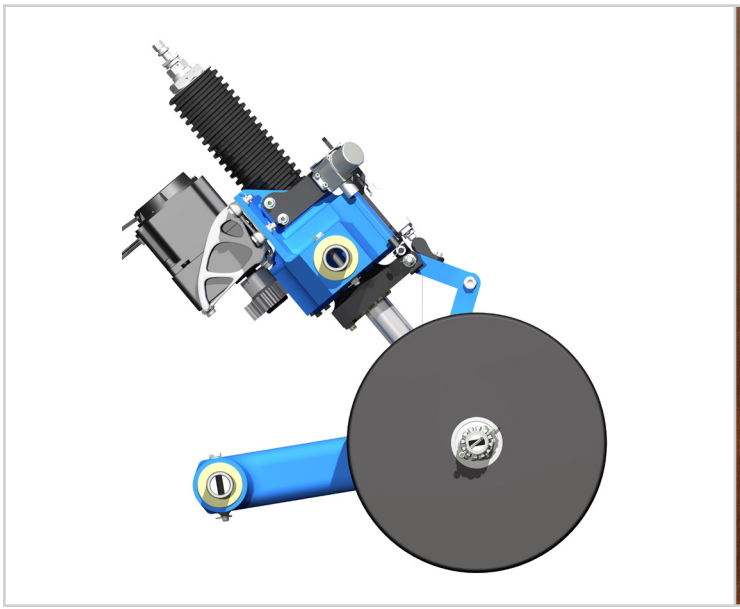
CUSTOMER STORY

Ryerson's International Hyperloop Team



Images courtesy of RIHT

IN THE SUMMER OF 2015 Elon Musk of SpaceX introduced the Hyperloop Design Competition to further expedite the progress on the Hyperloop project. Graeme Klim, a Masters Student at Ryerson University heard about the competition and was immediately interested based on his prior experience working with aircraft landing systems. Graeme quickly connected with a number of his peers and formed Ryerson's International Hyperloop Team (RIHT). Graeme noted, "The competition called for submissions of a full pod, or a subsystem. Due to our team's size and prior expertise, we wanted to make a significant contribution so determined we would focus on a low speed and emergency subsystem that is similar to an aircraft's landing gear. We call it the Hyperloop Deployable Wheel System."

By September of 2015, the team had an initial design concept that they submitted to the competition's first elimination round. This portion of the competition had a few thousand entries which were quickly narrowed down to a few hundred. The team then had to submit its design report for another elimination round which narrowed the number of teams down to 125. These 125 teams, which consisted of schools from 20 different countries and multiple different states were invited to the Hyperloop Design Weekend in January of 2016. At this event, the RIHT team presented its concept to the judging committee. Graeme mentioned, "Our team was fortunate enough at this event to win the Subsystem Innovation Award for our wheel system."

SOLIDTHINKING INSPIRE IN THE DESIGN PROCESS

After winning the Subsystem Innovation award, the team was incredibly excited to kick off the development process on its wheel system and quickly began reaching out to sponsors. While speaking with sponsors, the team discovered the benefits that it could gain by implementing optimization tools on its design. It was at this time that the team was first introduced to solidThinking Inspire. Graeme mentioned, "Once we discovered Inspire, the team

RYERSON'S INTERNATIONAL HYPERLOOP TEAM

INDUSTRY

Transportation

CHALLENGE

Design a deployable wheel subsystem similar to aircraft landing gear for a Hyperloop Pod that allows ease of movement at speeds under 100mph.

SOLUTION

Redesign of a custom motor bracket in solidThinking Inspire. Bracket was specifically designed for and produced with additive manufacturing.

RESULTS

- Weight reduction of approximately 77%
- Bracket produced in AlSi10Mg with additive manufacturing
- Additive manufacturing process helped save 53 in^3 of wasted material per bracket

at solidThinking set us up with an expert who would support us for training and design of the part. I already had a part candidate in mind for a bracket that mounts our motor. At the same time, I was also speaking with the team at Burloak Technologies, Inc. who specialize in metal additive manufacturing. That team agreed to be our sponsor for the production of the new optimized bracket. As you can see our final design for the bracket is very organic and unique. This suited it perfectly for production with additive manufacturing."

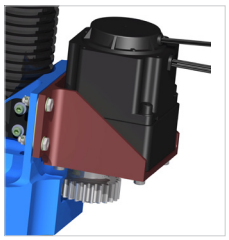
After a very quick training session, the team felt comfortable enough to test Inspire out in a true design situation. "The support from the Inspire team was great and the online tutorials were very useful for our team. These allowed us to quickly learn and become comfortable with the software," mentioned Graeme. The first step for the team was importing the initial geometry from their CAD system into Inspire. Next, the team utilized Inspire's built in analysis tools to confirm the conservatism of the initial design. This showed that the bracket was well overdesigned and was a great prospect for optimization. Graeme and team then used Inspire to apply a number of loads and constraints onto the part, and to assign the design space to be optimized.
After the setup was complete, the team performed its first optimization. "We tested out a number of different iterations and scenarios in Inspire. These included a number of different load cases, larger design spaces, and different optimization objectives. In all, I would say we ran about 4-5 different iterations, but were ultimately able to determine the best design based on a number of different factors." mentioned Graeme. Once the final optimization was determined, the team used Inspire's PolyNURBS tools to quickly and easily interpret the shape output into a solid geometry that is very organic and as Graeme mentioned, "additive manufacturing friendly."
Finally, the team ran a number of different finite element analysis tests on the new design to verify that it would perform well during all usage scenarios. Graeme noted, "Designing with Inspire was very fast, I would say the full design cycle for this part took only about a week's time.
The PolyNURBS tools in Inspire were very useful for us as well, they allowed us to quickly design the final part that was printed after the optimization."

Once the design was complete, the team handed off the part's design files to their partner Burloak Technologies, Inc. for the additive manufacturing. The final part was produced in AlSi10Mg and weighs in at over 70% lighter than the machine from solid bracket. The part is not only significantly more efficient, but also allowed for a significant reduction in wasted material, approximately 53in^3, per bracket.

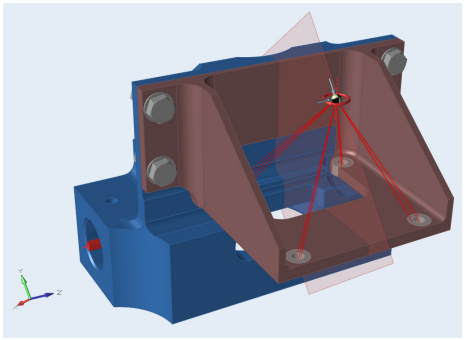
WHAT'S NEXT?

The team at RIHT plans to continue the development of its Hyperloop Deployable Wheel System. The team has grown significantly and now includes six students, as well as 5 advisors. Ultimately the team would like to include the Deployable Wheel System on another team's pod so a full system can be developed. Graeme mentioned, "A lot of teams have expressed interest in this as well as interest in us taking an advisory role on their team. We are currently exploring all options."

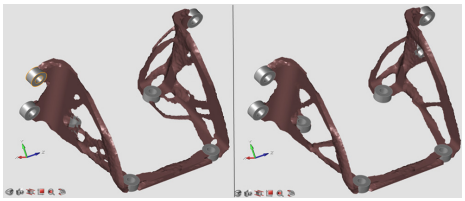
Final deployable wheel subsystem design



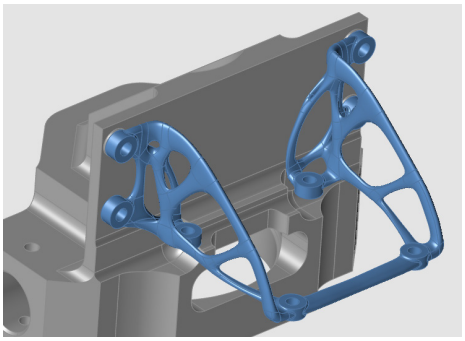
Original bracket design



Design space with loading conditions applied in Inspire



Inspire optimizations on the bracket



New bracket design based on Inspire's optimization

New Bracket Produced with Additive Manufacturing in use

ABOUT RYERSON'S INTERNATIONAL HYPERLOOP TEAM

Ryerson University is currently recognized as a leading institution for research and innovation, being ranked the top institution for undergraduate research in Canada in 2014. Within the past decade, the university has launched various research centres and institutes, as well as the Zone Learning option for students and business professionals interested in entrepreneurship.

Ryerson's location at the heart of downtown Toronto has motivated numerous strategic partnerships with surrounding businesses and spaces. The most significant recent development is the construction of four new Ryerson buildings: the Mattamy Athletic Centre at Toronto's historic Maple Leaf Gardens, the award-winning Student Learning Centre on Yonge Street, the Ryerson Image Centre on campus and the upcoming Daphne Cockwell Health Sciences Complex.

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