Waterloop

GOOSE I HALF SCALE PROTOTYPE

Website: http://www.teamwaterloop.com
Email: teamwaterloop@gmail.com
Facebook: https://www.facebook.com/waterloohyperloop/
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PROTOTYPE STATISTICS

Mass	250 kg
Payload Capacity	2300 kg
Expected Cruising Velocity	550 km/h
Length	2.5m
Height	0.9m
Width	0.8m

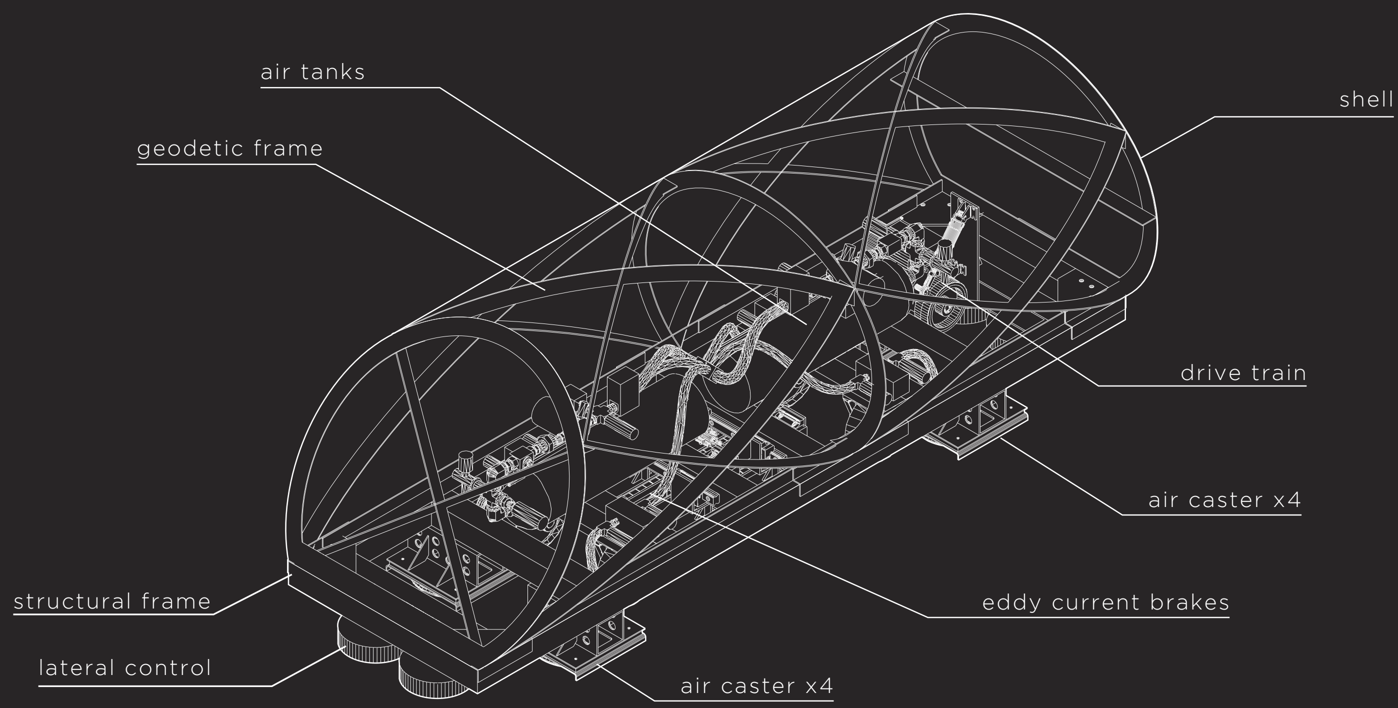
DESIGN PHILOSOPHY

This is the Hyperloop pod that we are building. The GOOSE I is our half-scale, functional prototype vehicle pod. Fabrication for the pod is already underway. This pod is entered in the SpaceX Hyperloop Pod Competition to perform full systems tests on SpaceX's one mile long test track at high-speeds and in a vacuum.

Our prototype design uses a minimalist strategy while retaining strict safety considerations. By selecting this design philosophy, a reduction in the manufacturing complexity, cost and mass is achieved; while simultaneously permitting an effective travel speed and increased reliability.

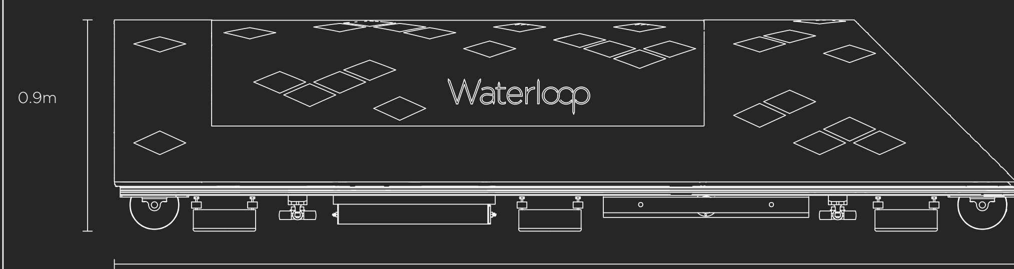
WATERLOOP

DESIGN PACKAGE

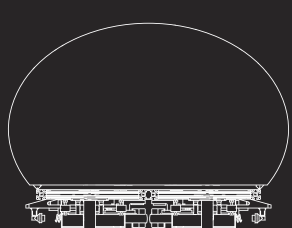


FRONT ELEVATION

SIDE ELEVATION



BACK ELEVATION



TOP VIEW

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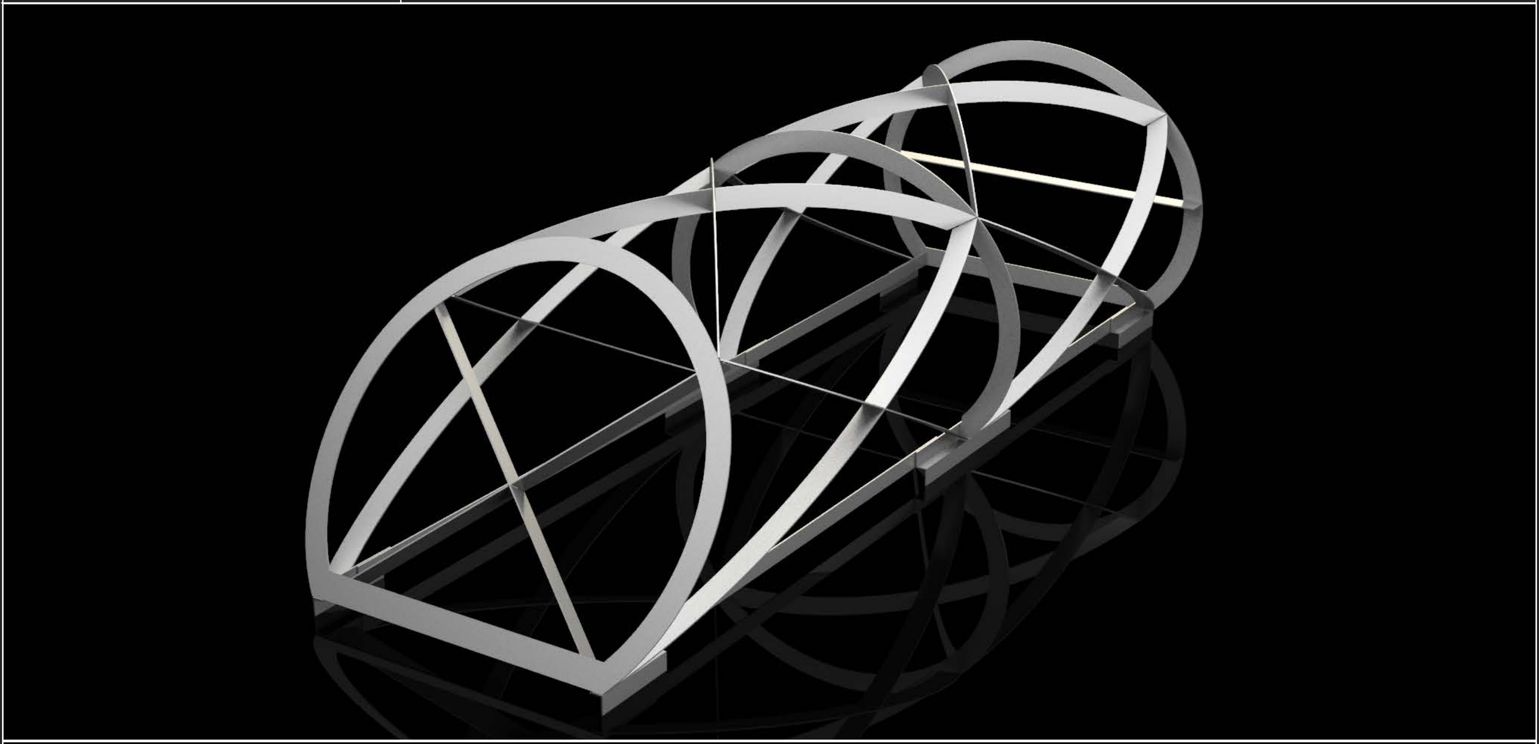
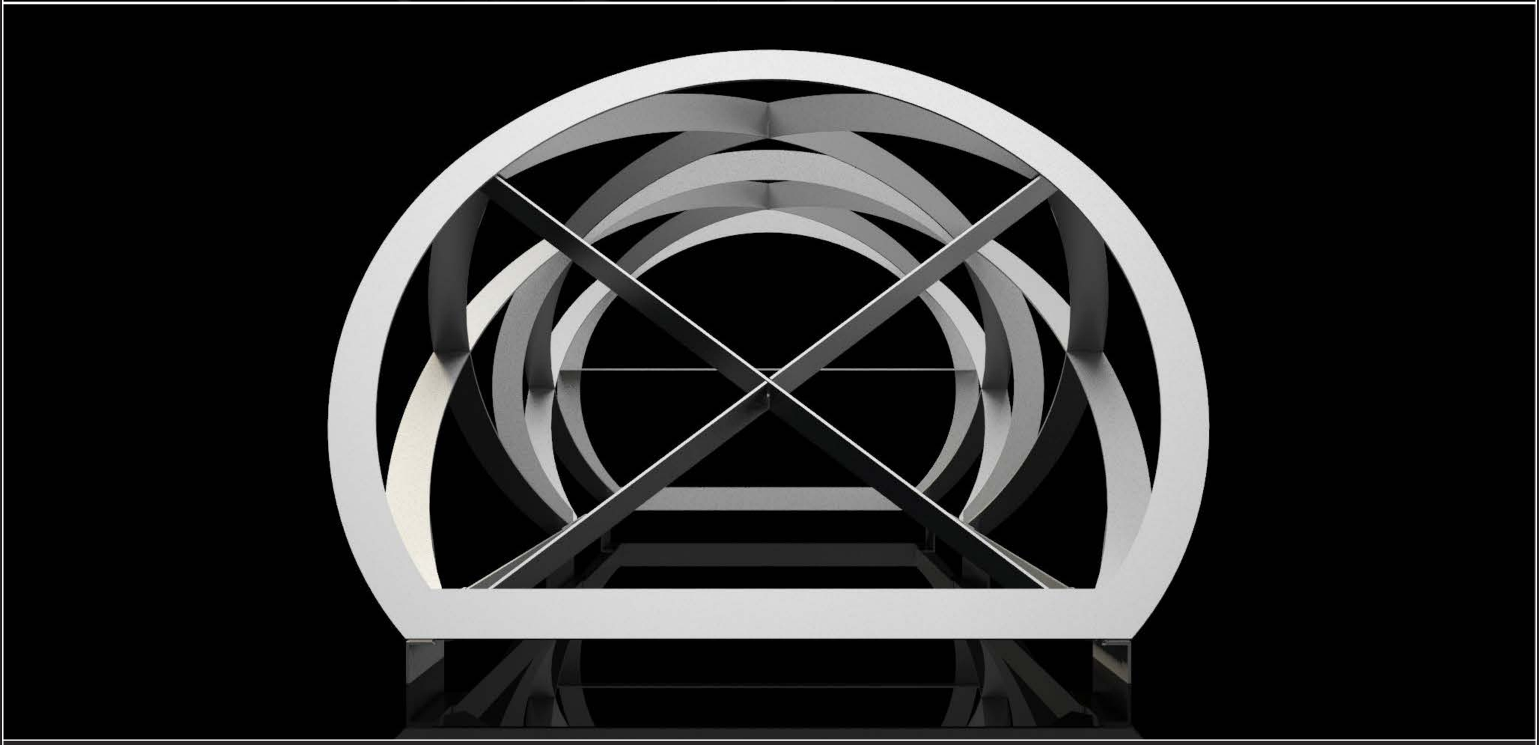
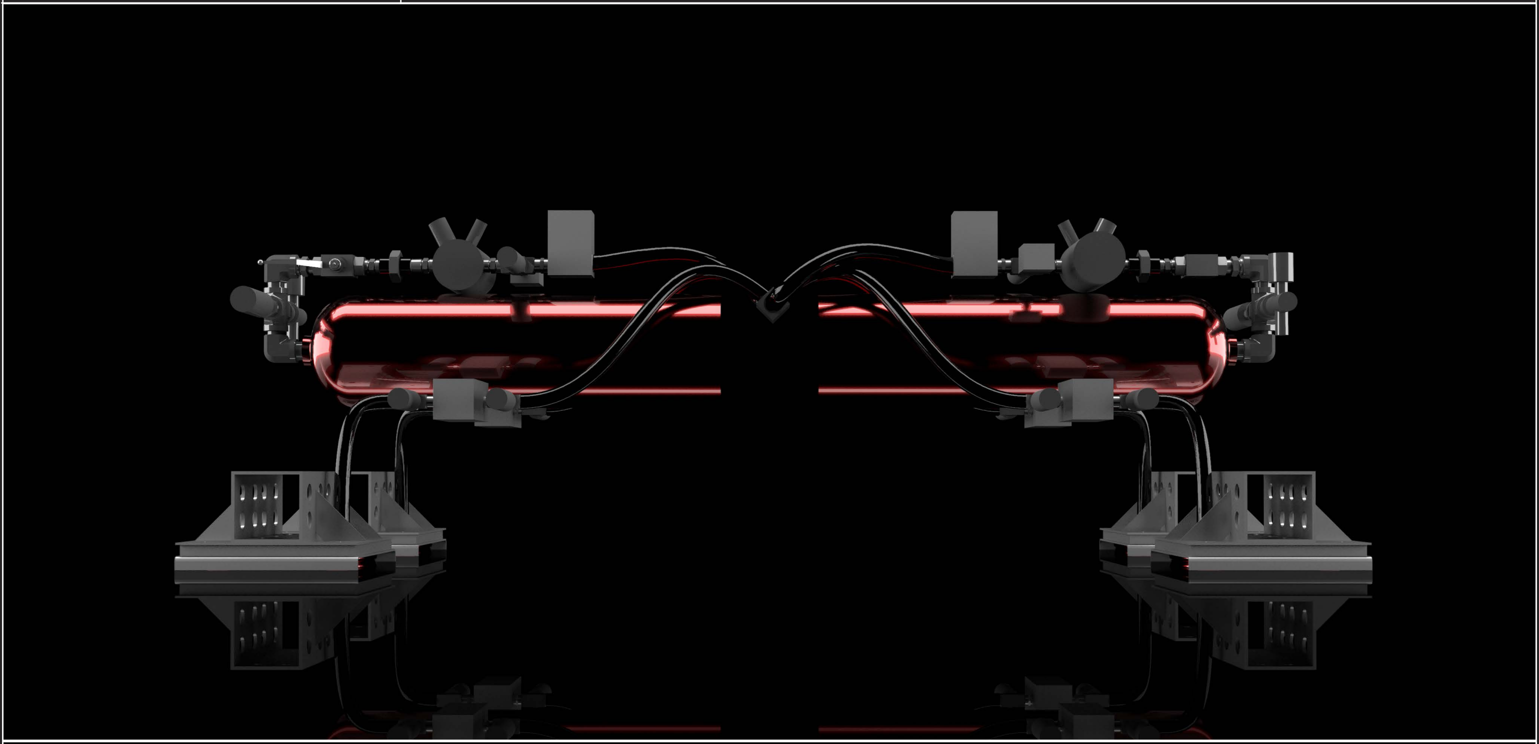
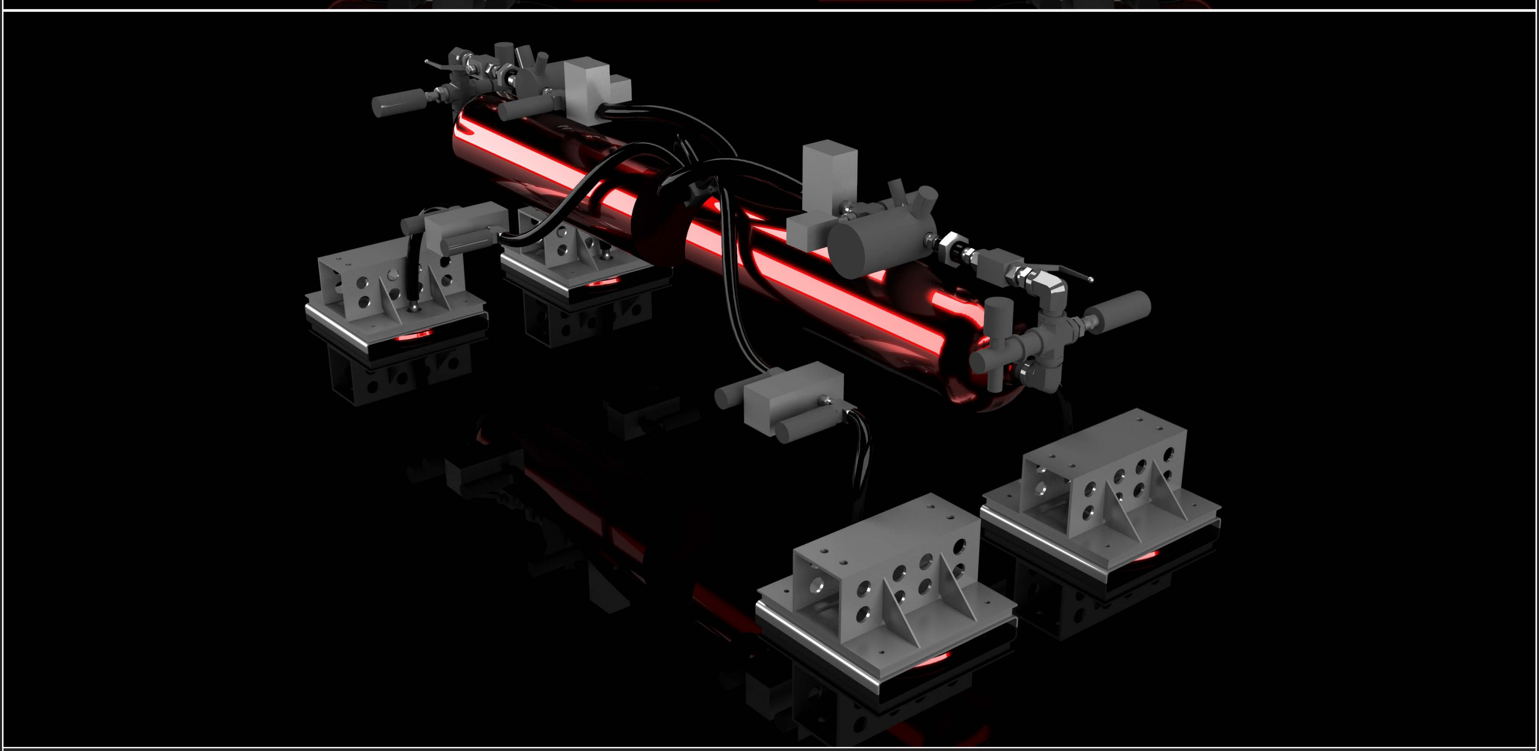




POD SHELL

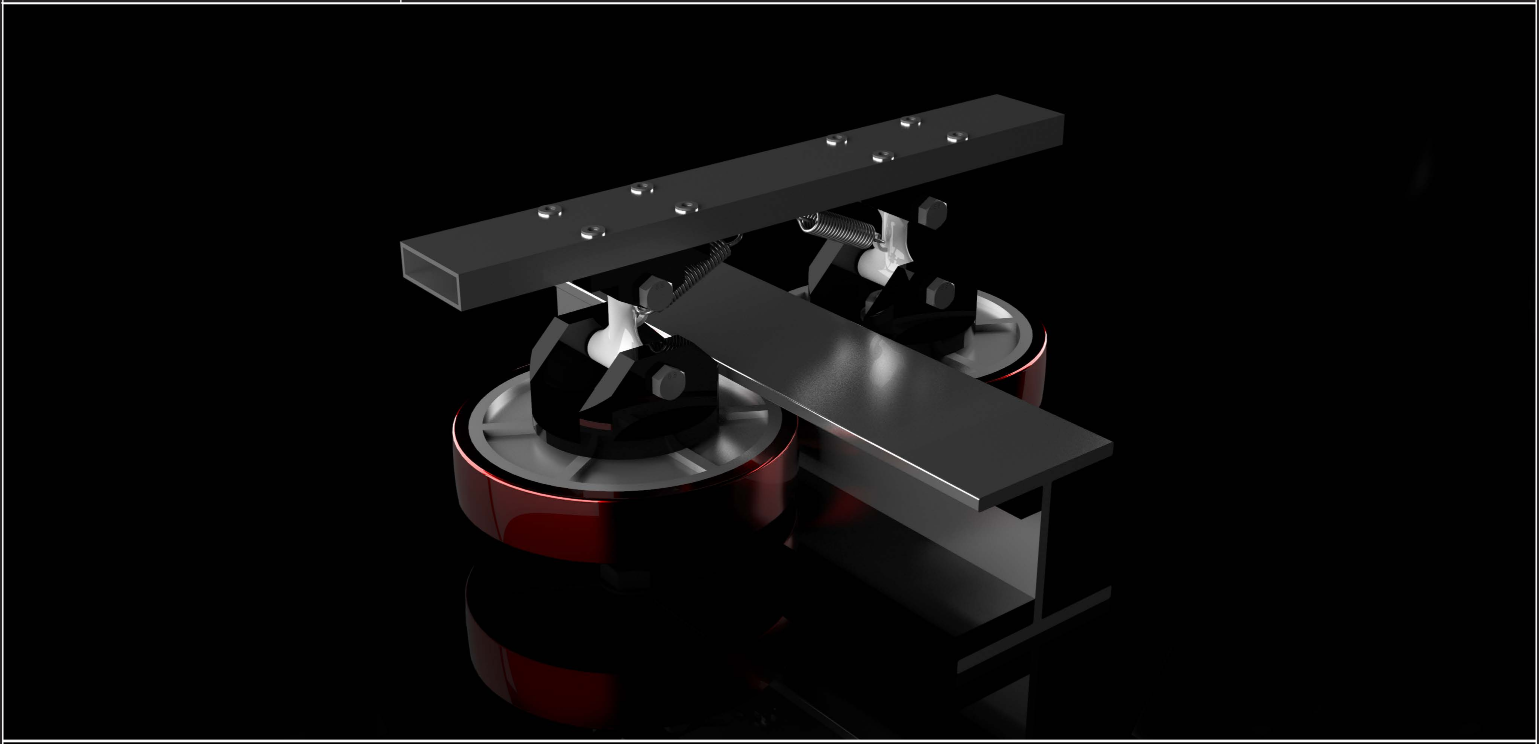
The shell is designed to be as lightweight as possible while withstanding all of the forces it will be subjected to in the one-mile long test drive. This is made possible by introducing a geodetic diagrid frame which is designed to accept the applied forces better than a standard rectilinear frame. Although this style of framing has traditionally been considered more difficult to manufacture, this is quickly overcome with modern technology by precision modelling of the entire assembly in 3D, and the use of rapid fabrication technology including laser cutting and 3D printing.

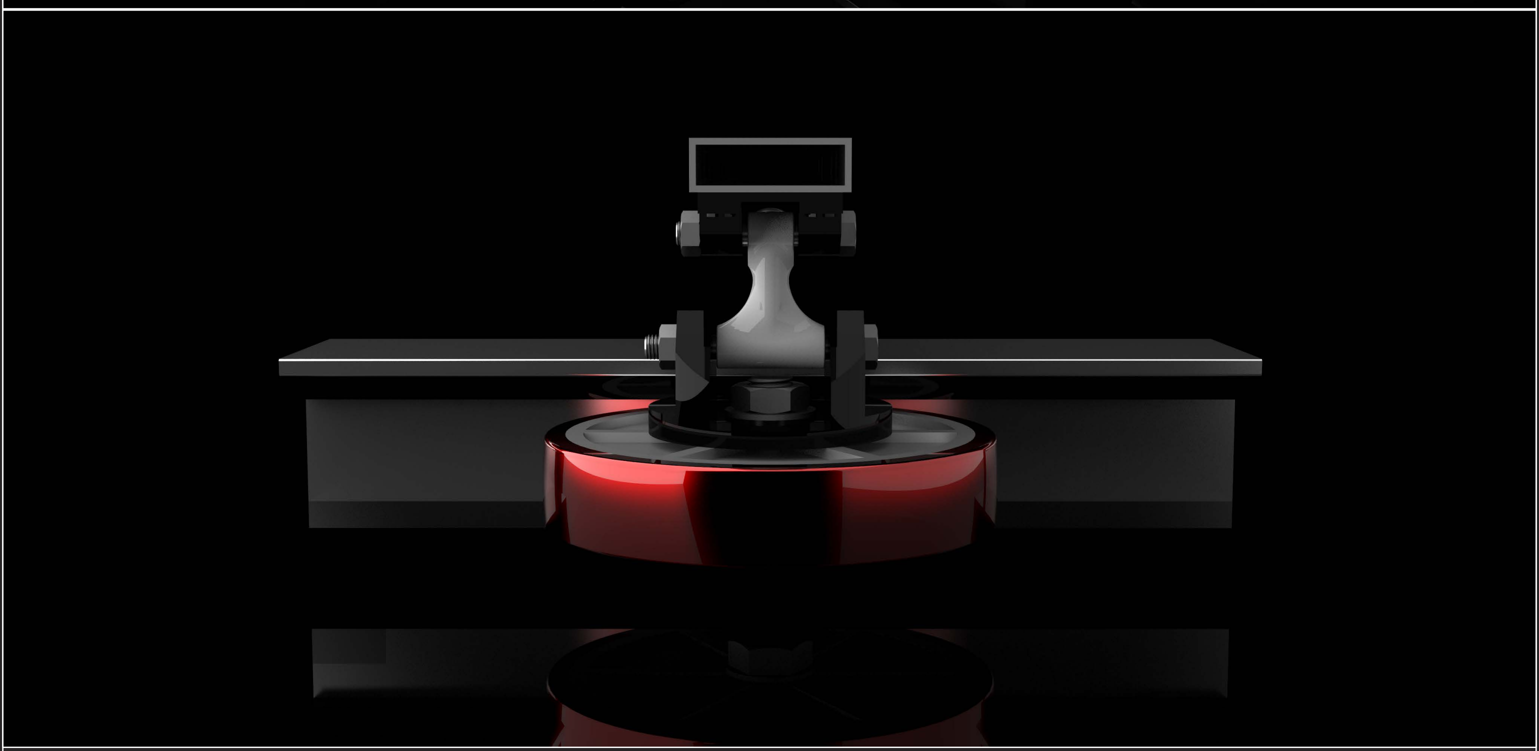




LEVITATION

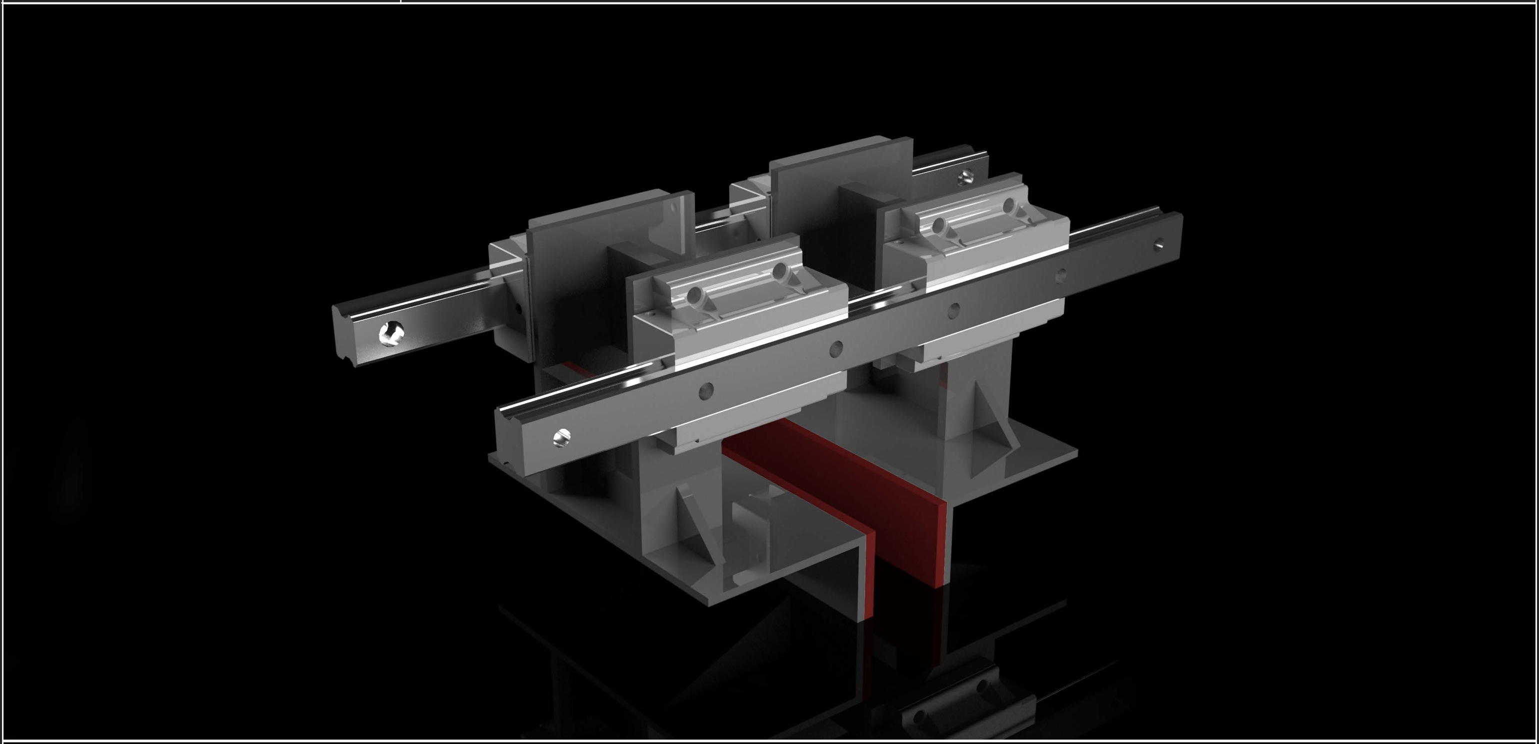
Air levitation through the form of four air casters is supplied via two on-board scuba air tanks. The air casters create a thin sheet of air similar to an air hockey table upon which our pod floats. Air levitation is significantly less expensive, less complex, and produces less drag than magnetic levitation. Although air caster technology has been in use for decades and is well understood, our levitation system will be first of its kind when used in the low pressure Hypertube at SpaceX next January 2017.

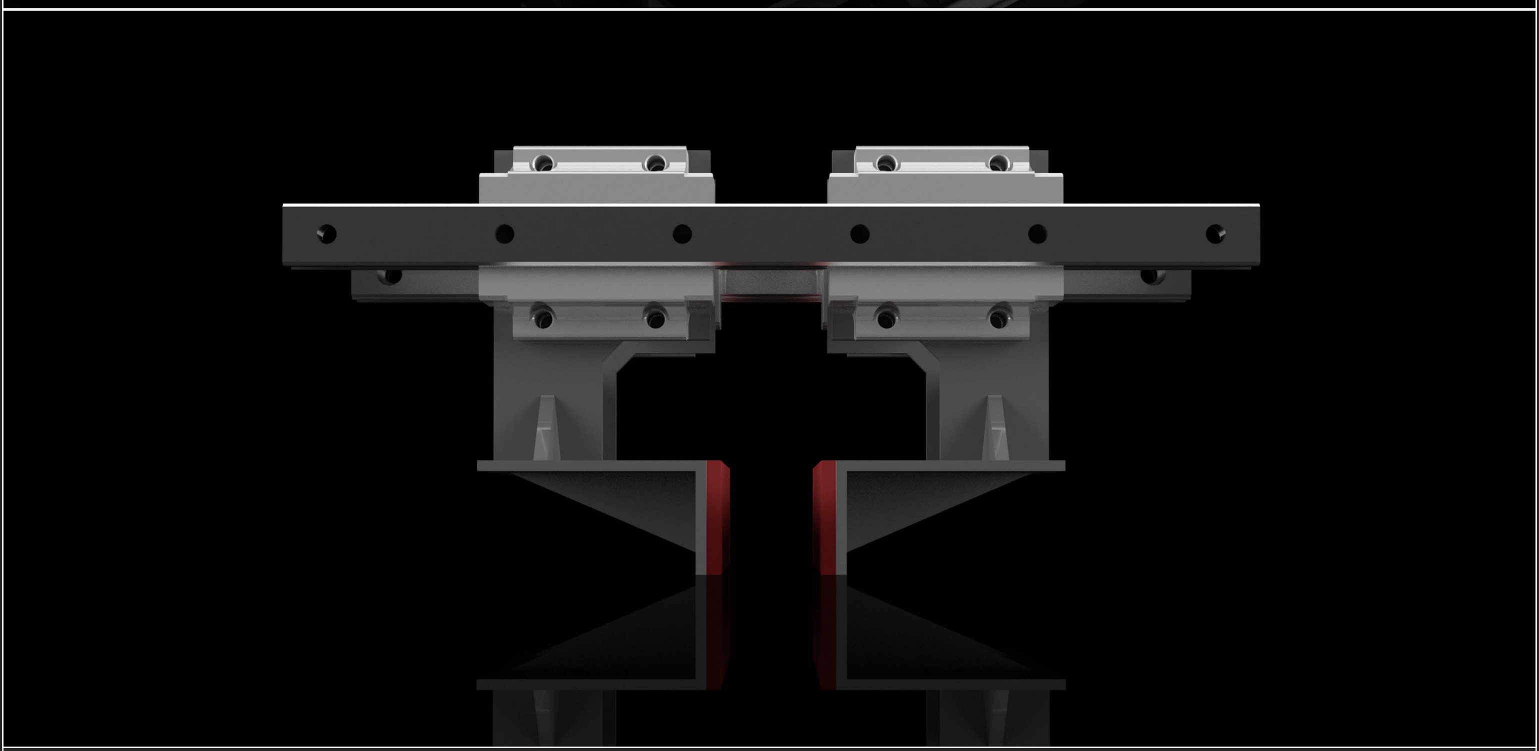




LATERAL CONTROL

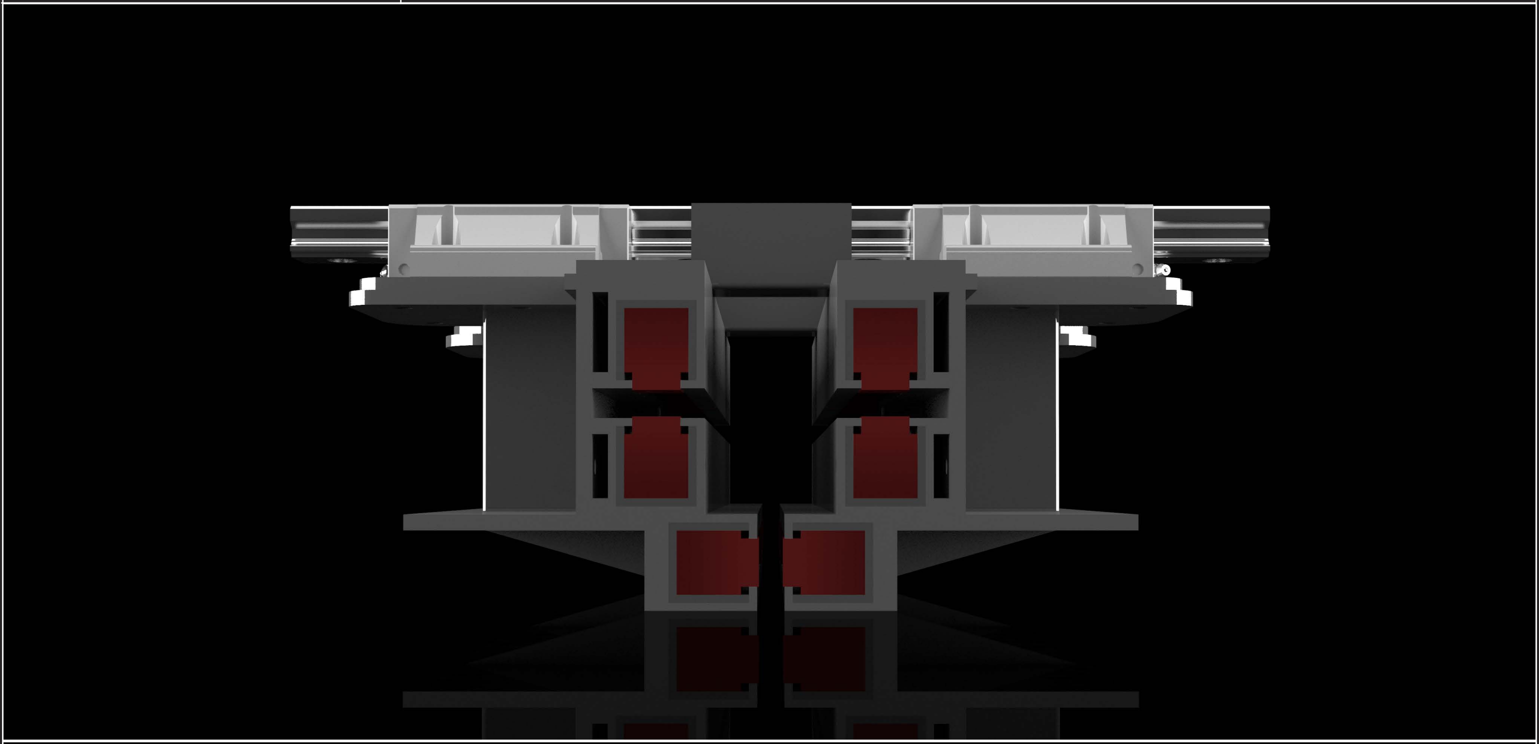
The lateral control system uses two sets of spring-loaded caster wheels to maintain the lateral stability of the Goose I, with respect to the I-beam of the Hypertube. The system combines reliability, efficiency, safety, and comfort by using high speed, high performance, and dampened wheels.

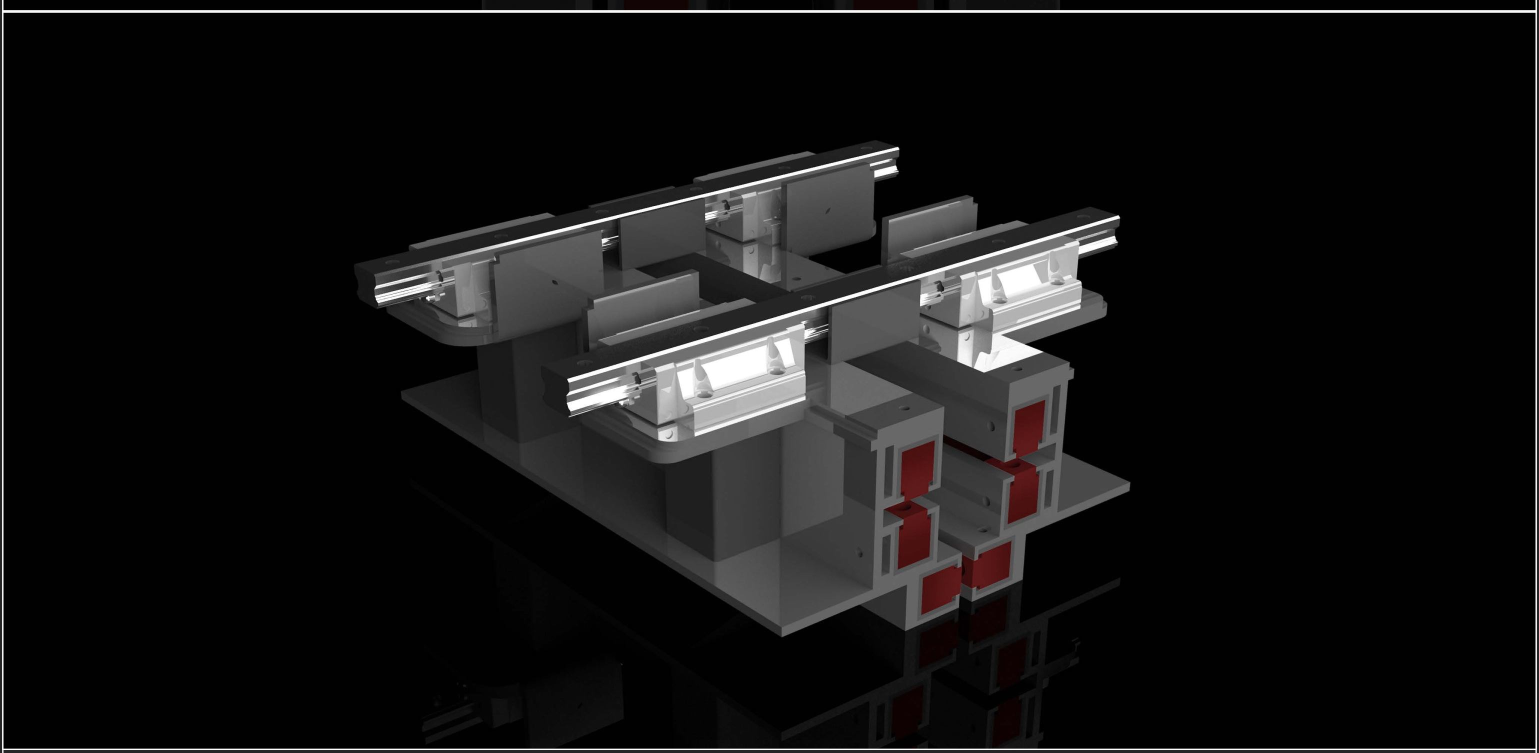




FRICTION BRAKING

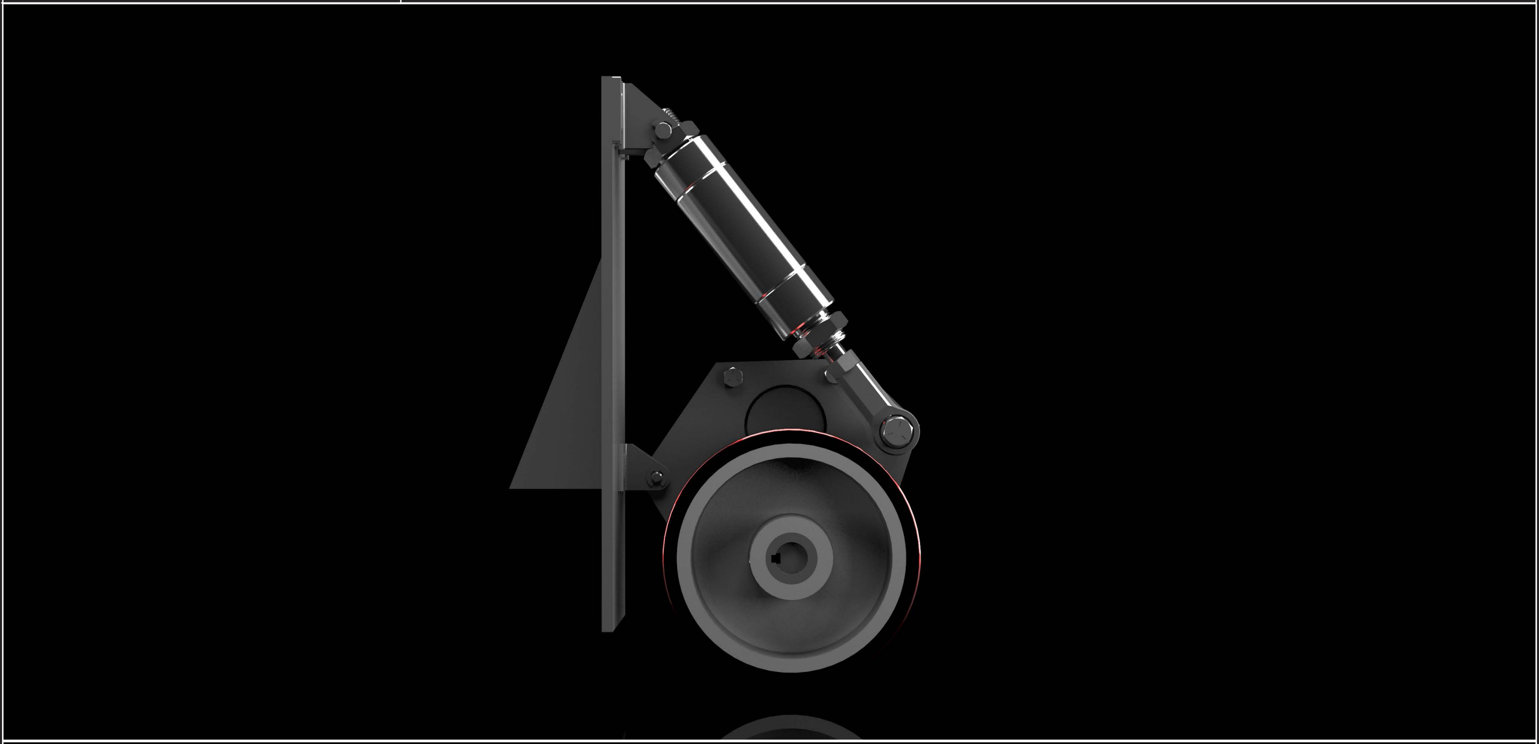
Our hybrid braking system is mechanically fail-safe and functions even if all other systems fail. A combination of eddy current braking and friction braking is used. This allows for greater control over heat generation, higher performance, lower maintenance, and safety through redundancy.





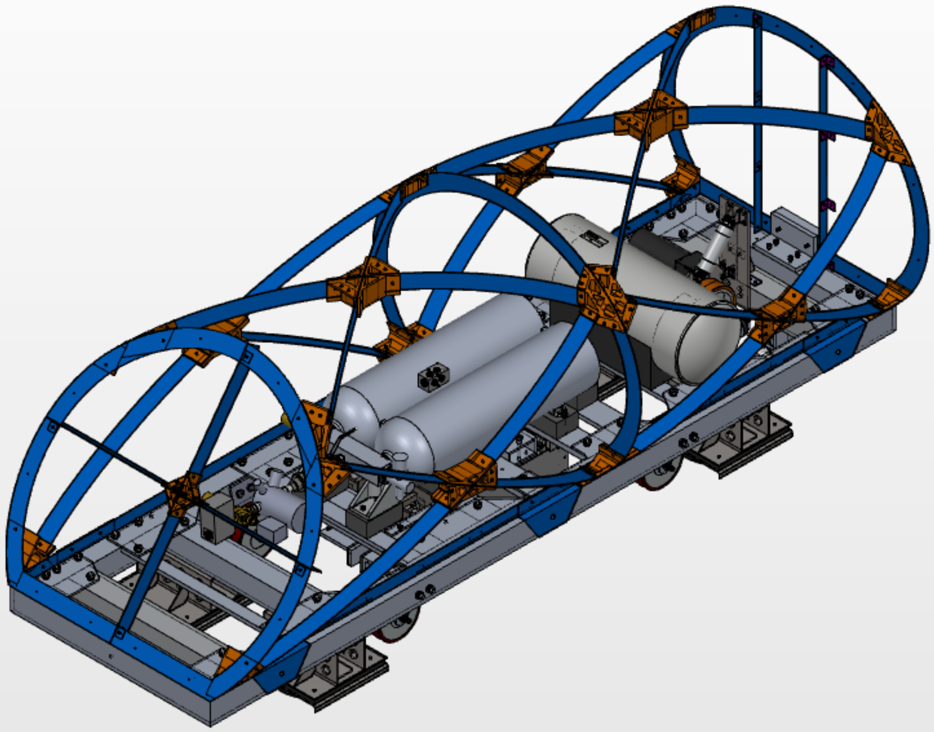
MAGNETIC BRAKING

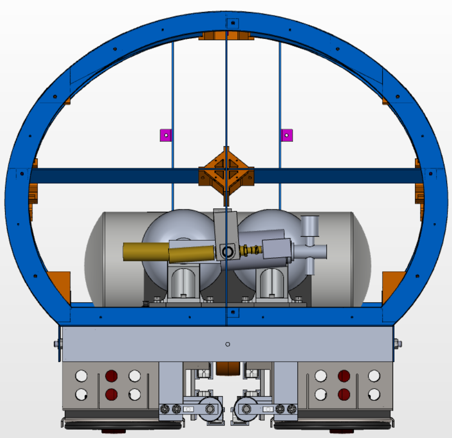
Our state-of-the-art contactless eddy current braking system uses 84 neodymium magnets arranged in a Halbach array. This arrangement doubles the magnetic strength on one side and cancels it out on the other. Braking force is achieved by exploiting the same drag produced in magnetic levitation - or when a permanent magnet is dropped down a copper tube. As the permanent magnets approach the I-beam while the pod is in motion, tiny circular electrical currents called eddy currents are induced within the beam which smoothly slows the pod down in a highly controlled fashion.

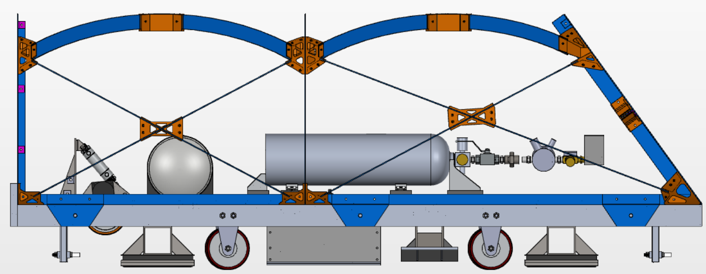


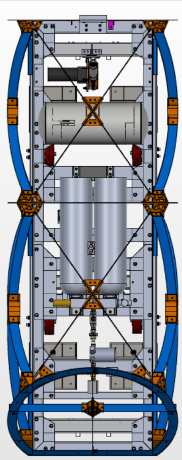
DRIVE TRAIN

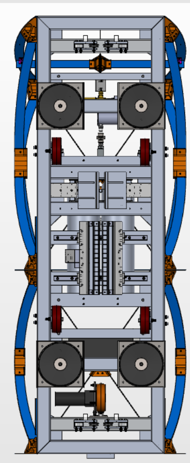
The Low-speed Drive system allows for taxiing before the test, in order to position for launch, and after the test so that the pod can exit the Hypertube. This system uses an air cylinder to retract the drive wheel into the pod during high speed travel. A set of four idler wheels keep the air casters from contacting the ground when levitation stops.





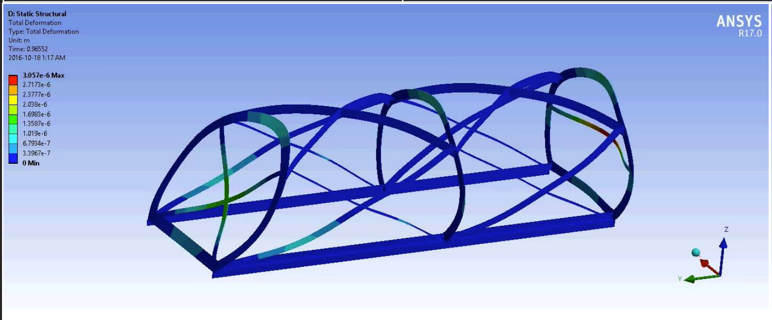




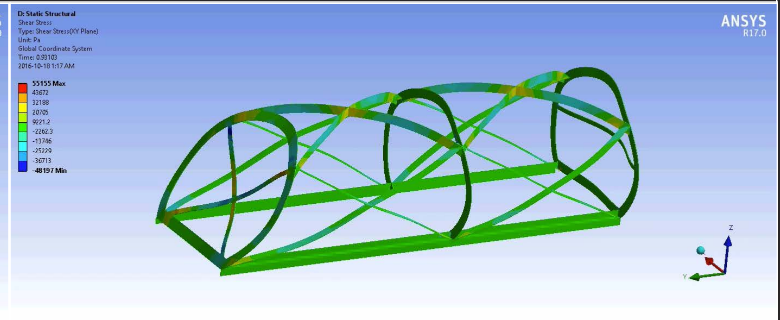


TECHNICAL CAD

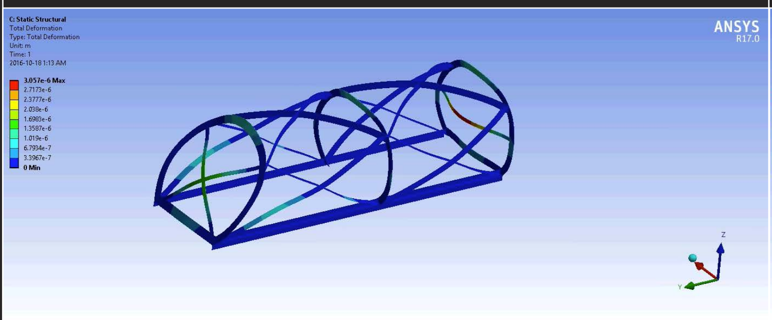
Screenshots of the full systems CAD of the pod used to manufacture the prototype.



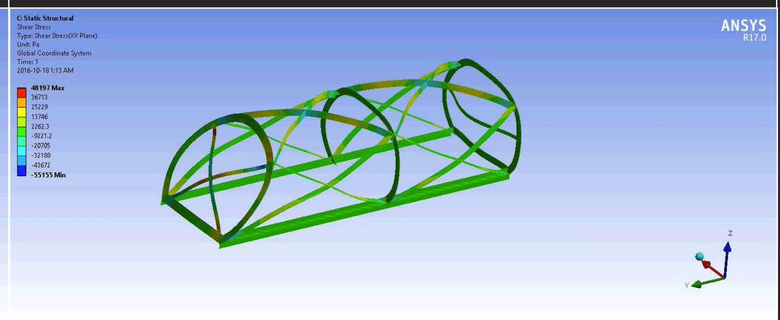
Exaggerated scale deformation simulation of 2.4g acceleration case



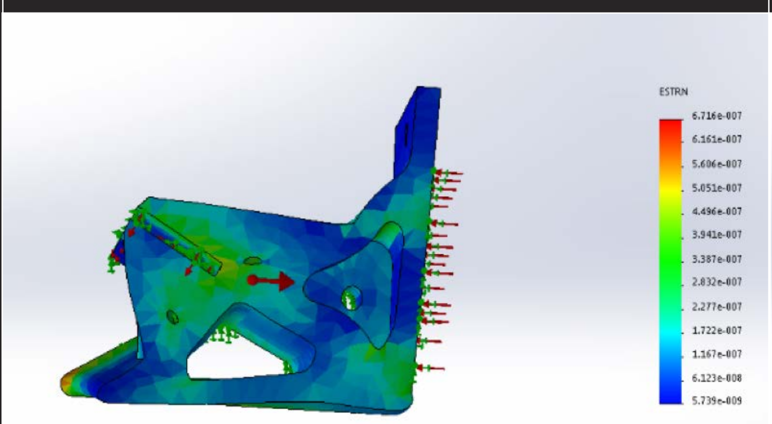
Exaggerated scale shear stress simulation of 2.4 acceleration case



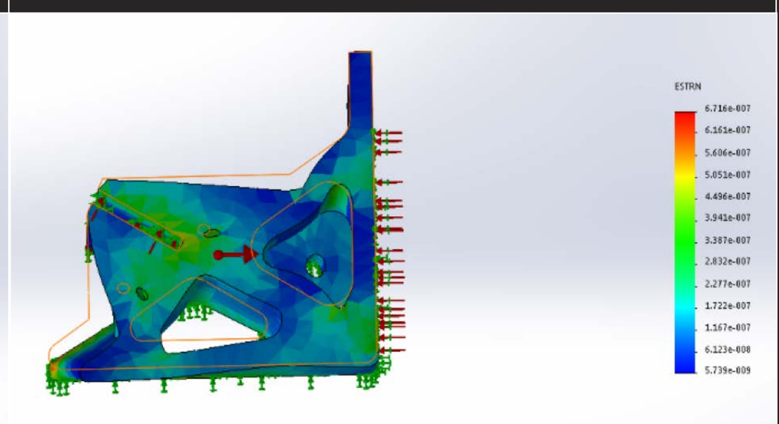
Exaggerated scale deformation simulation of 2.4g deceleration case



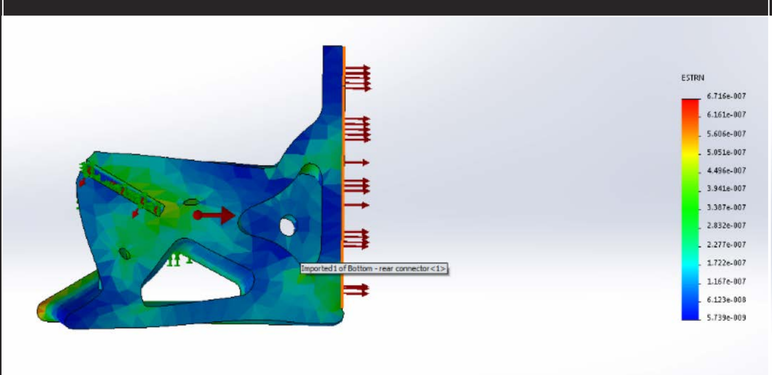
Exaggerated scale shear stress simulation of 2.4 deceleration case



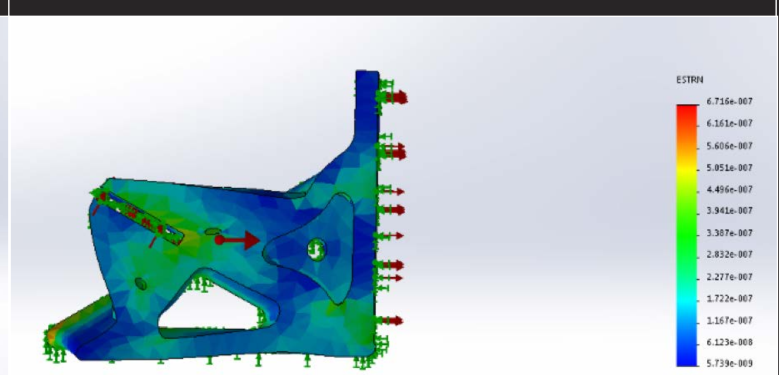
Deformation from the pulling pressure of 200000 Pascals (safety factor of 2) from diagonal member, and 300000 pascals (safety factor of 2) from the vertical member



Deformation from the pushing pressure of 200000 Pascals (safety factor of 2) from diagonal member, and 300000 Pascals (safety factor of 2) from the vertical member



Deformation from the pulling pressure of 200000 Pascals (safety factor of 2) from diagonal member, and compressive pressure of 300000 pascals (safety factor of 2) from the vertical member



Deformation from the pushing pressure of 200000 Pascals (safety factor of 2) from diagonal member, and 300000 Pascals (safety factor of 2) from the vertical member

LEVITATION TESTS

Excerpts from initial levitation tests of the pod using four air bearings to levitate the pod’s structural frame. Above: structural frame loading onto Waterloop test track fragment. Left: close-up of air-bearing with no air-pressure before levitation. Right: close-up of air bearing during levitation.

TEST TRACK FULL SYSTEMS TESTS

Full systems tests performed at the Waterloop 300ft test track in the warehouse testing facility before the SpaceX competition submission.

SPACEX COMPETITION SUBMISSION

Documentation from the SpaceX Hyperloop Pod Design Competition 1 submission in Hawthorne, California at SpaceX headquarters. Documentation is from the third day of the competition, January 29, 2017, the only day photography was permitted.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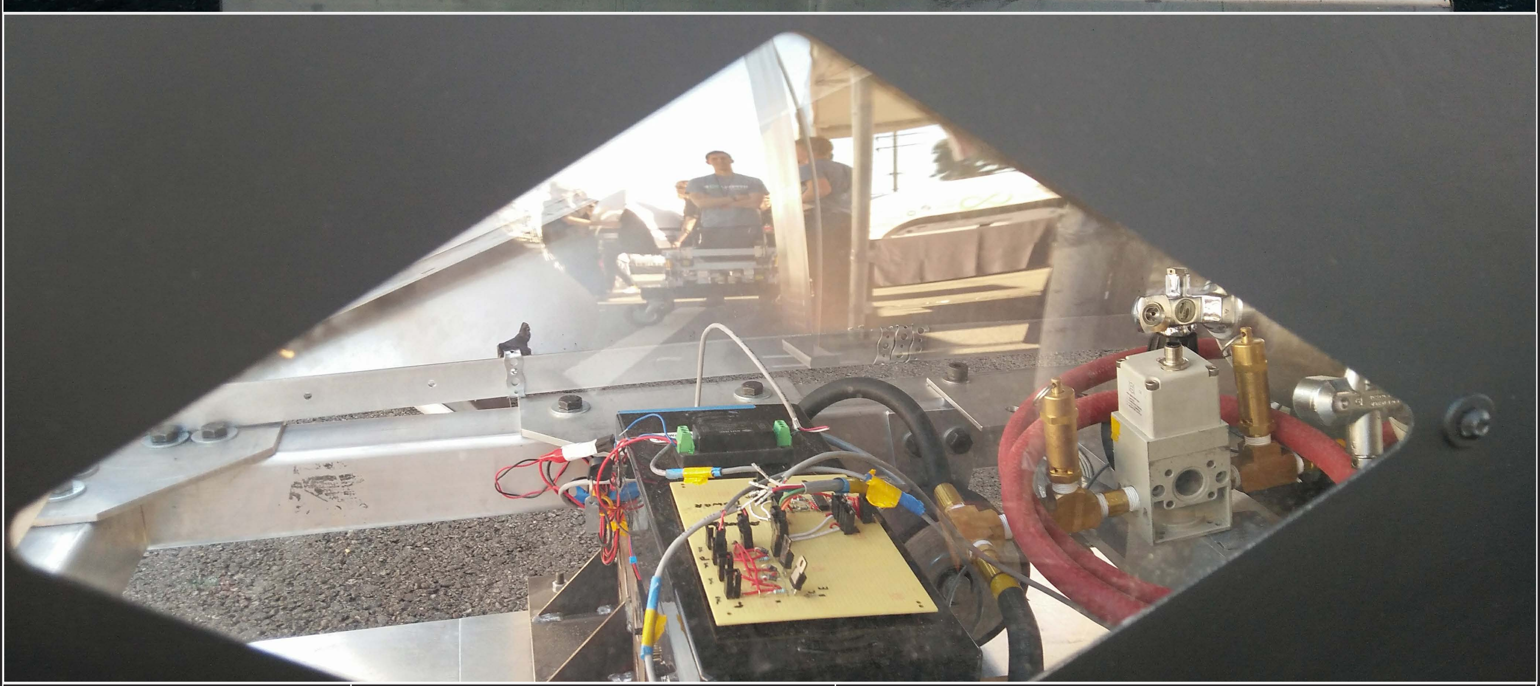

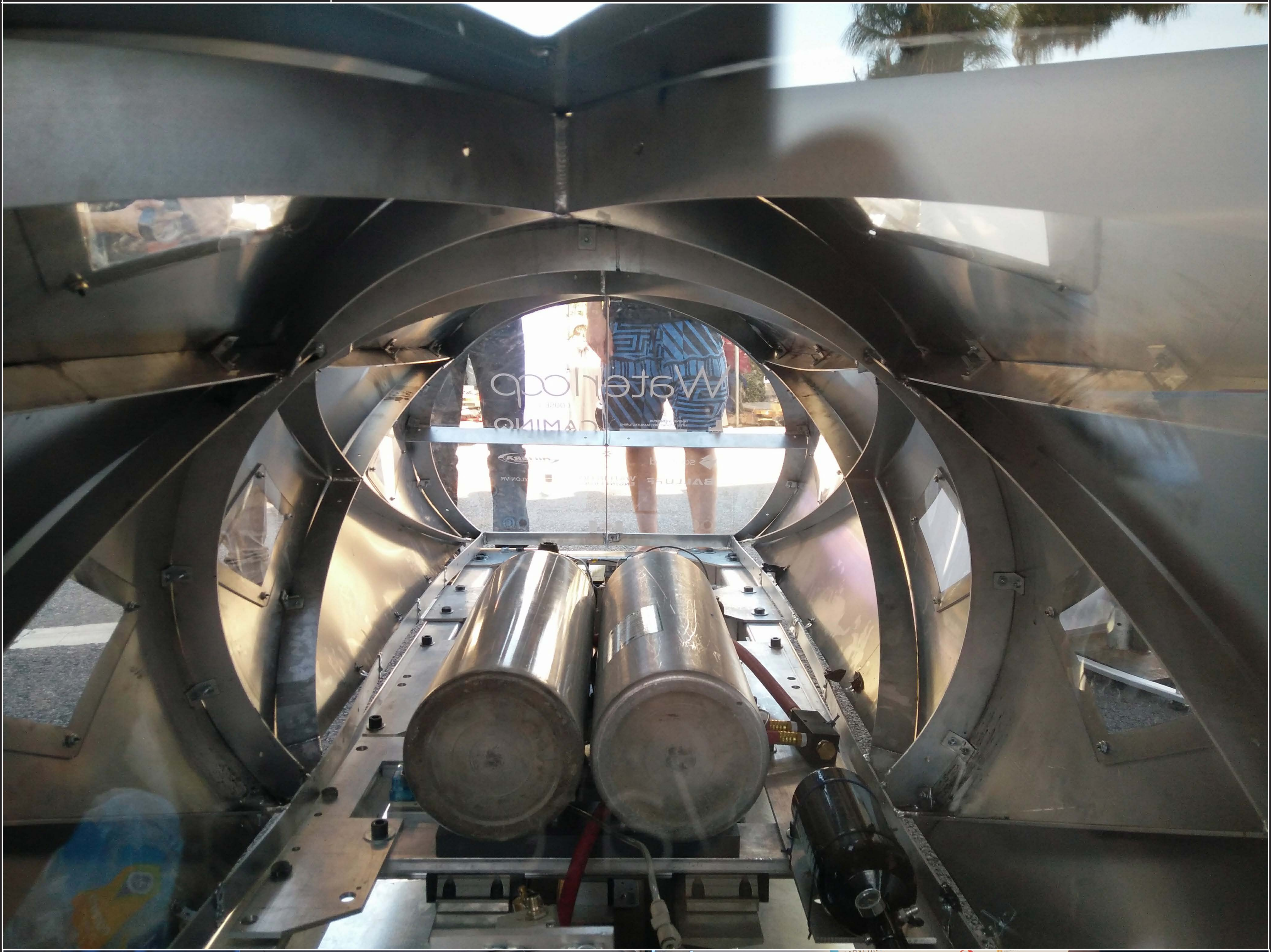

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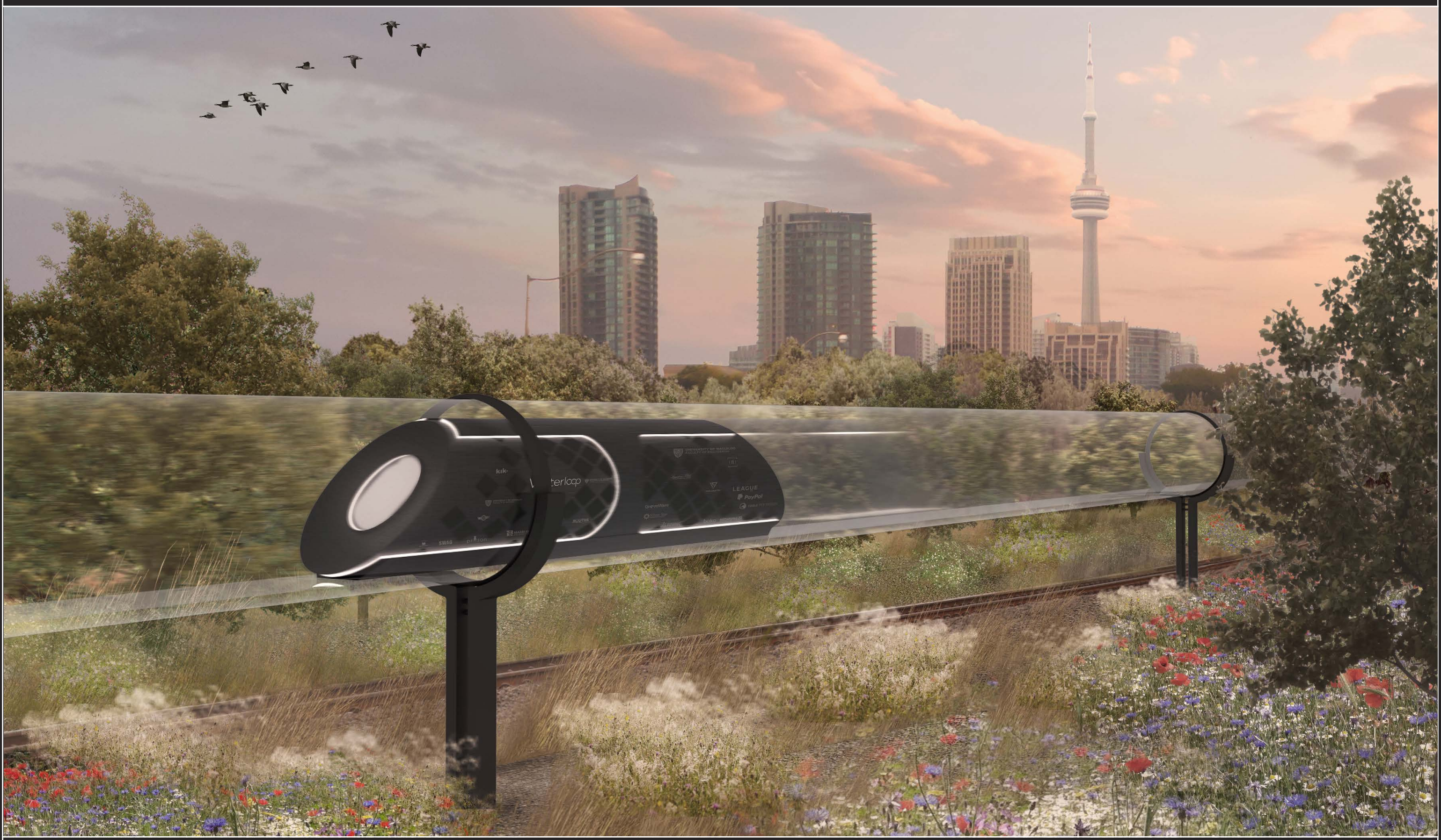
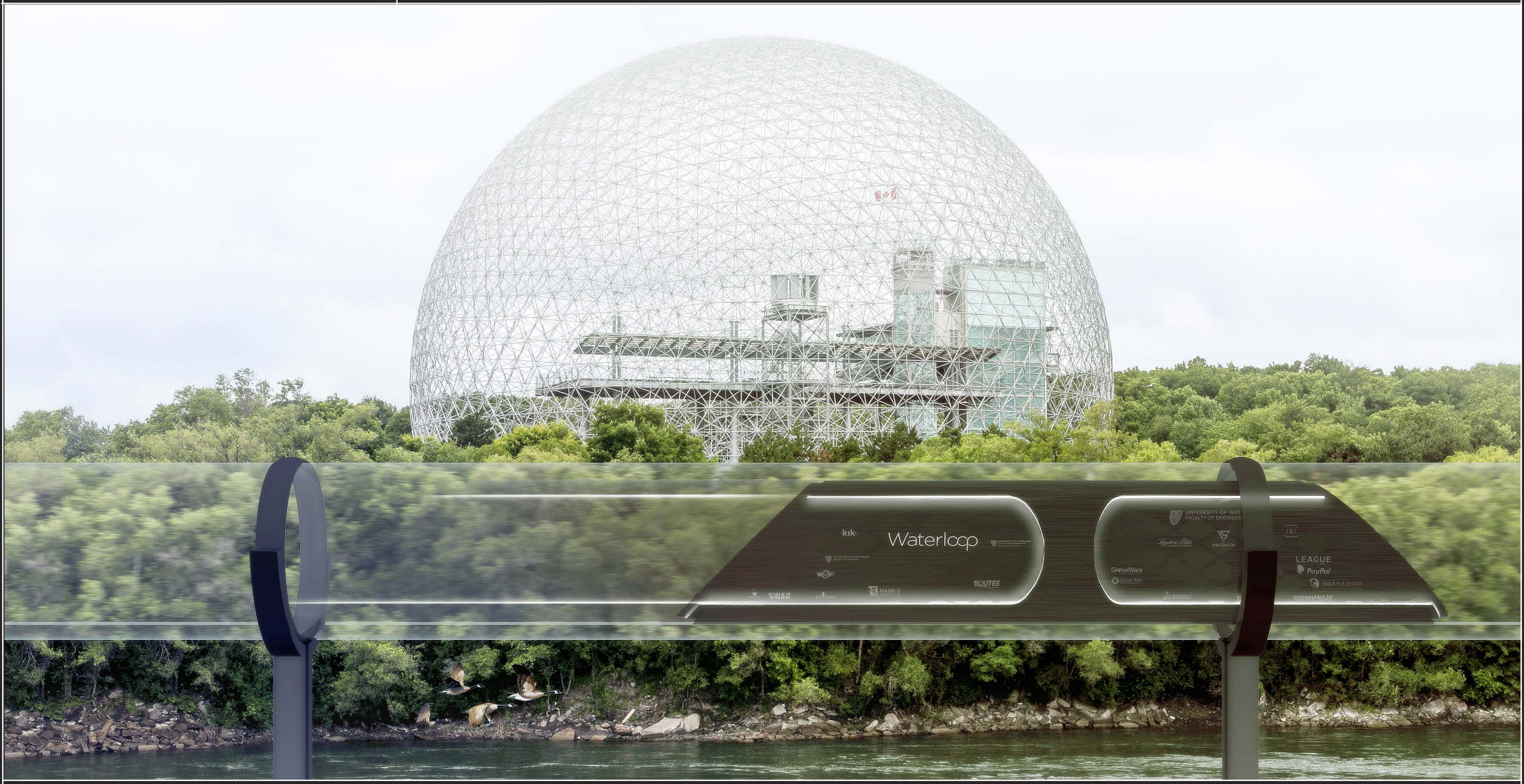
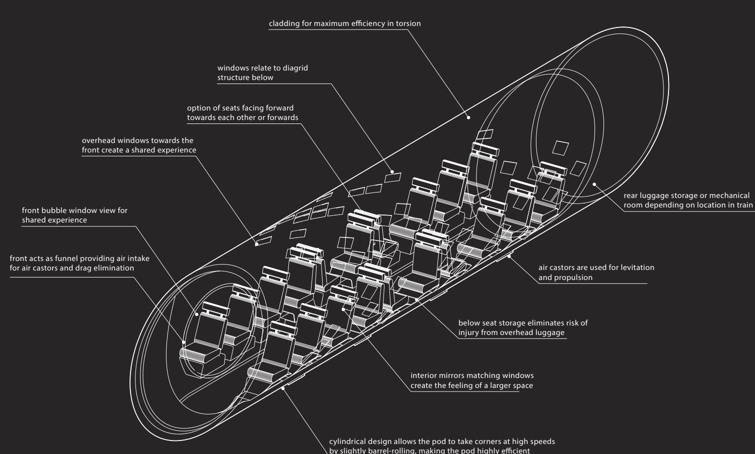


GOOSE X CONCEPT VEHICLE

WATERLOOP | DESIGN PACKAGE





CONCEPT STATISTICS

Top Speed	1,220km/h
Passenger Capacity	26 people
Interior Diameter	2.2m
Estimated Cost	$500 000

CONCEPT DESIGN

The exterior design of the pod highlights its primary design feature: the geodetic structural frame. The front end of the pod features a funnel like shape which would be used to collect the small amount of low pressure air in front of the train to eliminate air drag and supply air for the compressor which supplies the air casters. The matte black finish departs from contemporary transit imagery and signals in the new era of Hyperloop transit.

Due to cost efficiency, the diameter of the Hyperloop track must be kept as minimal as possible. For this reason, the pod design is kept as small as possible, and the curved geometry, white colour palette, and use of interior features resembling windows creates the illusion of a much bigger space.

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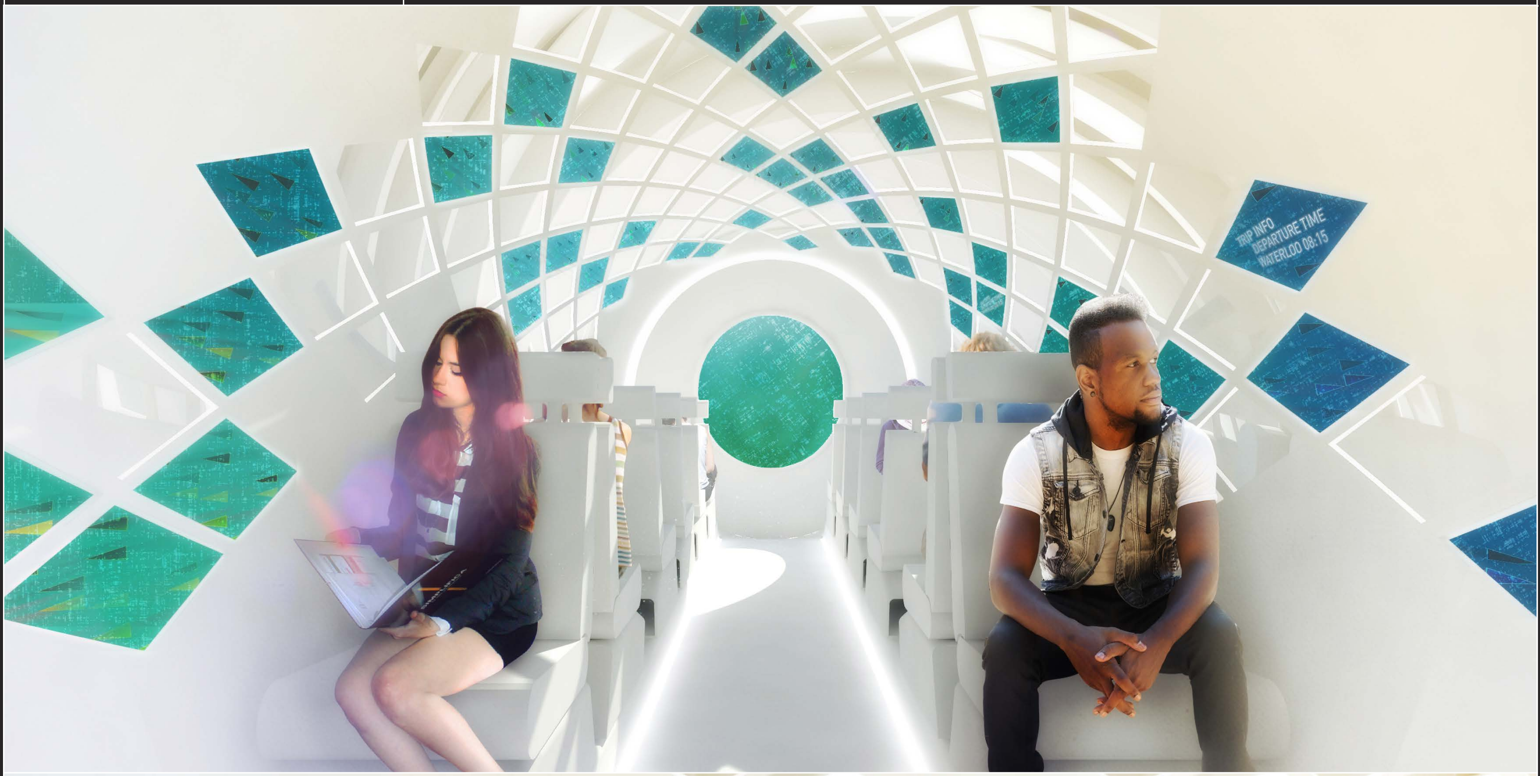
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