CASE STUDY

MATERIAL MATTERS

Metal to Composite Conversion

It's been said that all good ideas can be improved upon. This was the belief of a long-standing customer of ARaymond — a 150-year old company that offers innovative fastening and assembly solutions for the automotive and industrial sectors worldwide.

ARaymond's customer relied on a multi-functional fabricated steel bracket for an important application that, for all intents and purposes, did its job just fine. But there was room for improvement which had the potential to offer savings in weight and costs. In fact, reducing the mass of this product was a major incentive for this client.

"Our customer had traditionally only used steel for this product which is, of course, heavy and subject to corrosion," shares Bill Teller, Director of Engineering with ARaymond. After a training session on polymers, a few of the engineers from the company questioned whether it was possible to redesign the bracket.

"We have experience in converting large, steel parts to plastic, and explained that it could offer savings without jeopardizing the function of the part," adds Teller. "The customer was intrigued, and we immediately got started on the design."

Now consider an alternative assembly process, one where the final assembly takes place safely outside the unit where several fasteners can be engaged in one quick assembly motion. Imagine the efficiency gains and cost savings that this would create.

This scenario is just one of the challenges and assembly solutions the sales and engineering community of ARaymond tackle every day.

THE CHALLENGE

The use of plastic or composite rather than steel for this application required careful planning and engineering. For one, the bracket was fairly large, at about 18 inches tall. It was 10 inches deep and about eight inches wide.

Additionally, the fabricated bracket served multiple functions, so flexibility was essential for ease of assembly and effective operation. Safety was also a concern because this part was involved in critical tasks.

"To be honest, we weren't certain we'd be successful at first," says Teller. "The steel originally used in this part was around six millimeters thick and included multiple pieces that were welded together. So, it was a large, hefty bracket and we needed to ensure our design could meet the essential requirements for strength, safety, and function."

The team at ARaymond remained undaunted, however. With an advanced engineering team, decades of experience, and state-of-the-art simulation software, it was a welcome challenge.

THE SOLUTION

THE MATERIAL

"For this type of application, where safety and reliability are critical, the usual go-to-choice is an engineered resin," he says.

Typically, resins are a solid mixture of organic compounds that can convert into polymers. In this case, ARaymond's engineers selected nylon, which offers higher properties than the more commonly used polyethylene or polypropylene materials.

"After choosing the base resin — which was nylon in this case because of its strength and dimensional stability — it's then possible to include additional elements or substances to get the ideal properties. We added glass to the plastic, which is fairly common to do," he says.

The more glass, the stiffer and stronger the plastic. "However, you also have to balance the costs because the more glass also means the greater the expense. Design is like that…a continual balance of costs and benefits," adds Teller.

THE PROJECT

"For ARaymond, a design project such as this begins with a 3D digital environment, providing an opportunity for creativity, flexibility, and some trial and error.

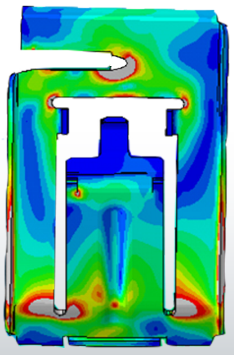
"First, we set the parameters," explains Teller. "This means establishing the part of an application that can and cannot change." This is imperative when working with plastic, which lacks the strength of steel. So, for instance, certain areas of the bracket application required more volume to ensure its durability and long-term reliability.

"The 3D environment allows us to play, so to speak, and find out where we can add materials or alter a section of the application or what have you, until we design a suitable model," he says. Of course, this stage also involves back-and-forth with the customer, sharing relevant data and ideas, to ensure an ideal outcome.

The results let engineers fine-tune their design. Perhaps the product has been over-designed in one area, for example, and it's possible to use less material without sacrificing its strength or function. The digital program lets users test various modifications.

Once the 3D model is complete, the next step involves finite element method (FEM) simulation, which is a valuable tool for simulating the behavior of an assembly under a certain set of conditions.

Finite Element Analysis Example



THE PROJECT CONTINUED

"It's basically a computer program where you input the models that you want analyzed to determine the strength and capability of a product," shares Teller. "We went through 12 different simulations for this particular part about four different times to ensure the ideal end-product. Each simulation is quite complex, analyzing for loading in different directions and at different levels."

Max loading analysis was one significant measure in this project because plastic has less strength than steel, but assessing fatigue loading was also critical. Fatigue is the weakening of a material caused by cyclic loading.

"The fatigue strength of a material is a lot less than its normal strength," he explains. "So, we might load something, say 100,000 times, which is typical for this type of product. And it's imperative to design accordingly and below the high-cycle levels."

Ultimately, the goal is to design a product that's safe, reliable, and performs effectively within its given application. And, ideally, the model will outperform its previous model in several features relating to costs and benefits.

"This is an interactive process that always involves the customer," stresses Teller. "We're continually getting their feedback in regards to material use and safety margins until we're both satisfied with the load requirements. So, a good, responsive working relationship is essential."

Good communication with the manufacturing team is also key. "Throughout the design and development process, which includes the iterative changes to the model, we also work with our manufacturing team to assure that the part can ultimately be manufactured to meet the tolerances we're expecting, and at a cost that's attractive to both us and the customer," he adds.

THE RESULT

A reduction in weight was the top reason ARaymond's customer was interested in redesigning the component from steel to plastic. And the engineers at ARaymond delivered.

After the redesign, the part went from 9 pounds to just 2.2 pounds — that's a 76% reduction in weight, which is impressive.

There were additional benefits, including:

- Greater dimensional stability
- Improved quality (tolerances)
- A reduction in the number of fasteners required
- Multiple component attachment features
- Ability to accommodate two sub-assemblies
- An improved lead time

"Collaboration was imperative to our success in this project. It's necessary to have trust on both sides because we're sharing a lot of proprietary information and engineering expertise," says Teller. "This entire process was also virtual and secure, saving time and travel for the customer. Overall, it was an interesting, challenging, and very successful project."

ABOUT ARAYMOND

With more than 150 years of product innovation in both plastic and metal, ARaymond has become one of the world's foremost assembly solution providers. Whether injection-molded plastic, metal or an assembly of the two, ARaymond offers a vast selection of solutions that eliminate the need for tools, improve assembly line ergonomics, streamline manufacturing, REDUCE TOTAL COST and facilitate serviceability.

With eleven engineering centers worldwide, ARaymond is leading the fastening and assembly solutions market with innovation, value-creation and sustainability. Our engineers are constantly exploring new and emerging trends such as lightweight materials, digital technologies and mechatronics. Development centers are strategically positioned in order to be close to you and your business and are equipped with 3D printing, full-service prototyping and product design validation

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