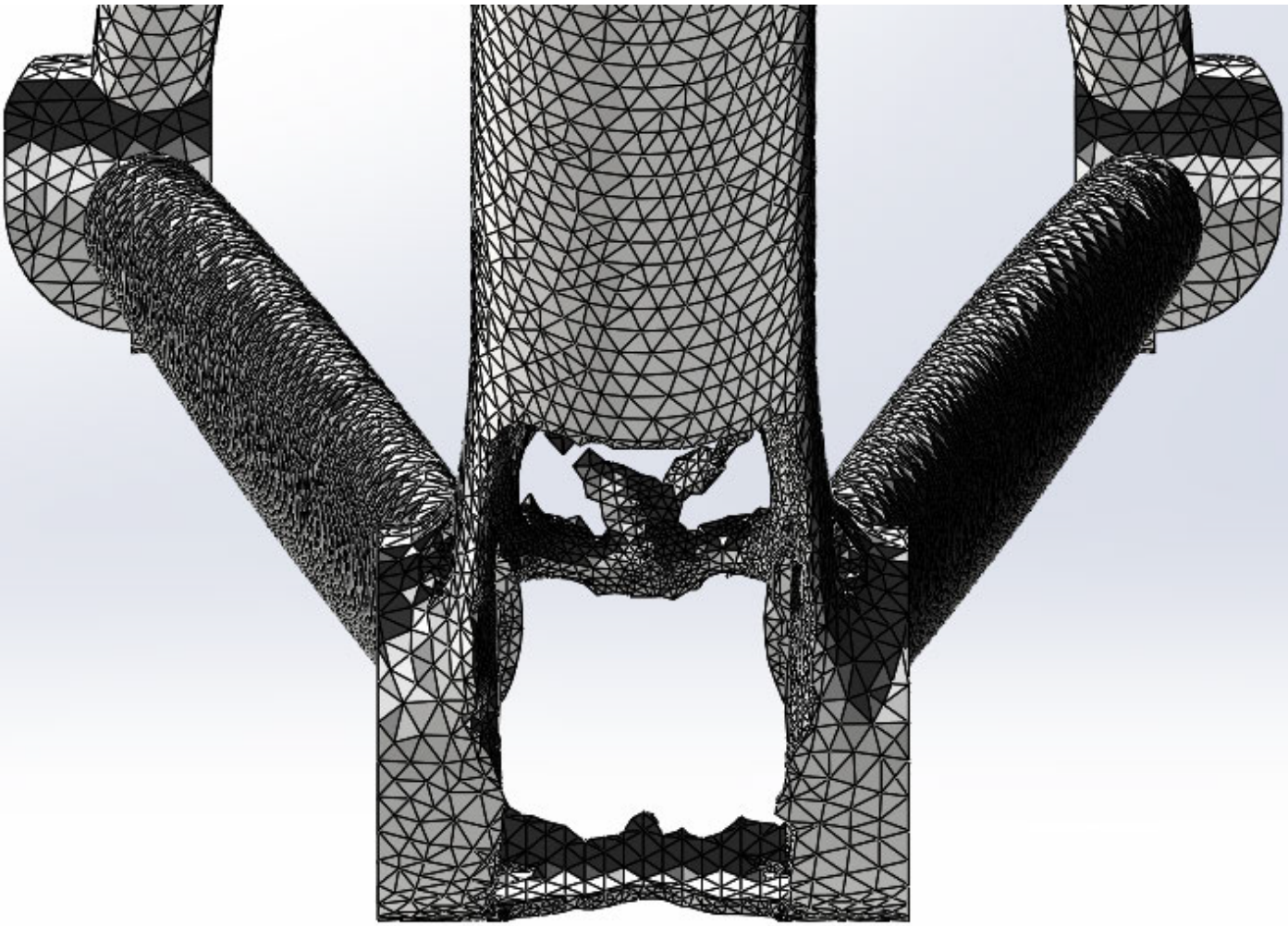
Size

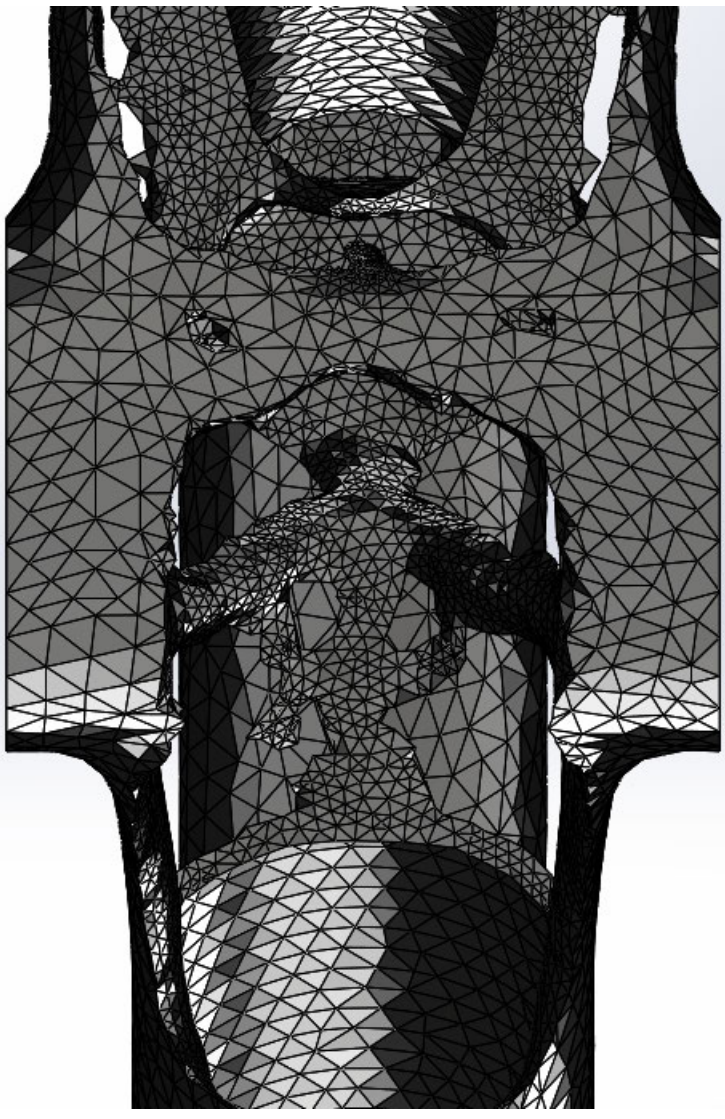
tapered front fork

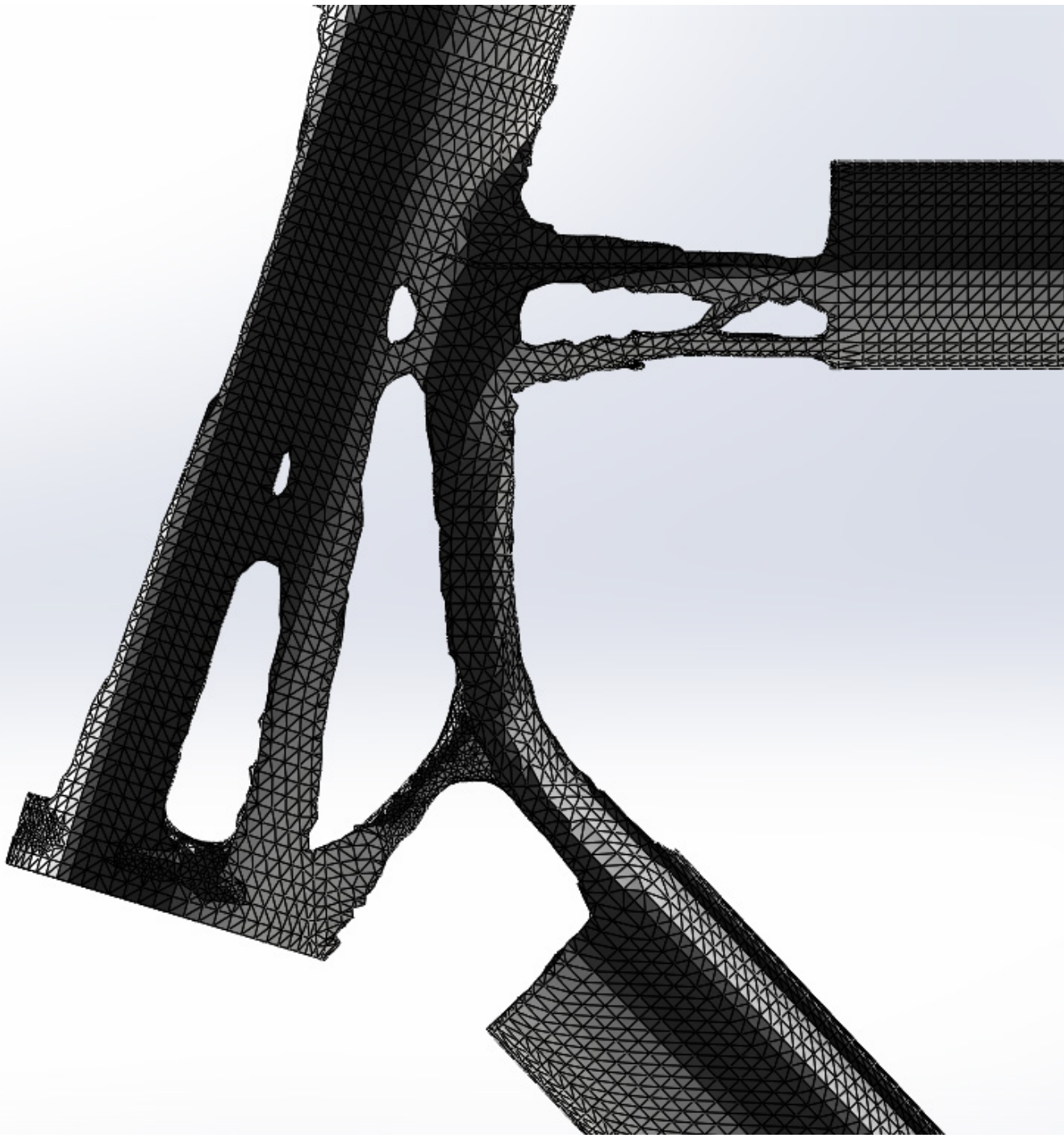
D

Views of the Raw topology calculations

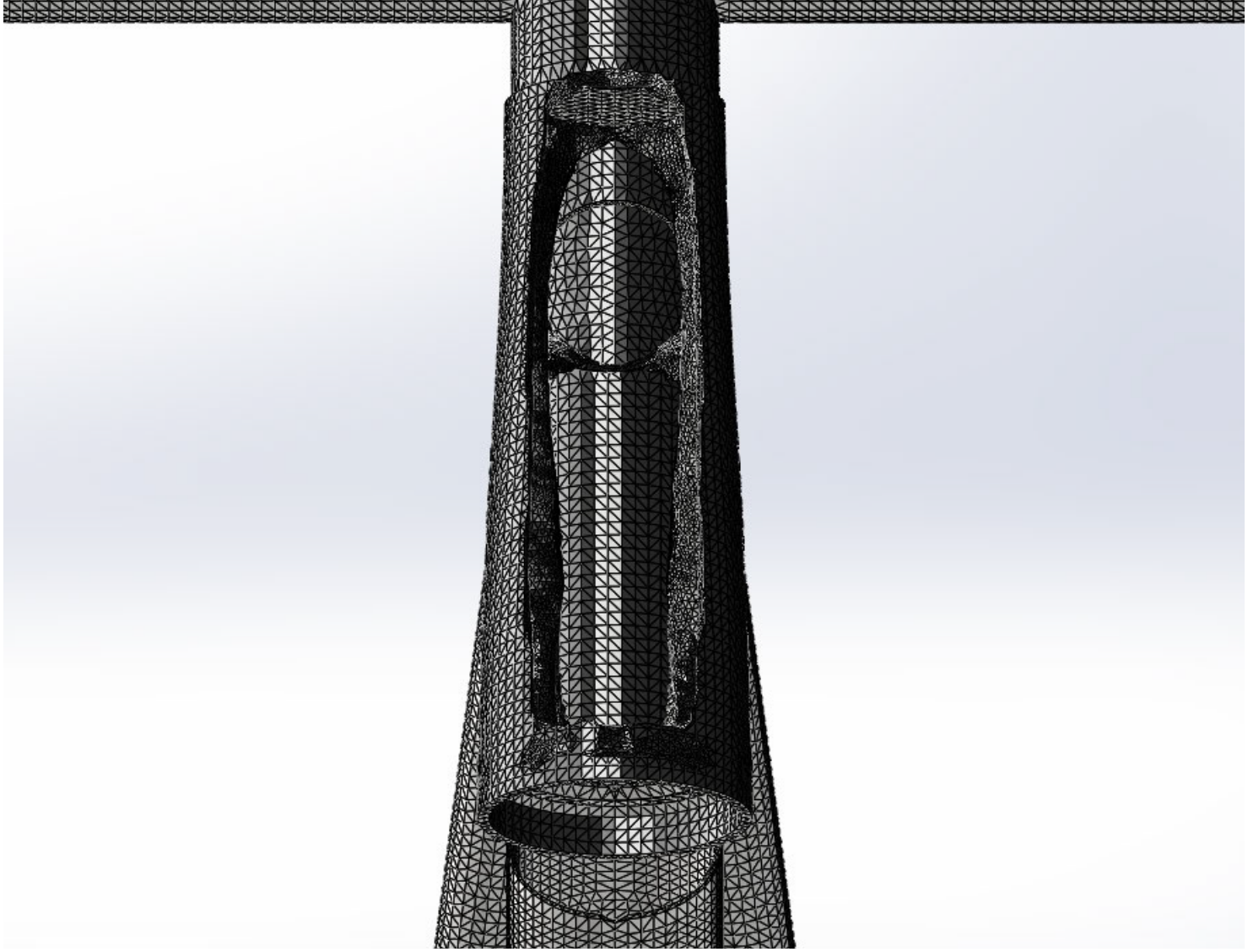
Bottom bracket

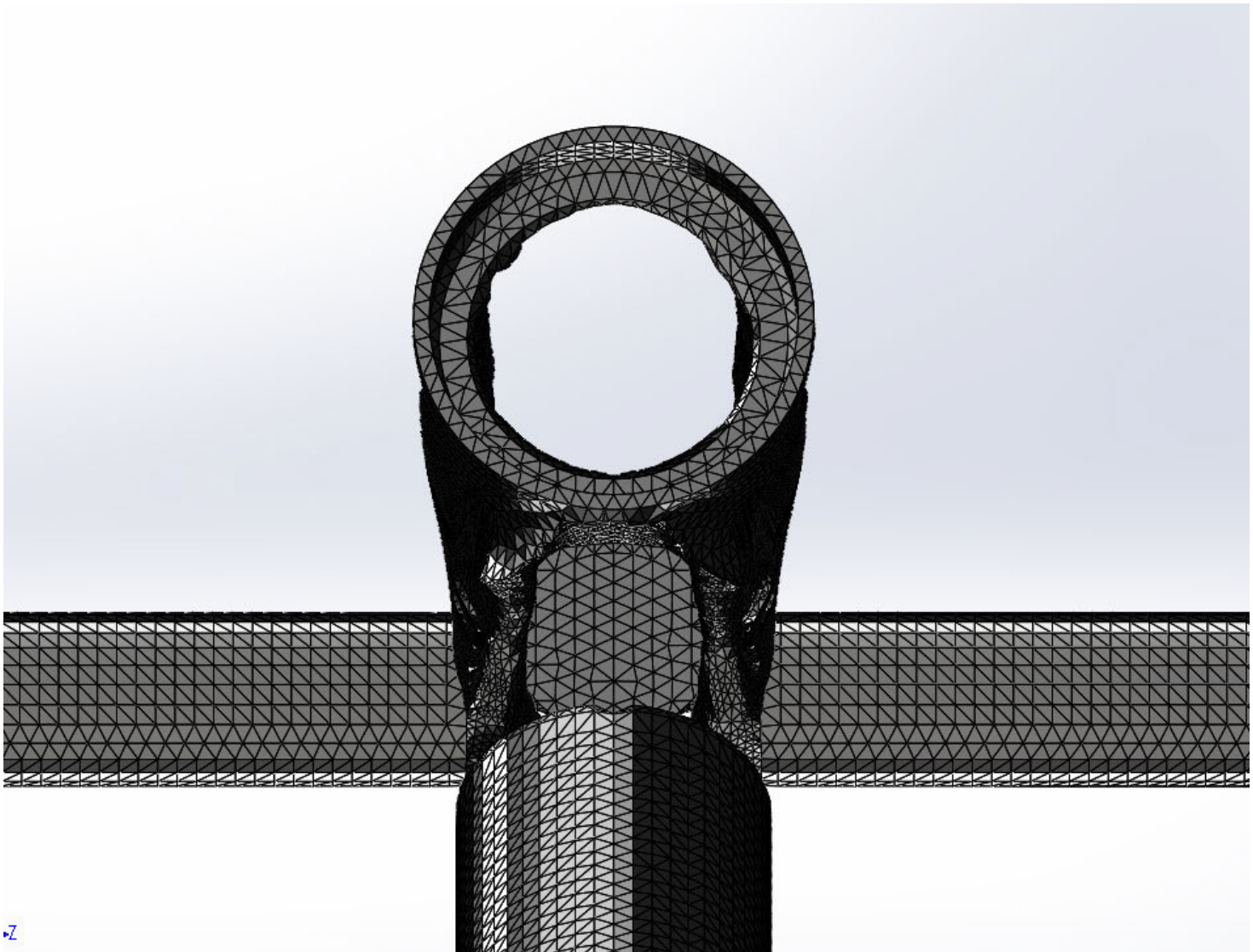


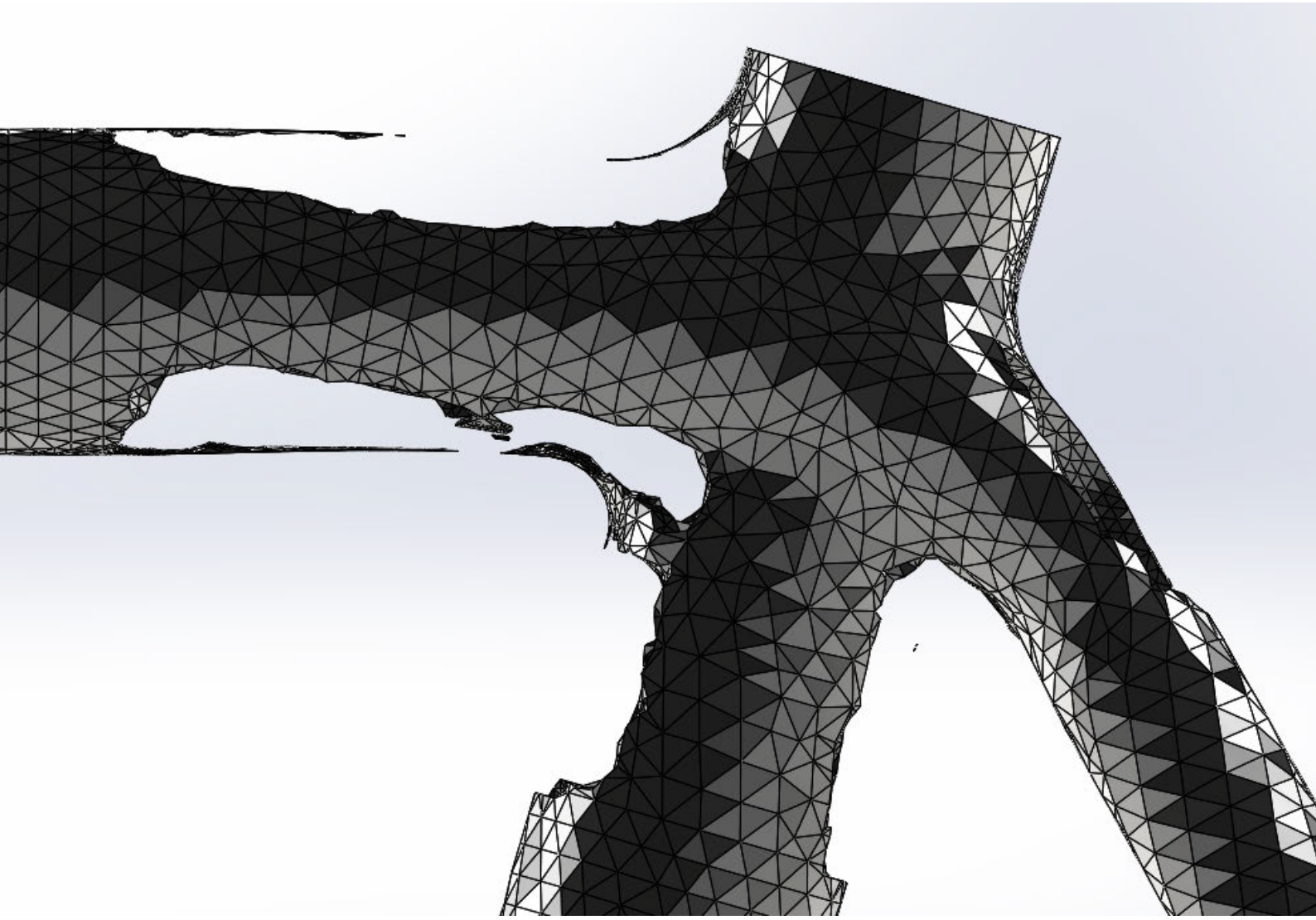




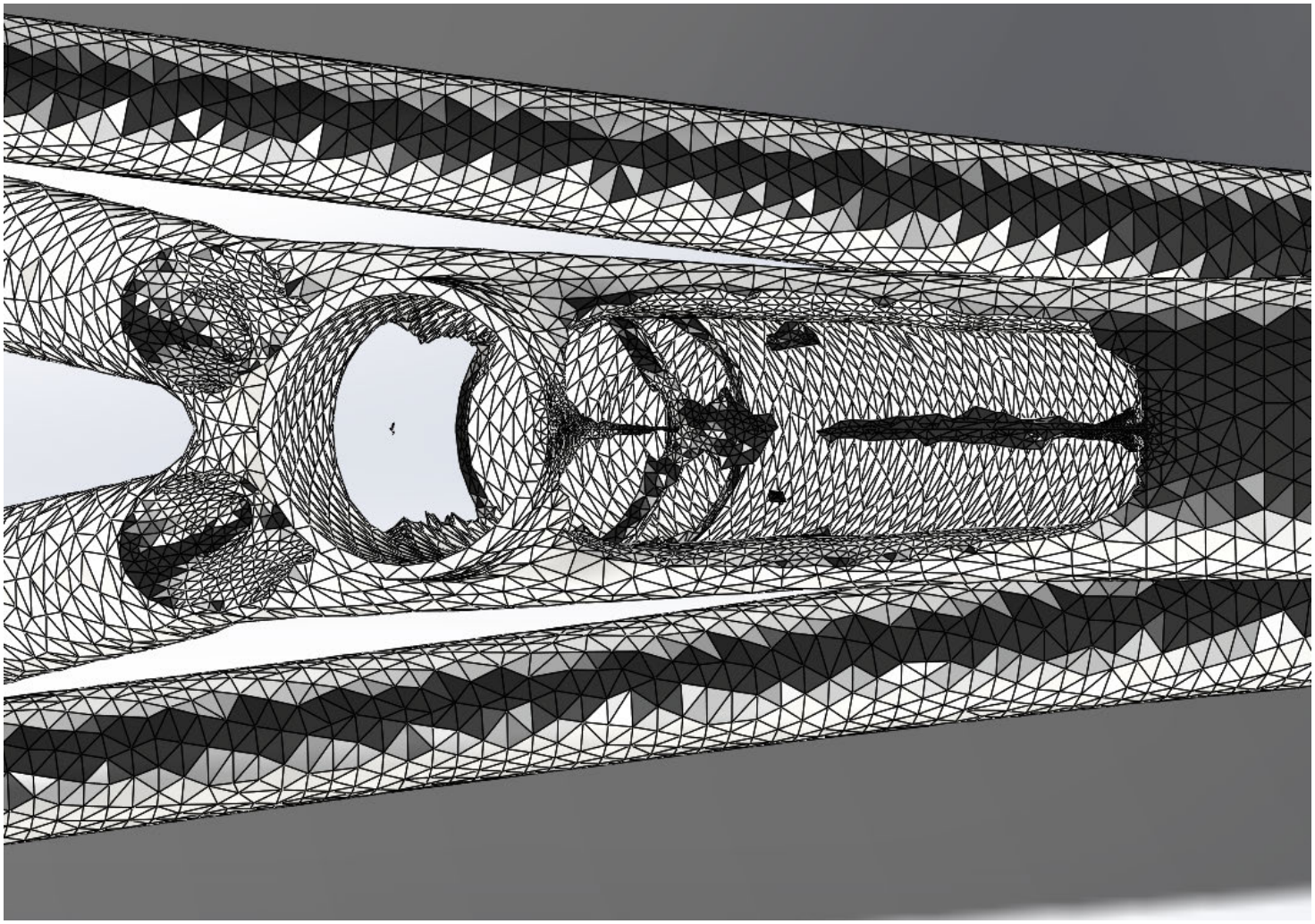
Head tube

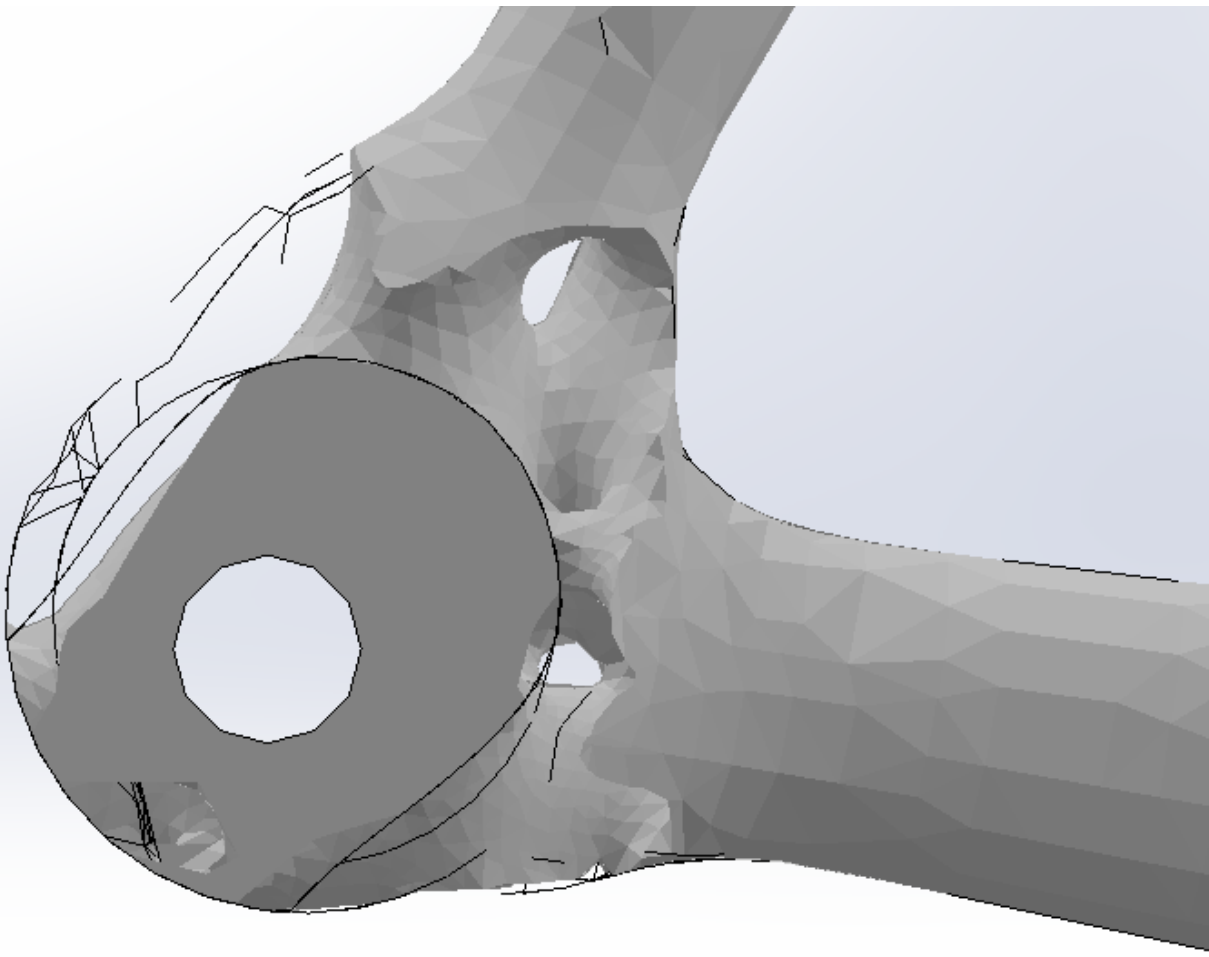






Seat tube



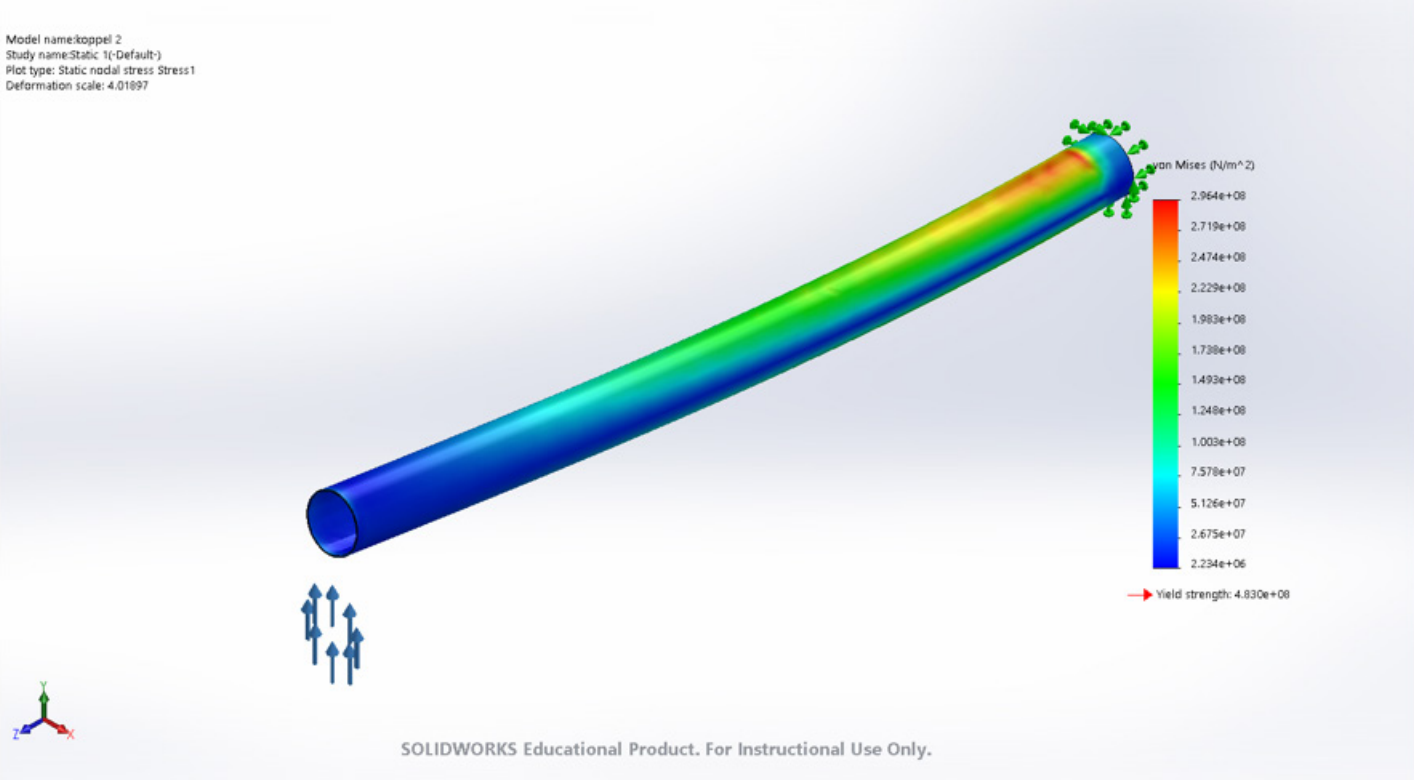


Drop out

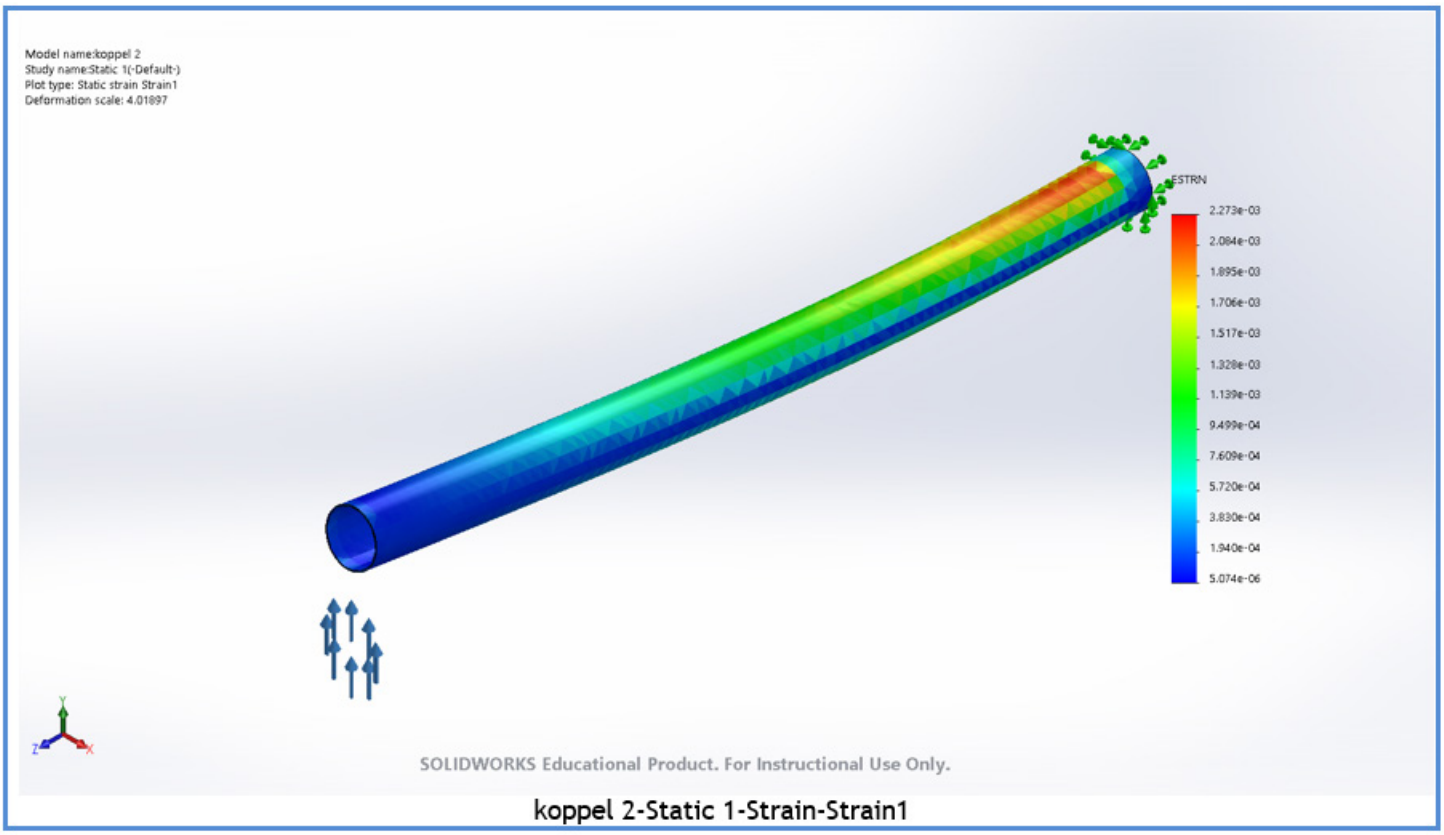
E

Simulation results tube inserts

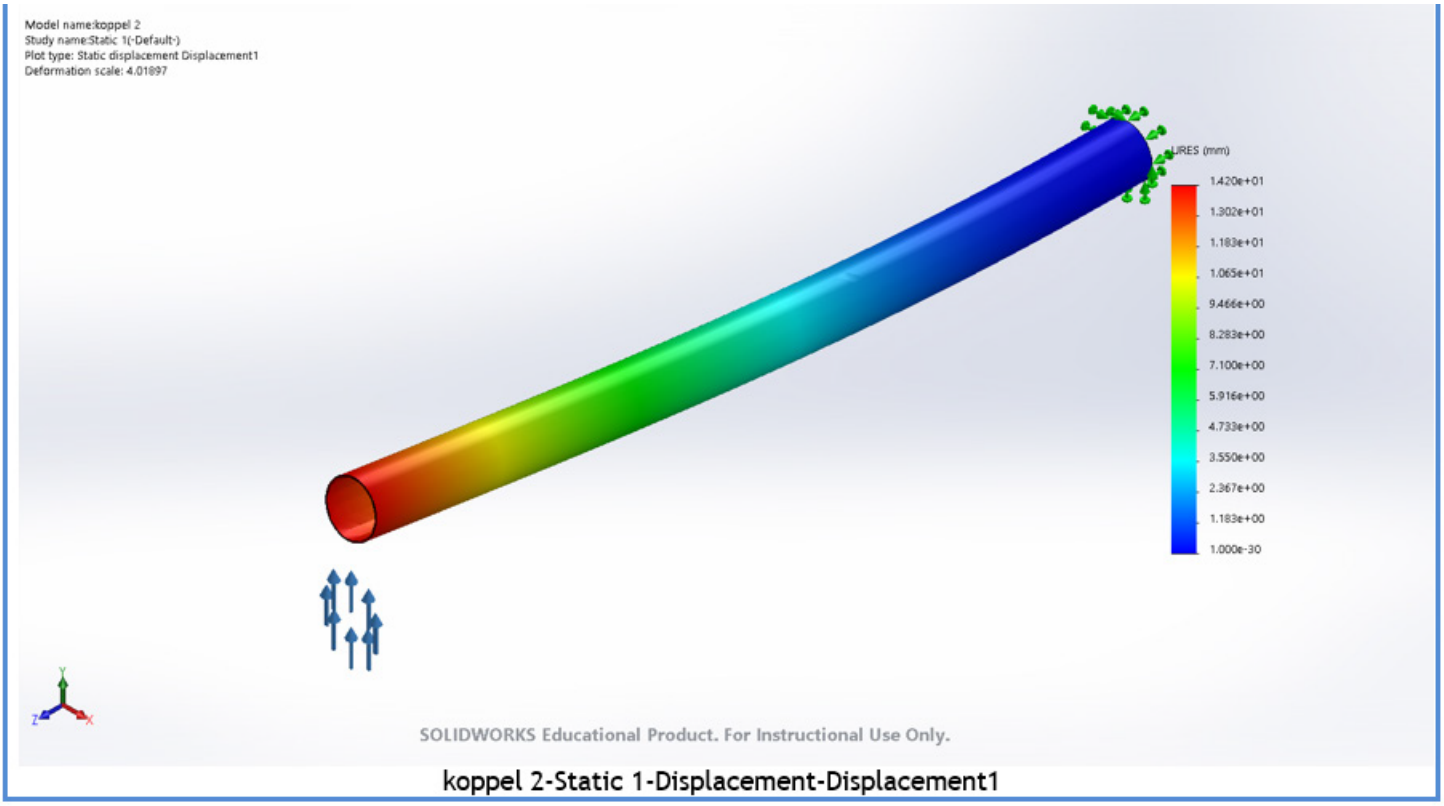
Name	Type	Min	Max
Stress1	VON: von Mises Stress	2.234e+06 N/m^2 Node: 18606	2.964e+08 N/m^2 Node: 1594



koppel 2-Static 1-Stress-Stress1



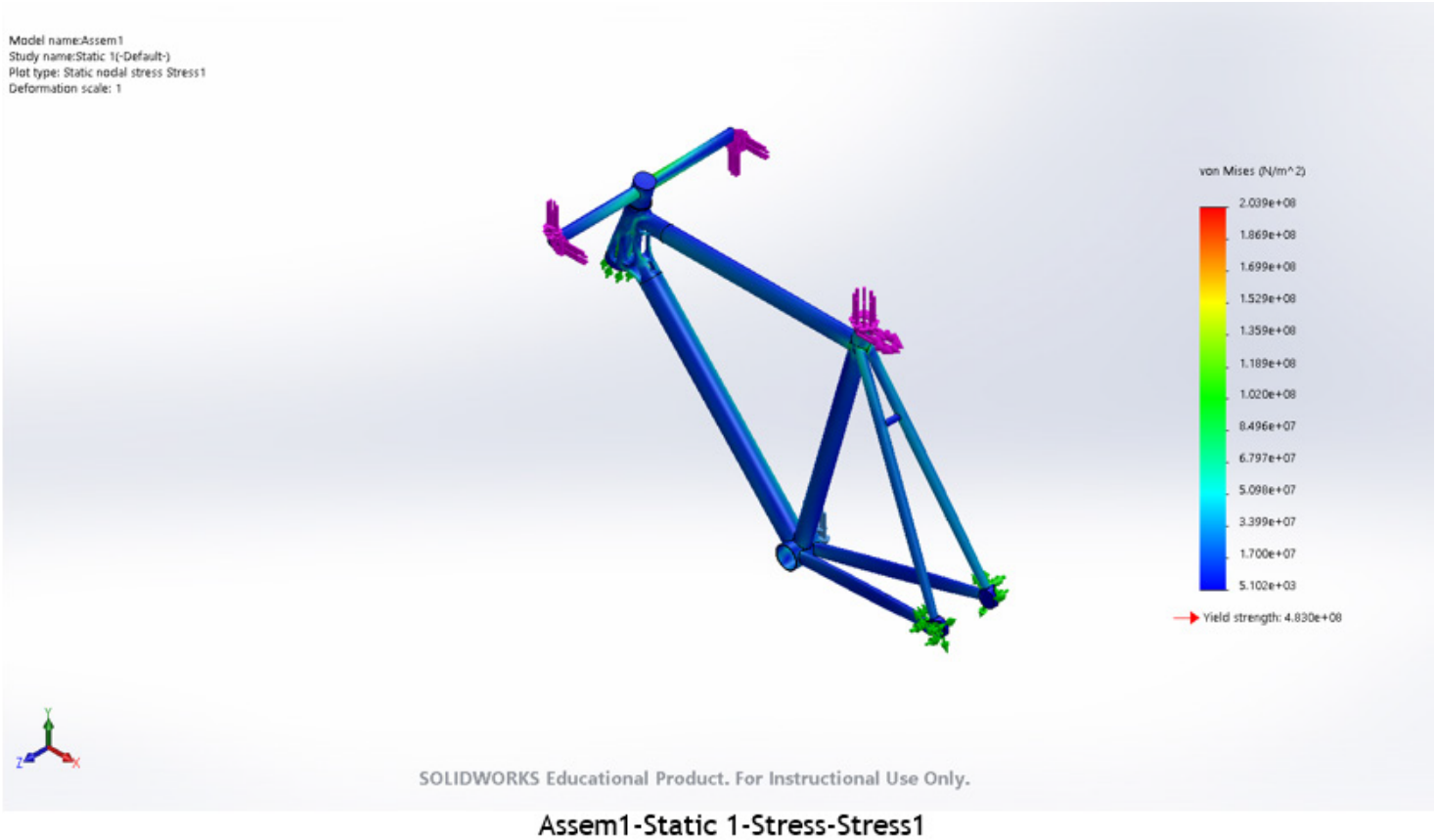
koppel 2-Static 1-Strain-Strain1



koppel 2-Static 1-Displacement-Displacement1

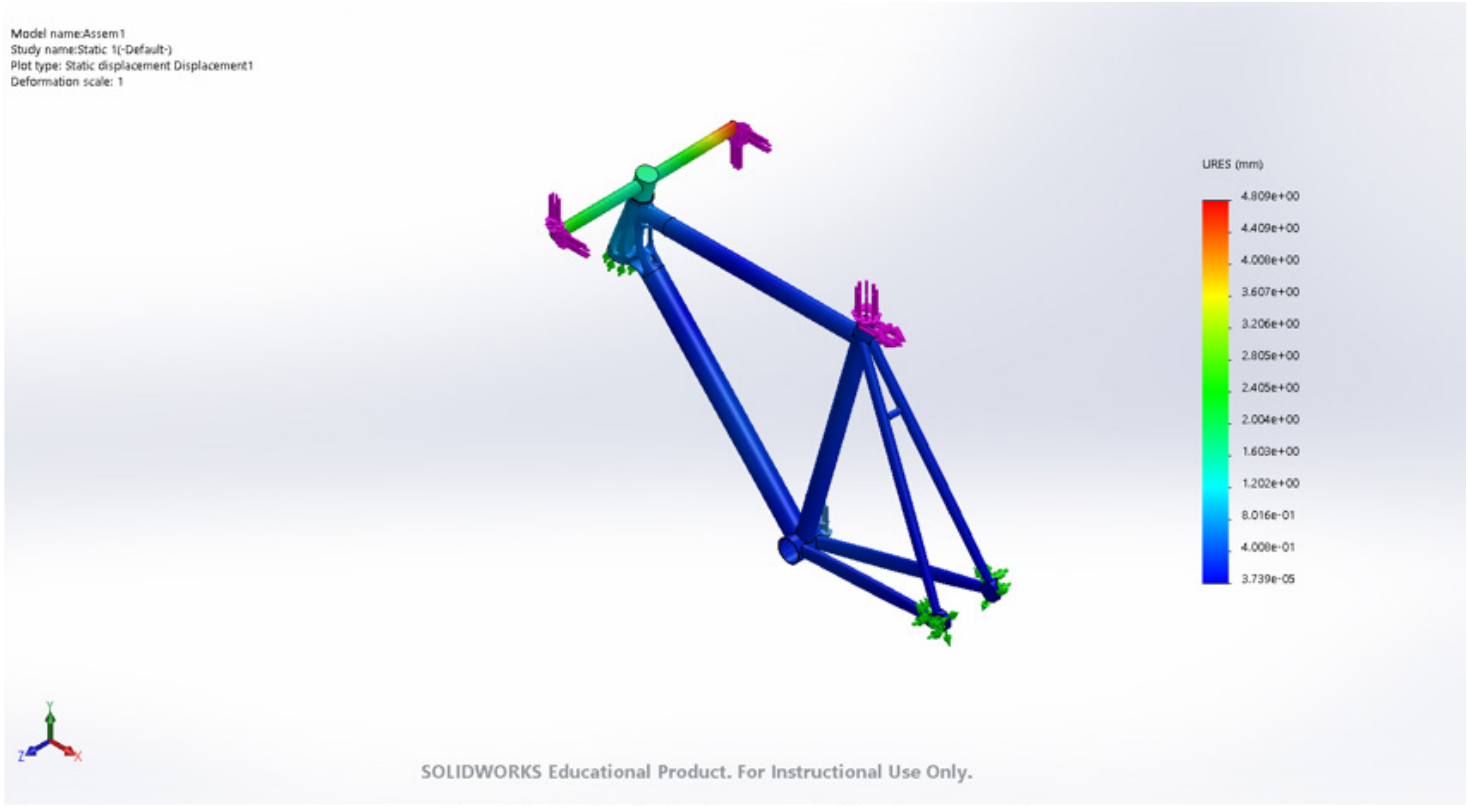
F

Partial simulation results

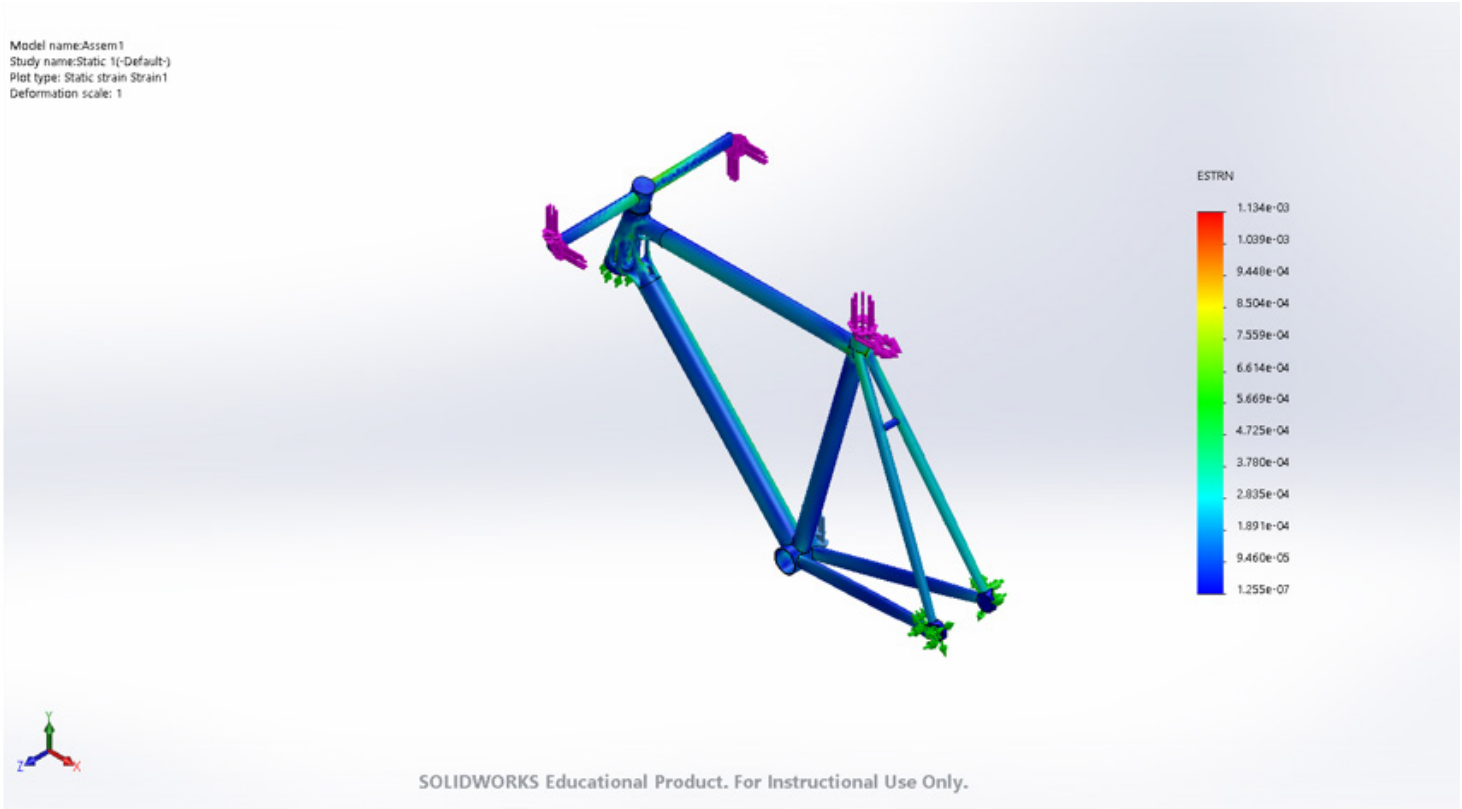


Assem1-Static 1-Stress-Stress1

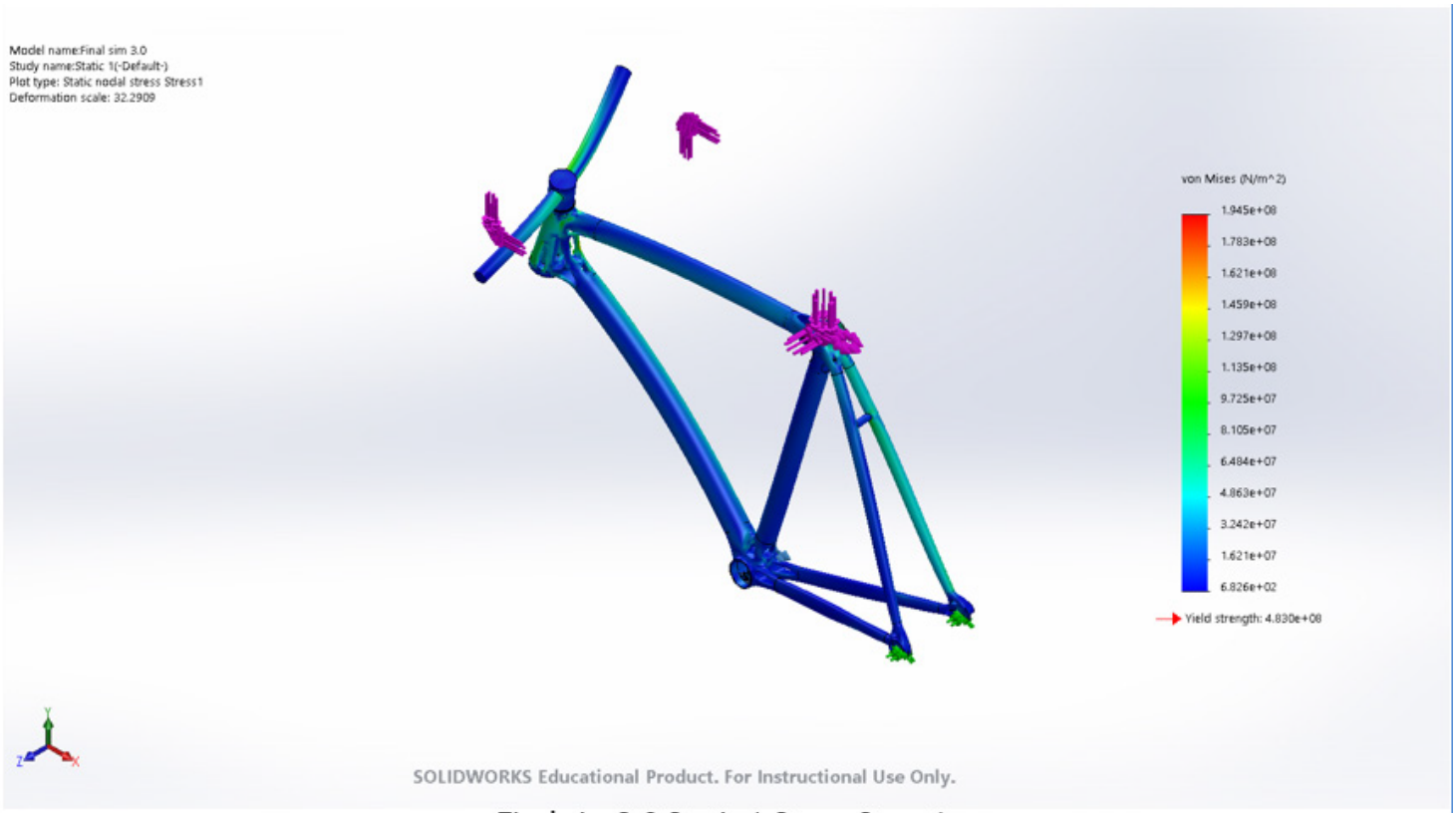
head tube



Assem1-Static 1-Displacement-Displacement1

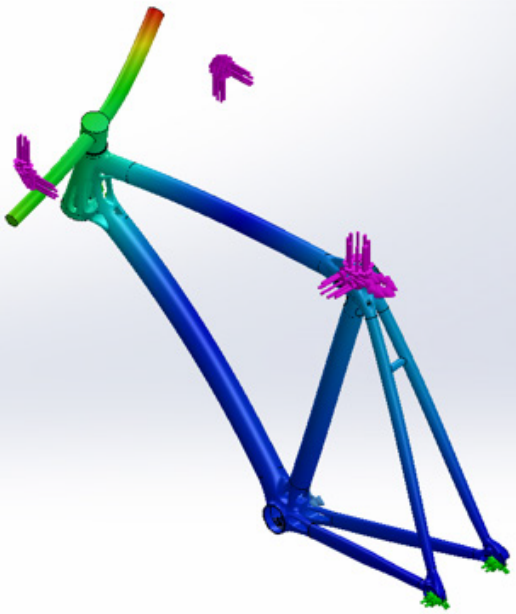


Assem1-Static 1-Strain-Strain1



bottom bracket

Model name:Final sim 3.0
Study name:Static 1(-Default-)
Plot type: Static displacement Displacement1
Deformation scale: 32.2909



URES (mm)
4.137e+00
3.793e+00
3.448e+00
3.103e+00
2.758e+00
2.413e+00
2.069e+00
1.724e+00
1.379e+00
1.034e+00
6.896e-01
3.448e-01
8.545e-06

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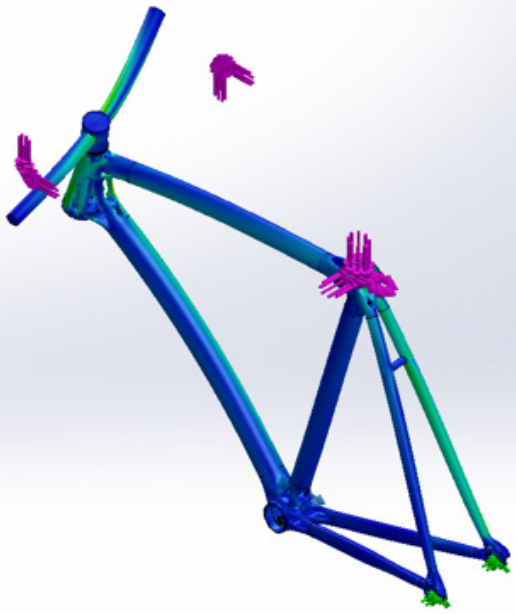
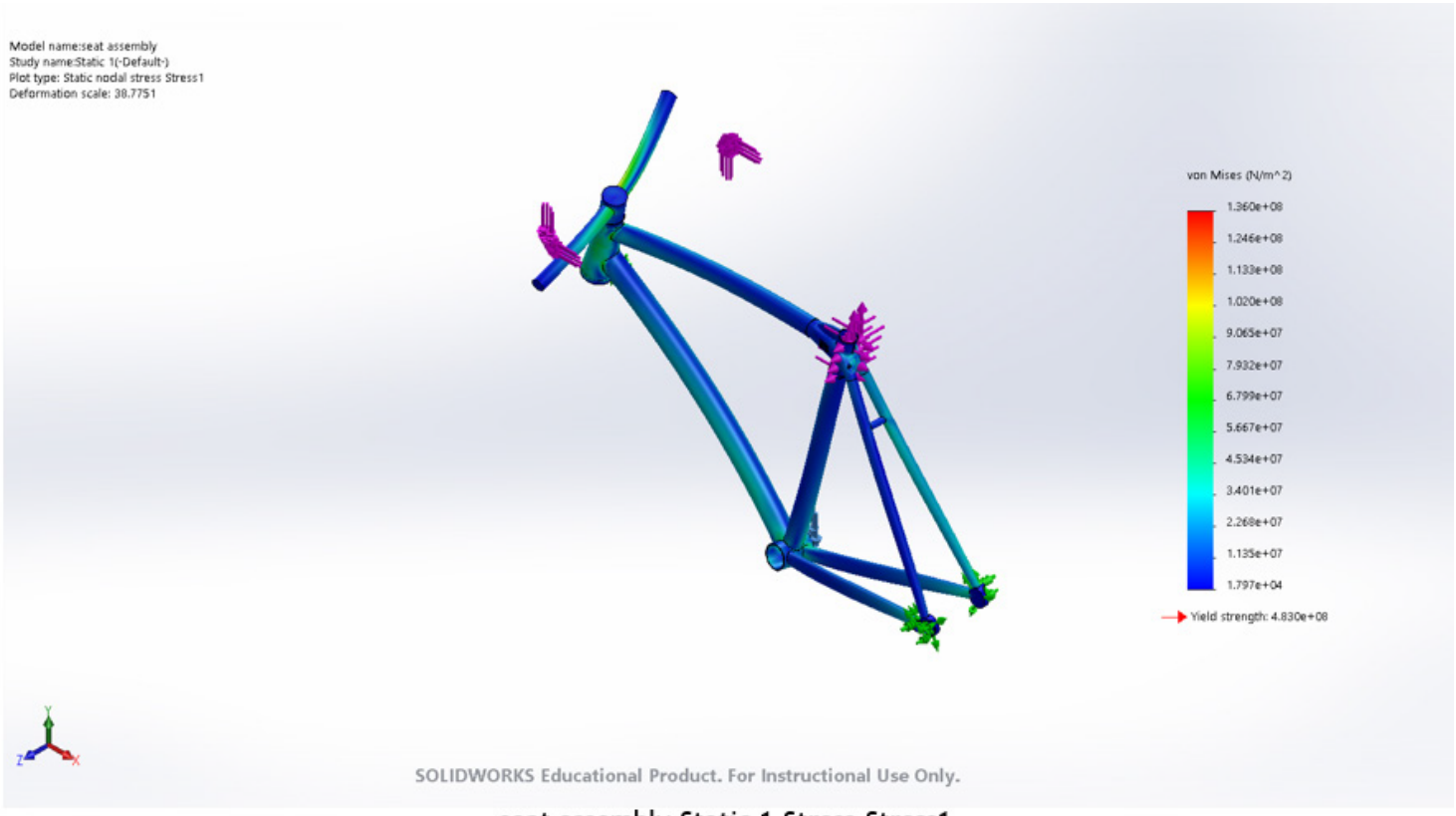
Study name:Static 1(-Default-)
Plot type: Static strain Strain1
Deformation scale: 32.2909

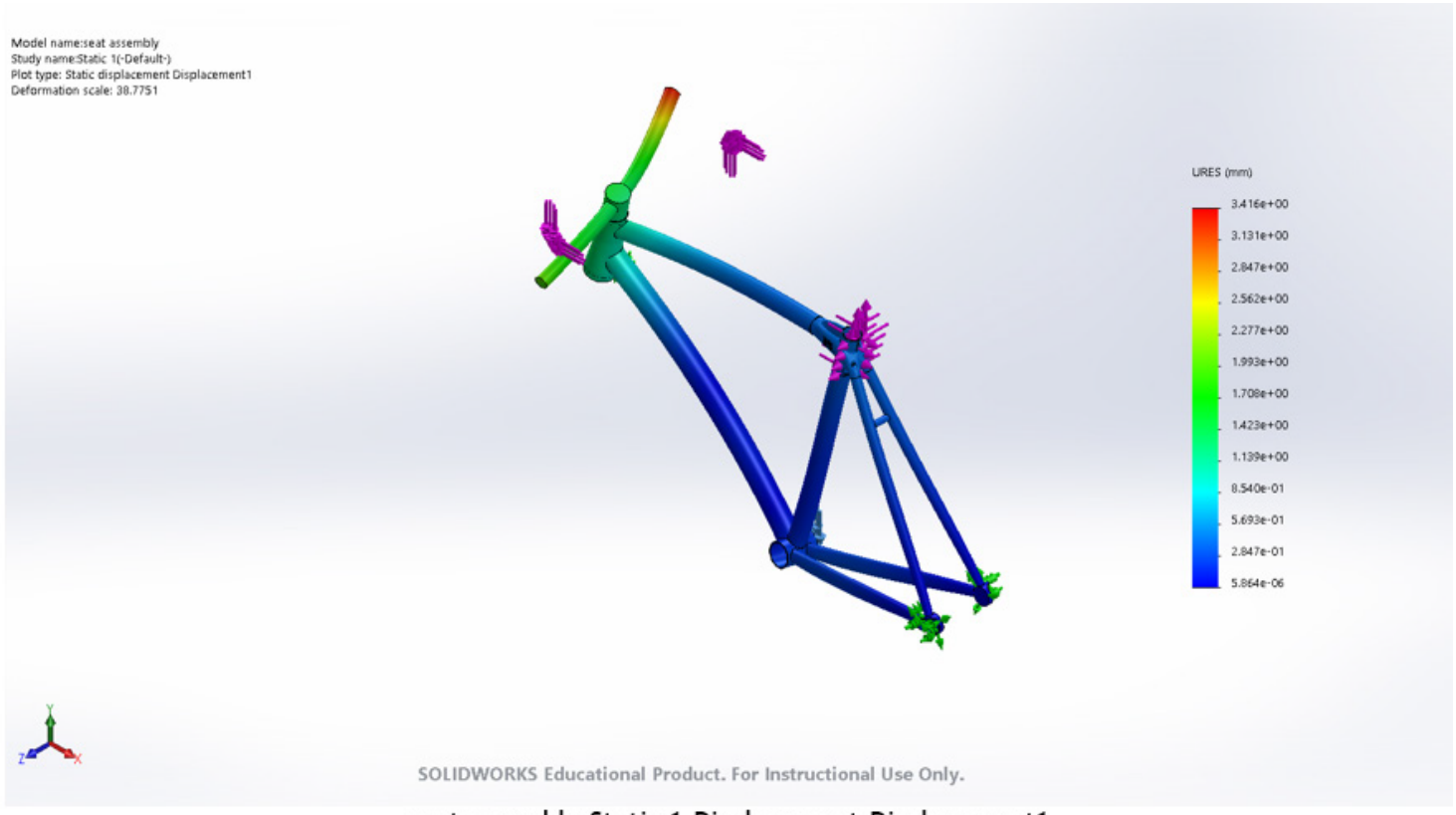


ESTRN
1.379e-03
1.264e-03
1.149e-03
1.034e-03
9.194e-04
8.045e-04
6.896e-04
5.746e-04
4.597e-04
3.448e-04
2.299e-04
1.149e-04
3.596e-09

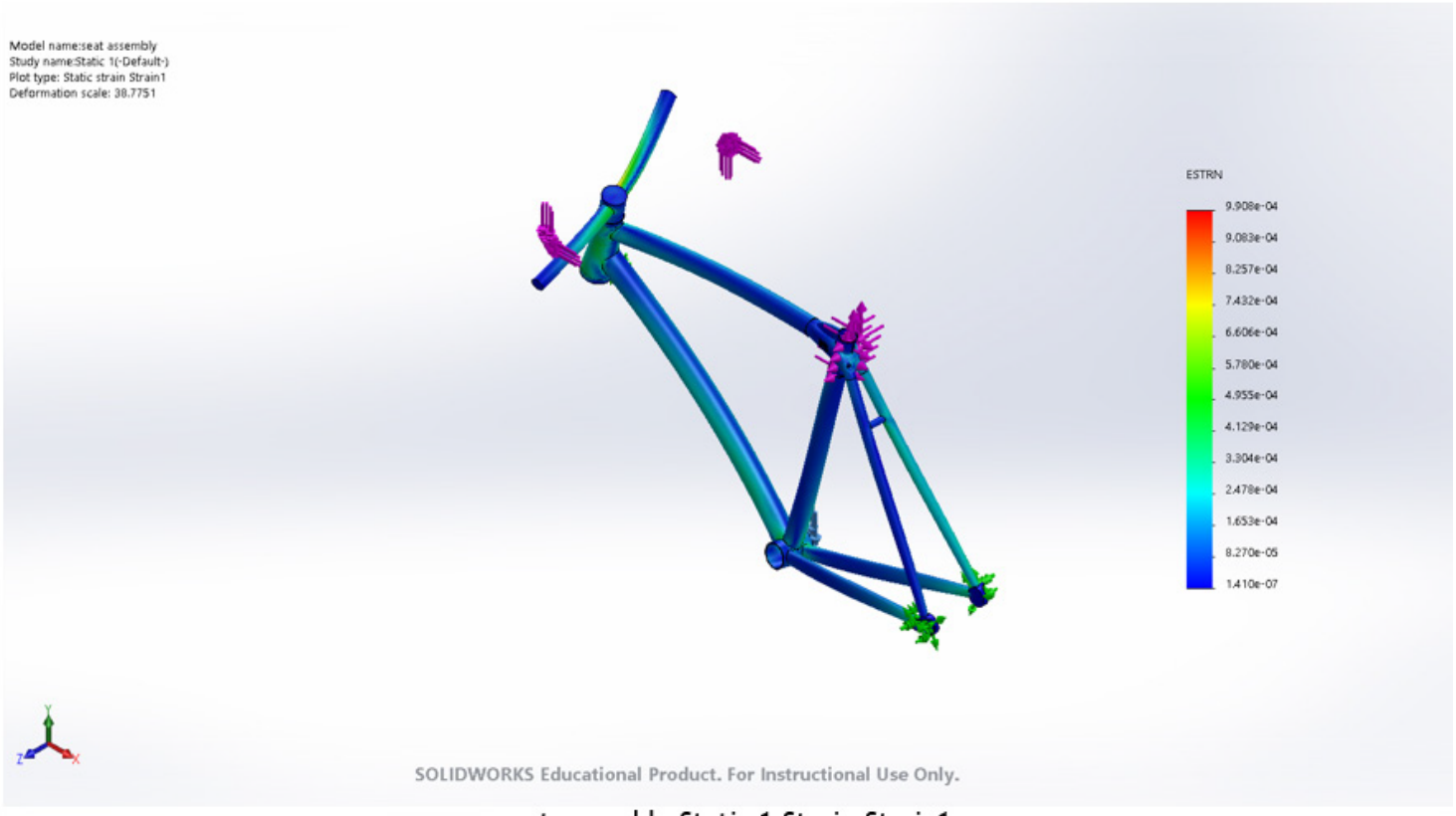


seat assembly-Static 1-Stress-Stress1

seat post



seat assembly-Static 1-Displacement-Displacement1



seat assembly-Static 1-Strain-Strain1

G

Final simulation

Hone Frame

Simulation of Final sim 3.0 1.5 safety factor

Date: donderdag 20 juni 2019
Designer: Solidworks
Study name: Static 1
Analysis type: Static

Table of Contents

Description

No Data

Assumptions

Model Information

Model name: Final sim 3.0 1.5 safety factor
Current Configuration: Default

Solid Bodies

Document Name and Reference	Treated As	Volumetric Properties	Document Path/Date Modified
Combine1 	Solid Body	Mass:3.07245 kg Volume:0.0006864 m^3 Density:4476.18 kg/m^3 Weight:30.11 N	C:\Users\bobby\OneDrive\Documenten\Afstuderen\final sim\Final sim 3.0 1.5 safety factor.SLDPRT Jun 20 10:33:17 2019

Study Properties

Study name	Static 1
Analysis type	Static
Mesh type	Solid Mesh
Thermal Effect:	On
Thermal option	Include temperature loads
Zero strain temperature	298 Kelvin
Include fluid pressure effects from SOLIDWORKS Flow Simulation	Off
Solver type	FFEPlus
Inplane Effect:	Off
Soft Spring:	Off
Inertial Relief:	Off
Incompatible bonding options	Automatic
Large displacement	Off
Compute free body forces	On
Friction	Off
Use Adaptive Method:	Off
Result folder	SOLIDWORKS document (C:\Users\bobby\OneDrive\Documenten\Afstuderen\final sim)

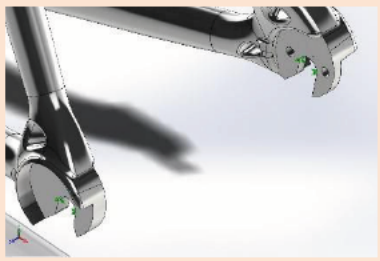
Units

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

Material Properties

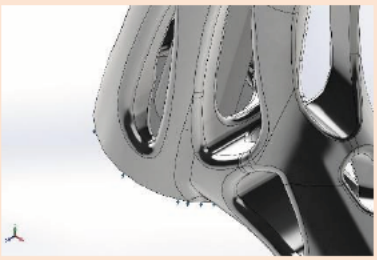
Model Reference	Properties		Components
	Name:	Ti-3Al-2.5v Grade 9 (1)	SolidBody 1(Combine1)(Final sim 3.0)
	Model type:	Linear Elastic Isotropic	
	Default failure criterion:	Unknown	
	Yield strength:	4.83e+08 N/m^2	
	Tensile strength:	1.07e+11 N/m^2	
	Elastic modulus:	1.1e+11 N/m^2	
	Poisson's ratio:	0.35	
	Mass density:	4480 kg/m^3	
	Thermal expansion coefficient:	8e-06 /Kelvin	
Curve Data:N/A			

Loads and Fixtures

Fixture name	Fixture Image	Fixture Details	
Fixed Hinge-1		Entities:	2 face(s)
		Type:	Fixed Hinge

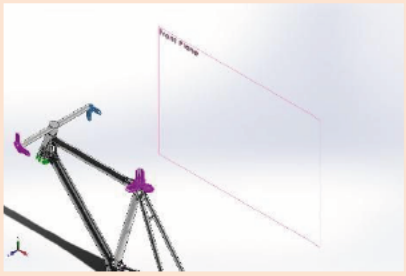
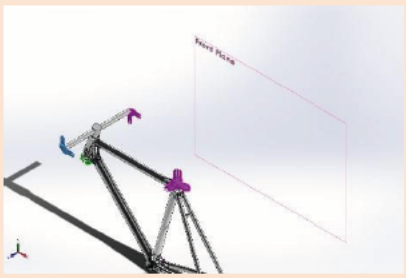
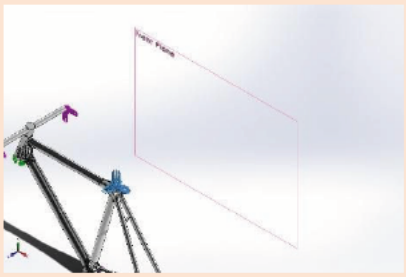
Resultant Forces

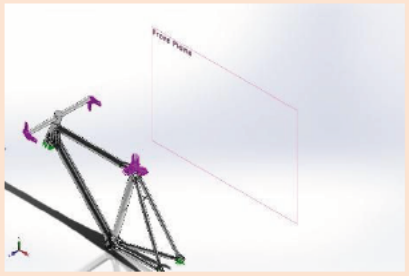
Components	X	Y	Z	Resultant
Reaction force(N)	-1850.21	2969.35	299.998	3511.45
Reaction Moment(N.m)	0	0	0	0

Roller/Slider-1		Entities: 1 face(s) Type: Roller/Slider

Resultant Forces

Components	X	Y	Z	Resultant
Reaction force(N)	518.209	1698.71	0	1776
Reaction Moment(N.m)	0	0	0	0

Load name	Load Image	Load Details
Force-1		Entities: 1 face(s), 1 plane(s) Reference: Front Plane Type: Apply force Values: -600, 957, --- N
Force-2		Entities: 1 face(s), 1 plane(s) Reference: Front Plane Type: Apply force Values: -600, -225, --- N
Force-3		Entities: 1 face(s), 1 plane(s) Reference: Front Plane Type: Apply force Values: 42, -3600, -300 N

Force-4		Entities: 1 face(s), 1 plane(s) Reference: Front Plane Type: Apply force Values: 2490, -1800, --- N

Connector Definitions

No Data

Contact Information

No Data

Mesh information

Mesh type	Solid Mesh
Mesher Used:	Blended curvature-based mesh
Jacobian points	4 Points
Maximum element size	1.74736 mm
Minimum element size	0.803787 mm
Mesh Quality Plot	High

Mesh information - Details

Total Nodes	2446789
Total Elements	1376574
Maximum Aspect Ratio	1173.8

% of elements with Aspect Ratio < 3	99
% of elements with Aspect Ratio > 10	0.0781
% of distorted elements(Jacobian)	0
Time to complete mesh(hh;mm;ss):	00:05:08
Computer name:	

Sensor Details

No Data

Resultant Forces

Reaction forces

Selection set	Units	Sum X	Sum Y	Sum Z	Resultant
Entire Model	N	-1332	4668.06	299.998	4863.64

Reaction Moments

Selection set	Units	Sum X	Sum Y	Sum Z	Resultant
Entire Model	N.m	0	0	0	0

Beams

No Data

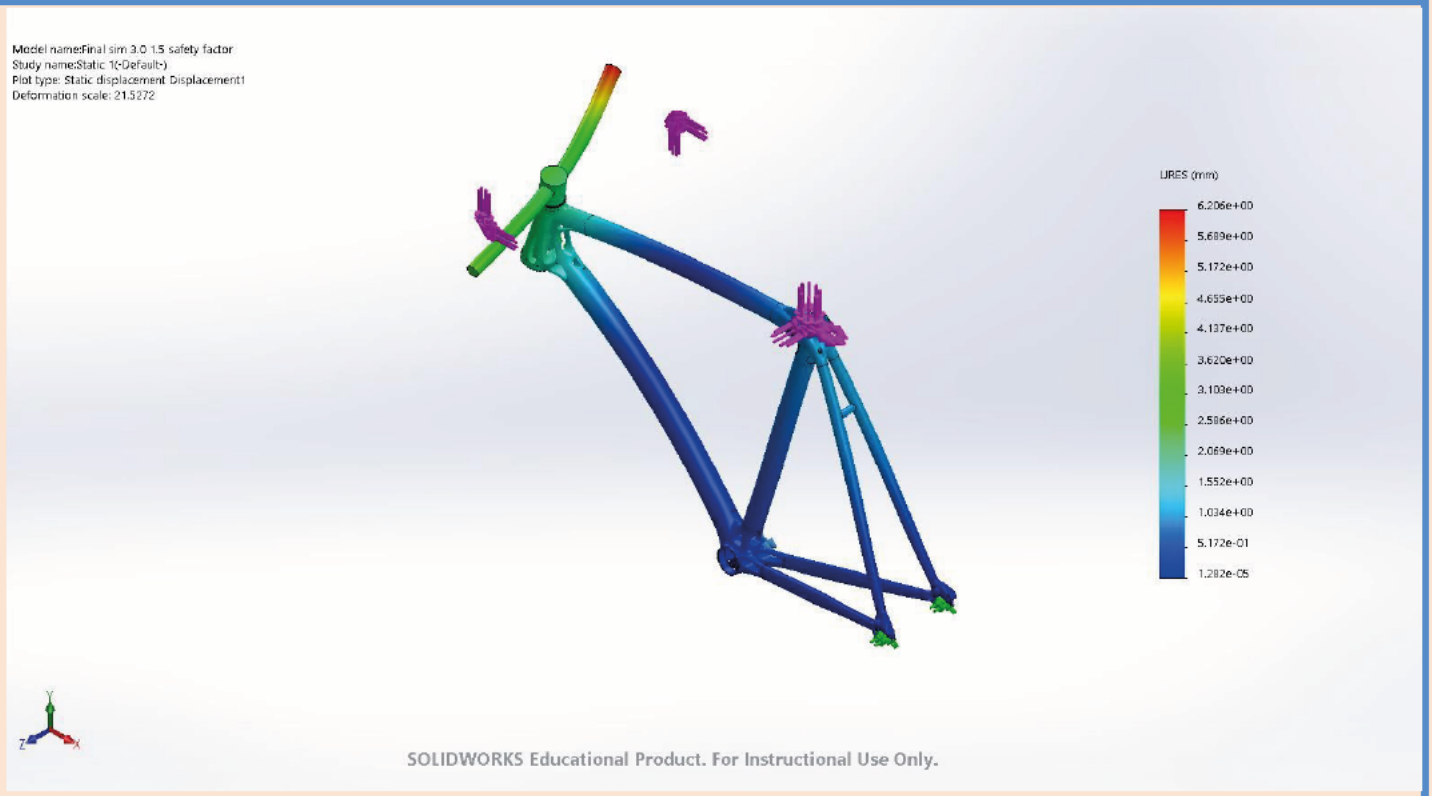
Study Results

Name	Type	Min	Max
Stress1	VON: von Mises Stress	1.142e+03 N/m^2 Node: 1906080	2.918e+08 N/m^2 Node: 494631

Final sim 3.0 1.5 safety factor-Static 1-Stress-Stress1

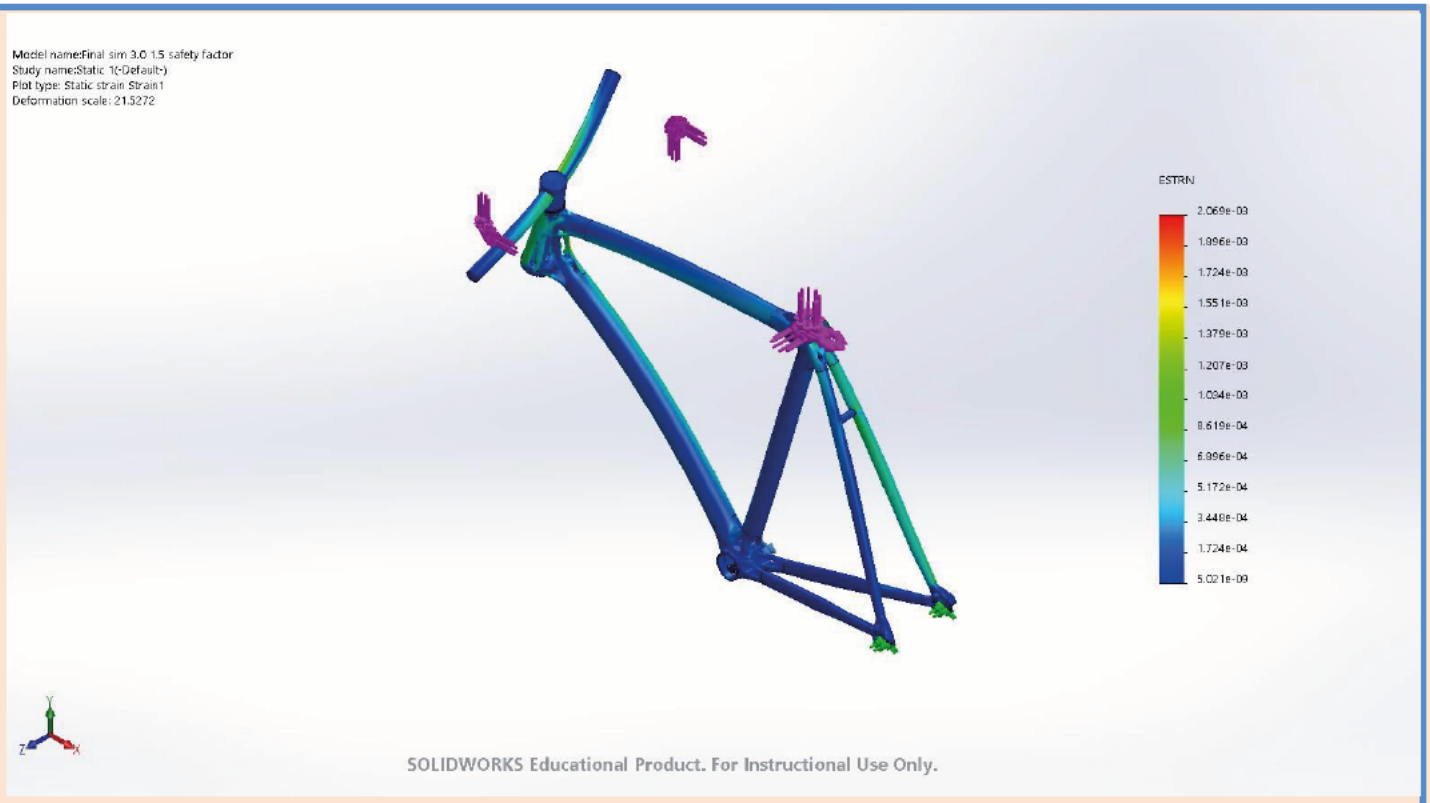
Name	Type	Min	Max

Displacement1	URES: Resultant Displacement	1.282e-05 mm Node: 402470	6.206e+00 mm Node: 383511



Final sim 3.0 1.5 safety factor-Static 1-Displacement-Displacement1

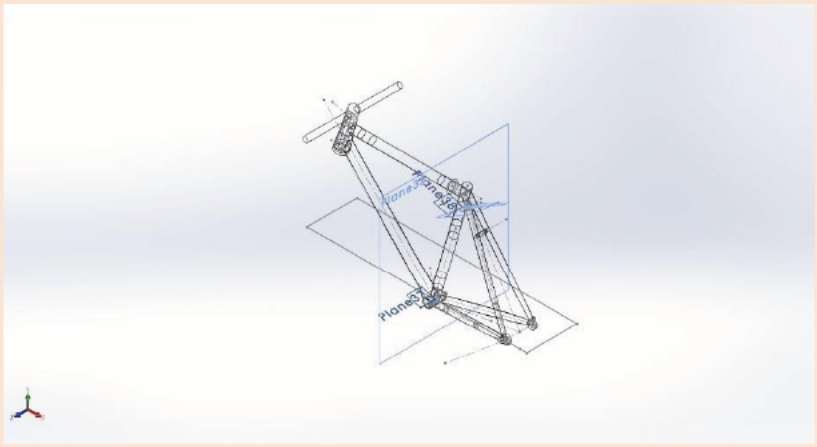
Name	Type	Min	Max
Strain1	ESTRN: Equivalent Strain	5.021e-09 Element: 362610	2.069e-03 Element: 899563



Final sim 3.0 1.5 safety factor-Static 1-Strain-Strain1

Conclusion

Original frame



Simulation of Braun origineel 1.5 safety factor

Date: donderdag 20 juni 2019
Designer: Solidworks
Study name: Static 3
Analysis type: Static

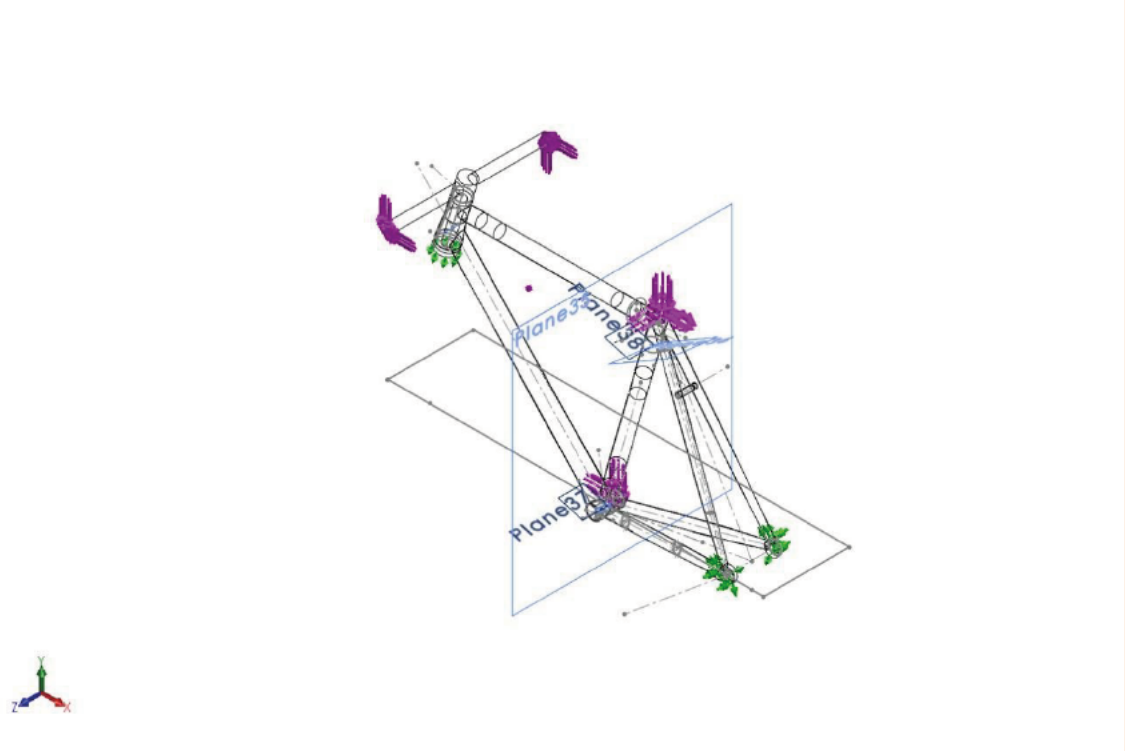
Table of Contents

Description

No Data

Assumptions

Model Information



Model name: Braun origineel 1.5 safety factor
Current Configuration: Default

Solid Bodies

Document Name and Reference	Treated As	Volumetric Properties	Document Path/Date Modified
Boss-Extrude9 	Solid Body	Mass:2.95906 kg Volume:0.000660507 m^3 Density:4479.98 kg/m^3 Weight:28.9988 N	C:\Users\bobby\OneDrive\Documenten\Afstuderen\final sim\Braun origineel 1.5 safety factor.SLDPRT Jun 20 10:48:12 2019

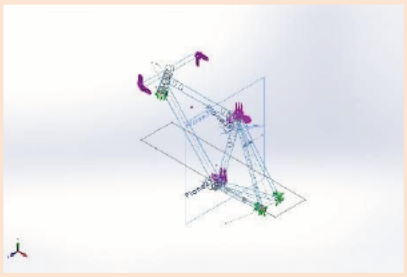
Study Properties

Study name	Static 3
Analysis type	Static
Mesh type	Solid Mesh
Thermal Effect:	On
Thermal option	Include temperature loads
Zero strain temperature	298 Kelvin
Include fluid pressure effects from SOLIDWORKS Flow Simulation	Off
Solver type	FFEPlus
Inplane Effect:	Off
Soft Spring:	Off
Inertial Relief:	Off
Incompatible bonding options	Automatic
Large displacement	Off
Compute free body forces	On
Friction	Off
Use Adaptive Method:	Off
Result folder	SOLIDWORKS document (C:\Users\bobby\OneDrive\Documenten\Afstuderen\final sim)

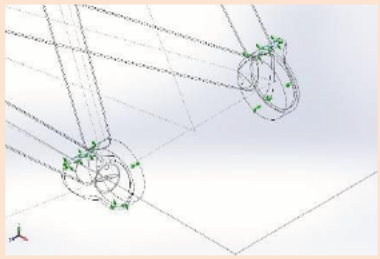
Units

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

Material Properties

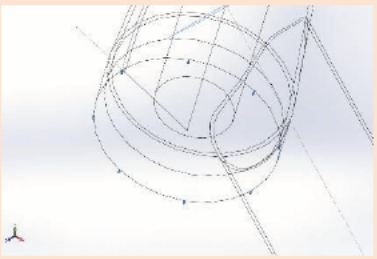
Model Reference	Properties		Components
	Name:	Ti-3Al-2.5v Grade 9 (1)	SolidBody 1(Boss-Extrude9)(Braun titanium verbeterd met stuur)
	Model type:	Linear Elastic Isotropic	
	Default failure criterion:	Unknown	
	Yield strength:	4.83e+08 N/m^2	
	Tensile strength:	1.07e+11 N/m^2	
	Elastic modulus:	1.1e+11 N/m^2	
	Poisson's ratio:	0.35	
	Mass density:	4480 kg/m^3	
	Thermal expansion coefficient:	8e-06 /Kelvin	
Curve Data:N/A			

Loads and Fixtures

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

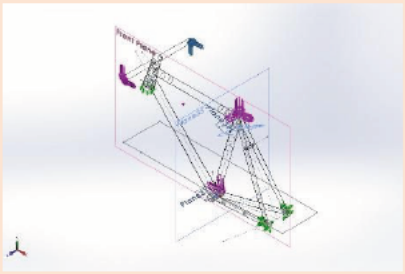
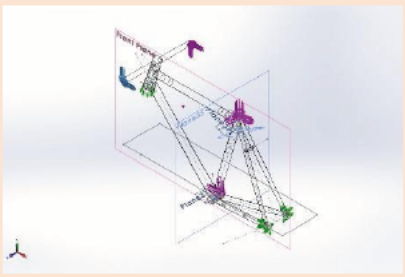
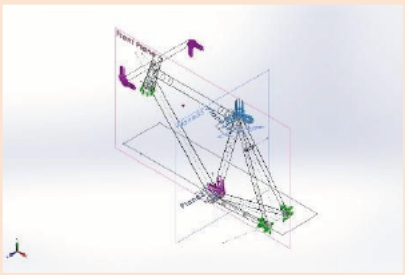
Resultant Forces

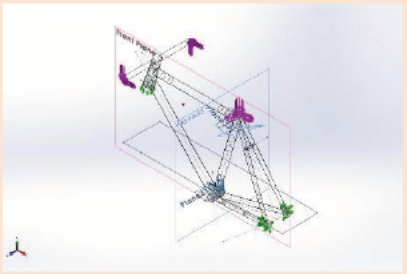
Components	X	Y	Z	Resultant
Reaction force(N)	-1855.71	3026.26	300.024	3562.57
Reaction Moment(N.m)	0	0	0	0

Roller/Slider-1		Entities: 1 face(s) Type: Roller/Slider

Resultant Forces

Components	X	Y	Z	Resultant
Reaction force(N)	523.703	1716.72	0	1794.82
Reaction Moment(N.m)	0	0	0	0

Load name	Load Image	Load Details
Force-1		Entities: 1 face(s), 1 plane(s) Reference: Front Plane Type: Apply force Values: -600, 957, --- N
Force-2		Entities: 1 face(s), 1 plane(s) Reference: Front Plane Type: Apply force Values: -600, -300, --- N
Force-3		Entities: 1 face(s), 1 plane(s) Reference: Front Plane Type: Apply force Values: 42, -3600, -300 N

Force-4		Entities: 1 face(s), 1 plane(s) Reference: Front Plane Type: Apply force Values: 2490, -1800, --- N

Connector Definitions

No Data

Contact Information

No Data

Mesh information

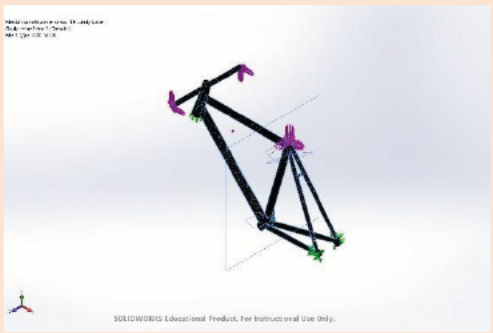
Mesh type	Solid Mesh
Mesher Used:	Standard mesh
Automatic Transition:	Off
Include Mesh Auto Loops:	Off
Jacobian points	4 Points
Element Size	12.6791 mm
Tolerance	0.633956 mm
Mesh Quality Plot	High

Mesh information - Details

Total Nodes	340037

Total Elements	181631
Maximum Aspect Ratio	32.645
% of elements with Aspect Ratio < 3	34.7
% of elements with Aspect Ratio > 10	0.655
% of distorted elements(Jacobian)	0
Time to complete mesh(hh;mm;ss):	00:00:21
Computer name:	

Mesh Control Information:

Mesh Control Name	Mesh Control Image	Mesh Control Details
Control-1		Entities: 1 Solid Body (s) Units: mm Size: 4.22622 Ratio: 1.5

Sensor Details

No Data

Resultant Forces

Reaction forces

Selection set	Units	Sum X	Sum Y	Sum Z	Resultant
Entire Model	N	-1332	4742.99	300.024	4935.6

Reaction Moments

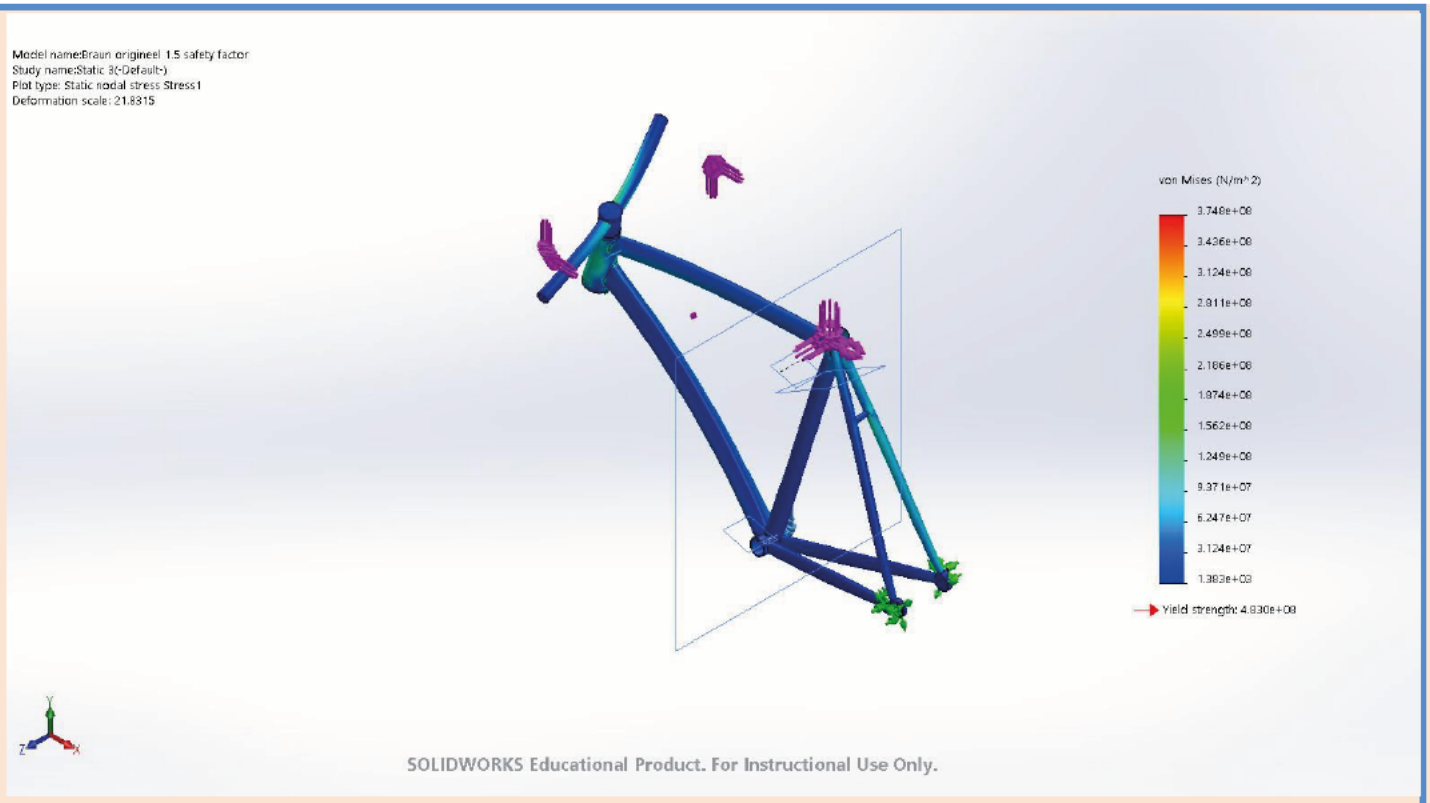
Selection set	Units	Sum X	Sum Y	Sum Z	Resultant
Entire Model	N.m	0	0	0	0

Beams

No Data

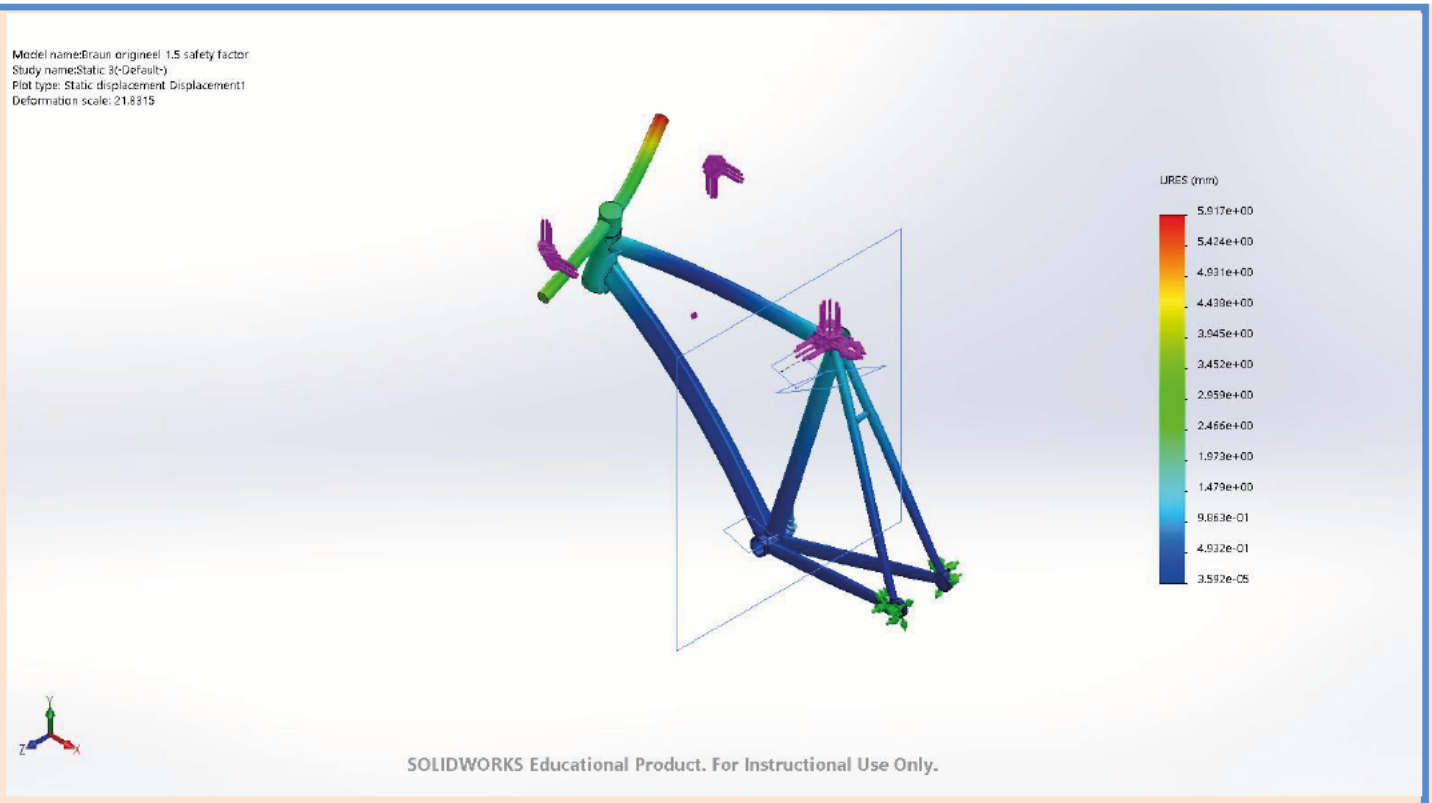
Study Results

Name	Type	Min	Max
Stress1	VON: von Mises Stress	1.383e+03 N/m^2 Node: 56212	3.748e+08 N/m^2 Node: 56238



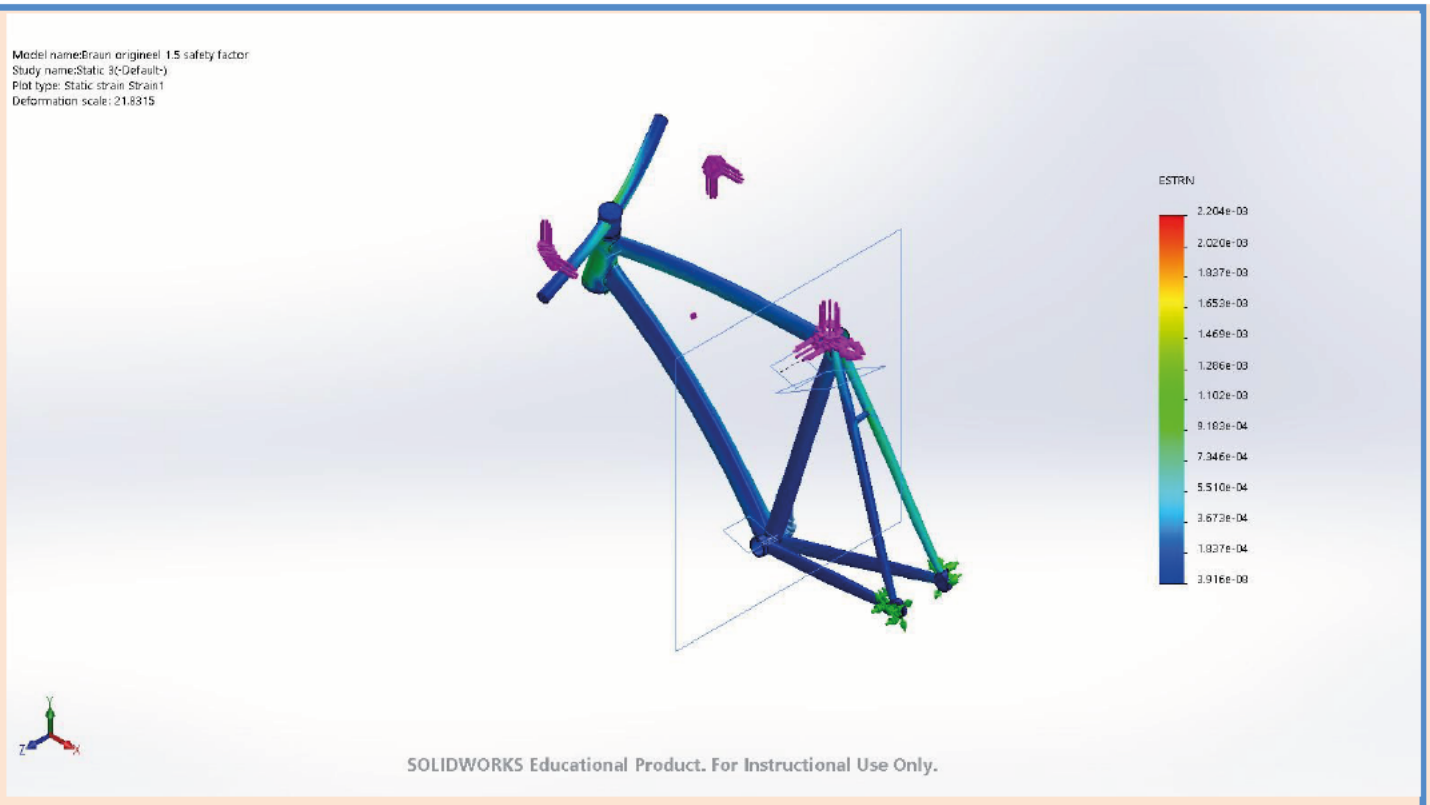
Braun origineel 1.5 safety factor-Static 3-Stress-Stress1

Name	Type	Min	Max
Displacement1	URES: Resultant Displacement	3.592e-05 mm Node: 37092	5.917e+00 mm Node: 56499



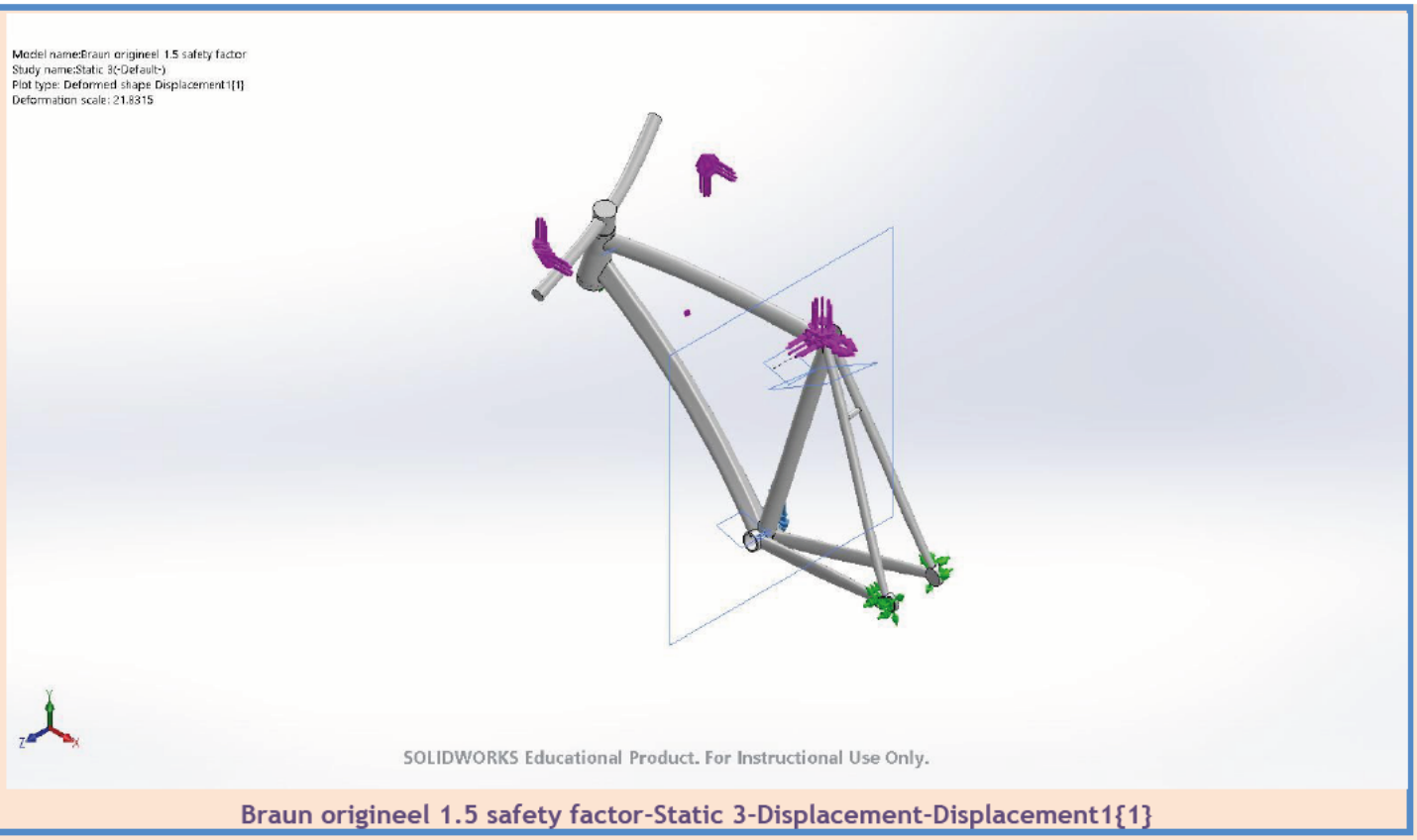
Braun origineel 1.5 safety factor-Static 3-Displacement-Displacement1

Name	Type	Min	Max
Strain1	ESTRN: Equivalent Strain	3.916e-08 Element: 26166	2.204e-03 Element: 23086



Braun origineel 1.5 safety factor-Static 3-Strain-Strain1

Name	Type
Displacement1{1}	Deformed shape



Braun origineel 1.5 safety factor-Static 3-Displacement-Displacement1{1}

Conclusion

H

cyclist groups

The image builder
This group of cyclists has a very diverse lifestyle. With an average age of 41 years, this is the youngest group within the total consumer group. The image builder practices one sport, road race cycling. Most of the image-builder cyclists are relatively new to the sport. Most importantly is that he/she has the newest gear from the biggest brands. Every kilometre that has been driven is posted on social media like Strava and/or Facebook.

These cyclists most of the time are very strict about rules and regulations on equipment and sportswear. A good example of these rules is described on the website of Velominati (Velominati,2016). The image builder is prepared to pay a lot of money for new parts to get a marginal gain in performance and is always up to date on the newest trends. Also, very open to new technology, as long as it is been presented and backed by one of the big cycling brands and/or professional cyclists.

- Road race cycling is the only sport
- Focus on improvement and result
- Sensitive for new products and trends
- Copies the big brands and/or professional cyclist

The Adventurer
This group of cyclists looks further into sports than road race cycling alone. They, for example, are also interested in mountain biking, working out, etc. The consumer group is in search of thrill and adventure. This group could also be described as ‘cycling sporter’. The goal of cycling is to see new places, have new experiences and to get fit. Going off the beaten path requires equipment that can withstand the adventures of the user group. These cyclists are focussed on all-around equipment.

They are less interested in traditional media (newspapers, magazines and books), and have about the same social media tendencies as the image builder. The adventurers are less focussed on the performance and resulting times and speeds, but more on the experience and place. Just like the image builder, the group very gadget sensitive.

- Does multiple (cycle related) sports
- Focus on participation and surroundings
- Sensitive for new products and trends
- Influenced by social media and peers

The Fanatic

The sport of road race cycling is the favourite and only activity of the fanatic. This consumer group grew up with the sport and now lives and breathes it. A large part of the group has practised the sport on competition level when they were younger or still participate as seniors in competitions. After the performance on the bicycle, health and general fitness are the most important factors to ride a bicycle.

The fanatic rides together with friends or his peers from a local cycling club. These cycling clubs are most of the time a large part of their social environment. The fanatic is interested in traditional media, cycling magazines, papers and some blogs. When the fanatic needs new products they are often inspired by these media or look to the gear that the professional is using. The fanatic is realistic about setting goals and knows his/her own limits.

- Road race cycling is the only sport
- Focus on performance and result
- Brand loyal, only switches to new products if proven by the professional or backed by media
- Influenced by peers and traditional media

The Purist

The most important thing for the purist is the journey itself. These cyclists do not get themselves worked up with ambitious goals, but instead, enjoy the freedom of riding a bicycle. Besides the freedom of cycling, another benefit of cycling is that the body and mind stay fit. The purists are more of a traditional group of riders, loyal to a brand and a conservative attitude. This is reflected in their owned products, a rational consumption style, oriented on high-quality and a long lifespan. The purist rides solo for most of the time, but sometimes a friend tags along. Interested in traditional media, cycling magazines, papers and some blogs.

- Road race cycling is the only sport
- Focus on experience
- Brand-loyal. Buys products that last a long time
- Not easily influenced, trusts simple technology that is tested through time

Figure XXX symbolizes the four different cyclist groups. The visual clearly shows that the four groups do have overlaps. Some fanatic road race cyclists also participate in the sport of mountain biking, some purists participate in a competition, etc. During my interviews a noticed that there is an overlap between every group, except, the image-builder and the purist. These two groups do not mix because of one thing, the image-builder is progressive, the purist conservative. The difference between these two groups can quickly be observed in the newness of the products that are used by the consumer.

DESIGN FOR our future

TU Delft

IDE Master Graduation

Project team, Procedural checks and personal Project brief

This document contains the agreements made between student and supervisory team about the student's IDE Master Graduation Project. This document can also include the involvement of an external organisation, however, it does not cover any legal employment relationship that the student and the client (might) agree upon. Next to that, this document facilitates the required procedural checks. In this document:

- The student defines the team, what he/she is going to do/deliver and how that will come about.
- SSC E&SA (Shared Service Center, Education & Student Affairs) reports on the student's registration and study progress.
- IDE's Board of Examiners confirms if the student is allowed to start the Graduation Project.

USE ADOBE ACROBAT READER TO OPEN, EDIT AND SAVE THIS DOCUMENT
Download again and reopen in case you tried other software, such as Preview (Mac) or a webbrowser.

STUDENT DATA & MASTER PROGRAMME

Save this form according the format "IDE Master Graduation Project Brief_familyname_firstname_studentnumber_dd-mm-yyyy".
Complete all blue parts of the form and include the approved Project Brief in your Graduation Report as Appendix 1 !

family name [redacted]
initials [redacted] given name [redacted]
student number [redacted]
street & no. [redacted]
zipcode & city [redacted]
country [redacted]
phone [redacted]
email [redacted]

Your master programme (only select the options that apply to you):

IDE master(s): ★ IPD ○ DfI ○ SPD
2nd non-IDE master:
individual programme: - - (give date of approval)
honours programme: ○ Honours Programme Master
specialisation / annotation: ○ Medisign
○ Tech. in Sustainable Design
○ Entrepeneurship

SUPERVISORY TEAM **

Fill in the required data for the supervisory team members. Please check the instructions on the right !

** chair S. Van de Geer dept. / section: design aesthetics
** mentor D.I. Brand dept. / section: design aesthetics
2nd mentor Herman Braun
organisation: Herman Braun Racefietsen
city: Spijkenisse country: The Netherlands

comments (optional) Van de Geer and Brand both are member of DA. But their expertise is more complementary then overlapping. Brand operates in the field of Zen design, creating form while Van de geer is more form in relation to M&D, techn.issues

Chair should request the IDE Board of Examiners for approval of a non-IDE mentor, including a motivation letter and c.v..

Second mentor only applies in case the assignment is hosted by an external organisation.

Ensure a heterogeneous team. In case you wish to include two team members from the same section, please explain why.

APPROVAL PROJECT BRIEF

To be filled in by the chair of the supervisory team.

chair S. Van de Geer date - - signature

CHECK STUDY PROGRESS

To be filled in by the SSC E&SA (Shared Service Center, Education & Student Affairs), after approval of the project brief by the Chair.
The study progress will be checked for a 2nd time just before the green light meeting.

Master electives no. of EC accumulated in total: _____ EC

Of which, taking the conditional requirements into account, can be part of the exam programme _____ EC

List of electives obtained before the third semester without approval of the BoE

★ YES all 1st year master courses passed

NO missing 1st year master courses are:

name date - - signature

FORMAL APPROVAL GRADUATION PROJECT

To be filled in by the Board of Examiners of IDE TU Delft. Please check the supervisory team and study the parts of the brief marked **.
Next, please assess, (dis)approve and sign this Project Brief, by using the criteria below.

- Does the project fit within the (MSc)-programme of the student (taking into account, if described, the activities done next to the obligatory MSc specific courses)?
- Is the level of the project challenging enough for a MSc IDE graduating student?
- Is the project expected to be doable within 100 working days/20 weeks ?
- Does the composition of the supervisory team comply with the regulations and fit the assignment ?

Content: APPROVED NOT APPROVED

Procedure: APPROVED NOT APPROVED

comments

name date - - signature

Initials & Name B.M. Adriaansens Student number 4225708

Title of Project Road race cycling frame of the future

Road race cycling frame of the future — project title

Please state the title of your graduation project (above) and the start date and end date (below). Keep the title compact and simple. Do not use abbreviations. The remainder of this document allows you to define and clarify your graduation project.

start date - - — - - end date

INTRODUCTION **

Please describe, the context of your project, and address the main stakeholders (interests) within this context in a concise yet complete manner. Who are involved, what do they value and how do they currently operate within the given context? What are the main opportunities and limitations you are currently aware of (cultural- and social norms, resources (time, money,...), technology, ...).

The road race bicycle, a seemingly simple product. Two wheels, a frame, a handlebar, two pedals and you are ready to race. This isn't the case when we look at the road race cycle industry of today. New innovations enter the market at a rapid pace. The bicycle enthousiast wants to have the newest parts to shave seconds of their time. The bicycle consumer is also very keen to have the newest gadgets to show off to their friends, fellow cyclists. The big brands use this in their advantage, every year multiple innovations enter the market as can be seen in the article written by Design Innovation Award (2019). This rapid pace has its effects on the quality of products. Bicycles with the 'newest' technology can be bought without even being tested says Olaf Wit (2019), ex employee of Koga bicycle company. This brings up the question if the innovations are really beneficial for the cyclist or are they just a manifestation of the money driven design of the big brands within the cycling industry?

Contradictions and misinformation are common within the cycling industry. The cycle has many variables, that when mixed, all give a different outcome. Weight, aerodynamics and stiffness are the most important factors that come into play when designing a bicycle. Every sort of the road racing sector has its own mix of these factors to give the optimal bike. The big brands all claim to have found the optimal mix of factors, however the next month there is a newer mix that is even better. This creates a consumer base that doesn't know right from wrong and just blindly follows the example of what the pro cyclist rides on. This example can be seen if we look at the average road race cycling enthusiast, as everyone is suddenly starting to ride on aerodynamic formed carbon frames. On the other hand, we can see a movement that is less convinced by all of these innovations. The 'Steel is real' movement (Strong frames, 2016) is rapidly growing in the USA. We can also see some pro cyclists that are convinced of the 'older' steel bicycle frames and even outperform pros on their carbon bikes, an example of this can be read in Templin, (2018).

Someone who is in the midst of this is Herman Braun. Herman Braun and his son Davey Braun run the company "Herman Braun cycling". Herman started working as the mechanic for the pro team of Kees Pellenaar (Professional cyclist) when he was just 16 years old. In 1983 he founded his own brand for road racing bicycles (Den Braber, 2016). Herman Braun and his son have built thousands of frames, which result in an gut feeling way of working based on his experience. The company solely builds custom bicycles out if steel and titanium in their high-tech workshop. 'Bicycles are made out of steel and carbon is for fishing' is a saying that can be heard often in the shop. The combination of the factors above and the hard headed way of Herman Braun are the factors that make a Braun bicycle a sought after product for some. This can be seen in examples of Leontien van Moorsels hour record bike and the badged over frames of Maarten den Bakker. Pricewise Braun bicycles are not that expensive compared to other custom made bicycles. A custom steel Braun frame starts at €1.050,- where a carbon custom frame starts at €6.000,-.

This despite their new Titanium frame. The problem that Braun is facing, is that he can not keep up with the competition. The bigger brands all produce carbon frames and let their sponsored teams ride on it. As stated before, the consumer blindly copies what the pro cyclist rides on. The implementation of the new technologies (like disk brakes) take a lot of time to implement in Braun designs. The bike frames are made from tubing created by the companies Dedacaii and Columbus, who maybe limit Braun in his pursuit of new shapes and technologies. This makes the bikes look outdated, not always fitted with the newest technology and made out of a material that the consumer is bias about.

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introduction (continued): space for images

image / figure 1: Carbon versus Steel frames

image / figure 2: Herman Braun and Davey Braun

Initials & Name B.M. Adriaansens Student number 4225708

Title of Project Road race cycling frame of the future

PROBLEM DEFINITION **

Limit and define the scope and solution space of your project to one that is manageable within one Master Graduation Project of 30 EC (= 20 full time weeks or 100 working days) and clearly indicate what issue(s) should be addressed in this project.

Innovation
Herman Braun tries to constantly innovate in his frames. He installs the newest parts on the frames to keep up to date to the newest trends, still this does not change much on the looks of the frame. In the carbon frame market a lot of experimental designs pop up, this is not the case with the metal-frames. The metal frames are designed via the tested out geometrics of Herman Braun. Is there a way to research a balance between new geometrics and the tested knowledge of herman Braun?
Weight
In the performance driven industry of road cycling everything needs to be as light as possible. New carbon frames are easily below 1kg, where Braun's are 1.5Kg. The difference of +/-500 gram is massive in a market where cyclists pay €200,- more for a 50 gram lighter crankset on their bicycle. Is the a design solution that can decrease weight without losing strength? What impact would this solution have on custom frame building?
Aerodynamic
All of the mass produced frames tend to become more and more aerodynamically shaped. Round tubes that are used on Braun's bicycles are not aerodynamic compared to the tear drop shaped carbon frames. Is it possible to optimise the aerodynamics of a custom metal bicycle frame and is it really that important for the target group?
The consumer
Then there is the emotional aspect of owning and riding a bicycle. The mix of aspects on how choices are made to invest in a bicycle is illusive. We have the market that is performance driven but also the aspects of riding in a group of peers and all of the effects of group behaviour. Is it possible to translate the symbiotic working of the different aspects of the cycling industry/community into viable input for the assignment?

ASSIGNMENT **

State in 2 or 3 sentences what you are going to research, design, create and / or generate, that will solve (part of) the issue(s) pointed out in "problem definition". Then illustrate this assignment by indicating what kind of solution you expect and / or aim to deliver, for instance: a product, a product-service combination, a strategy illustrated through product or product-service combination ideas, ... In case of a Specialisation and/or Annotation, make sure the assignment reflects this/these.

Design an innovation in the field of the custom metal road cycling frame. Look into performance improving trends in the market of bicycle frames and optimise one of these for a metal material made road cycling frame.

The main goal of the assignment is to deliver a product. As stated above the assignment focuses on innovation in metal custom frame building. To the company it could be much more than that. In the near future Davey the son of Herman needs to follow up his father as owner of the company. This product could help him to develop a new vision, his own vision. The company has always been led by Herman. The design assignment could be an opportunity to break old customs,create a new perspective and look into the future of the company.

The product itself can be an opportunity for marketing. It has opportunity to show the craftsmanship and perfection of Braun. The product could give a message to the market that prejudices about metal bikes are wrong, and it is a magical material that is still very much alive.

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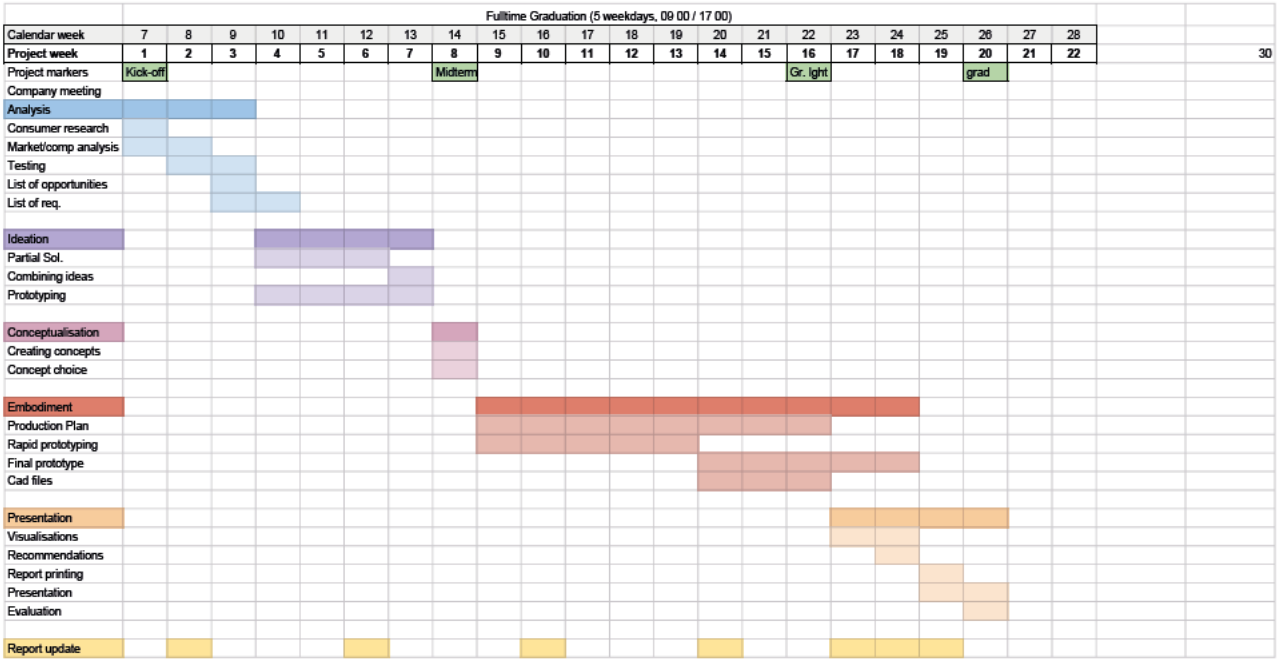
PLANNING AND APPROACH **

Include a Gantt Chart (replace the example below - more examples can be found in Manual 2) that shows the different phases of your project, deliverables you have in mind, meetings, and how you plan to spend your time. Please note that all activities should fit within the given net time of 30 EC = 20 full time weeks or 100 working days, and your planning should include a kick-off meeting, mid-term meeting, green light meeting and graduation ceremony. Illustrate your Gantt Chart by, for instance, explaining your approach, and please indicate periods of part-time activities and/or periods of not spending time on your graduation project, if any, for instance because of holidays or parallel activities.

start date - - - - end date



The schedule is based on a full-time workweek (5 days a week/ 09:00 to 18:00)

I did not include holidays in my planning as I like to work and finish a project before taking a break, this helps me to focus. The schedule has a fairly short analysation part as the focus should mainly be on designing, building and experimenting. This so I plan to really end the project with an finished product.

MOTIVATION AND PERSONAL AMBITIONS

Explain why you set up this project, what competences you want to prove and learn. For example: acquired competences from your MSc programme, the elective semester, extra-curricular activities (etc.) and point out the competences you have yet developed. Optionally, describe which personal learning ambitions you explicitly want to address in this project, on top of the learning objectives of the Graduation Project, such as: in depth knowledge a on specific subject, broadening your competences or experimenting with a specific tool and/or methodology, ... Stick to no more than five ambitions.

2 Years ago together with a group of friends I designed an orthopedic clipless bicycle pedal for the course advanced embodiment design. That is where I discovered my fascination for working in the field of the development of sports related products. I would like to explore the possibilities of continuing to work in this field in the future. Next to that I would like to set up my own company. This assignment has the opportunity to learn more about small business management, Herman Braun cycles is very small and I am in direct contact to the owner(s) (Herman and Davey). This will not be a big focus of the project, more something I would like to look at on the side.

During my studies at the faculty of industrial design in Delft was educated in the field of Materials, production techniques, and aesthetics. I always tried to incorporate this into my work in a very design doing like manner. This way of working was thought to me by Bruno Ninaber during my internship at his company. I would like to improve my skill set by putting my knowledge into practice.

During my bachelor thesis I focussed on working on a tight schedule. Everything was planned out beforehand and had a seperate time slot. This was a very neat way of working and relieved me of a lot of stress, I want to implement this way of working into my graduation as well.

The ambitions for my graduation project are:
-Learning more about metal Materials
-Learning about new production techniques
-Refine form and aesthetics
-Learn about small business management
-Plan and schedule everything

FINAL COMMENTS

In case your project brief needs final comments, please add any information you think is relevant.

See appendix 1 for sources.

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